TWELFTH EDITION

Levison's Textbook for Dental Nurses

with website

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Dedicated to the joyous memory of my wonderful Mum and Dad – together again at last on 17th January 2017.

Carole Hollins

Levison's Textbook for Dental Nurses

Twelfth Edition

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WILEY Blackwell

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Introduction to the Twelfth Edition

Once again, the five years since the publication of the last edition of this ever-popular textbook has seen momentous changes in the fields of dentistry and dental nursing, not least of which have been the ability of dental care professionals to become both practice owners and/or registered managers of a practice with the Care Quality Commission (in England)! Although the 'new contract' for NHS practices has yet to be finalised and rolled out, it is apparent that in future dental care professionals will play a greater role than ever before in the delivery of oral healthcare to patients, so exciting times indeed are ahead for the dental nursing profession.

While this edition provides the underpinning knowledge required to cover the extensive curriculum contents of the National Examining Board for Dental Nurses' (NEBDN) National Diploma qualification, there have been numerous revisions and updates to several chapters as well as the addition of a whole new chapter covering many of the more popular 'extended duties' now available to qualified and registered dental nurses. Revisions include information on the new enhanced continuing professional development (eCPD) requirements, the nine principles of the General Dental Council's *Standards for the Dental Team*, and information on the principles of duty of care and student professionalism. Updates have also occurred in several areas over the last five years, including health and safety, infection control and decontamination, data security and protection, oral cancer, oral health promotion, restorative dentistry and prosthodontics, and orthodontics. In addition, a new section on dental implants has been included to provide a level of background knowledge about this rapidly expanding treatment option to student dental nurses.

As always, heavy emphasis has been placed throughout on the standards expected of a student dental nurse and ultimately a dental care professional, once qualified, and these are cross-referenced to several of the GDC's own publications. All readers are advised to access these very useful resources at their earliest opportunity during their training, using the website addresses provided. In addition, and where appropriate, website addresses are also included to allow

readers to access further information on many topics covered throughout the text, especially links to NEBDN's full curriculum and charting booklet download facilities, and links to more information on subject topics with national variations, such as infection control.

Following previous positive feedback, the text has again been interspersed with numerous photographs and illustrations to enhance the reader's learning experience, and bullet points have been included to highlight key facts throughout the text in an effort to aid students to focus their studies on essential knowledge in a user-friendly manner.

Finally, and as always, I sincerely hope this text stimulates some readers to be sufficiently inspired during their studies to continue their careers beyond their initial qualification, to consider extended duties, post-registration qualifications, other dental professional careers and, ultimately, practice ownership!

Carole Hollins

Introduction to the First Edition

This book is designed to cover the syllabus for the British Dental Nurses and Assistants Examination. Although written primarily for nurses preparing for this examination, it also provides an outline of dental surgery for those embarking on a career of dental nursing, thus helping them gain a greater understanding of the nature and aims of their duties. For examination purposes, the subject matter is deliberately presented in a dogmatic fashion and, to aid final revision, there is a summary after each chapter.

The text was prepared during a winter spent in the North Isles of Shetland with the School Health Service mobile dental unit; and for helpful advice and encouragement throughout, I am indebted to my former dental nurse, Miss M.E. Isbister. I wish to thank my wife for typing the manuscript; my sister, Miss B. Levison, for the drawings; the Amalgamated Dental Trade Distributors Ltd for providing some new blocks; and Mr P. Saugman of Blackwell Science for his guidance.

H. Levison

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In updating this edition, I am once again very grateful to the following organisations for their permissions to refer to and reproduce various documents, booklets and publications throughout the text and I hope I have done justice to their content: the General Dental Council, the Care Quality Commission (and their national equivalents), the Department of Health, the British Dental Association, the Faculty of General Dental Practice (UK), the National Institute for Health and Clinical Excellence, the Health and Safety Executive, and the Resuscitation Council (UK).

As a practising dentist, I also express my sincere thanks to various Companies without whose help and support the delivery of good quality oral health care would be so much harder to achieve, and whose contact details are included in this edition for the benefit of the readership: The First Principle, Dental Compliance Made Easier, Isopharm, Yorkshire Sedation Training, and Resuscitation Consultancy Medical Services.

Finally, I must express sincere thanks for the continued support of previous illustrators and great appreciation to the various staff at Wiley for their extensive help and support throughout the updating and publishing process, especially to Jenny Seward and her calm professionalism throughout. What a team and what a pleasure to work with them!

Abbreviations

ABCDE
airway, breathing, circulation, disability, exposure (unwell patient assessment)

ACVPU
alert, confused, verbal, painful, unresponsive (previously AVPU)

ADJ
amelodentinal junction

AED
automated external defibrillator

AF
automatic focus (camera)

AIDS
acquired immunodeficiency syndrome

ALARA
as low as reasonably achievable

ALARP
as low as reasonably practicable/possible

ANB
point A–nasion–point B (angle)

ANUG
acute necrotising ulcerative gingivitis

ARF
annual retention fee

ASA
American Society of Anesthesiologists (assessment grading for conscious sedation)

BADN
British Association of Dental Nurses

BDA
British Dental Association

BDJ
British Dental Journal

BDS
Bachelor of Dental Surgery

BLS
basic life support

BNF
British National Formulary

BPE
basic periodontal examination

BSA
Business Services Agency (previously Dental Practice Board)

CAL
computer-aided learning

C&G
City & Guilds

CCG
clinical commissioning group

CCTV
closed-circuit television

CDT
clinical dental technician

CG
clinical governance

CJD
Creutzfeldt–Jakob disease

CO_2
carbon dioxide chemical formula

COPD
chronic obstructive pulmonary disease

COSHH
Control of Substances Hazardous to Health

CPD
continuing professional development

CPITN
Community Periodontal Index of Treatment Needs

CPR
cardiopulmonary resuscitation

CQC
Care Quality Commission

CSF
cerebrospinal fluid

CVA
cerebrovascular accident (stroke)

DBS
Disclosure and Barring Service (previously Criminal Records Bureau)

DCP
dental care professional

DDPH
Diploma in Dental Public Health

DDR
Diploma in Dental Radiology

DGDP
Diploma in General Dental Practice

DMF
decayed, missing, filled (in secondary teeth – dmf in primary teeth)

DNA
deoxyribonucleic acid (individual genetic cell material)

do
distal occlusal

DOrth
Diploma in Orthodontics

DPF
Dental Practitioners' Formulary

DPIA
data protection impact assessment

DPO
data protection officer

DPT
dental panoramic tomograph (also OPG, orthopantomograph)

DRO
dental reference officer

DRSABC
danger, response, shout, airway, breathing, circulation (collapsed patient assessment)

DSE
display screen equipment

DSP
data security and protection (previously information governance)

DUWL
dental unit water line

DVLA
Driver and Vehicle Licensing Agency

DVT
deep vein thrombosis

eCPD
enhanced continuing professional development

EMQ
extended matching question

EVA
ethylene vinyl acetate (tray-making material)

EWC
European Waste Catalogue (codes)

FAST
Face, Arms, Speech weakness, Time to call 999 (stroke medical emergency)

FDI
World Dental Federation

FDS
Fellow in Dental Surgery

FGC
full gold crown

FGDP
Faculty of General Dental Practice

GA
general anaesthesia

GDC
General Dental Council

GDP
general dental practitioner

GDPR
General Data Protection Regulations

GI
gold inlay

GIC
glass ionomer cement

GIT
gastrointestinal tract

GP
gutta percha

GTN
glyceryl trinitrate (spray)

HBV
hepatitis B virus

HCV
hepatitis C virus

Hg
mercury chemical symbol

HIS
Healthcare Improvement Scotland

HIV
human immunodeficiency virus

HIW
Healthcare Inspectorate Wales

H_2O
water chemical formula

HPV
human papillomavirus

HRT
hormone replacement therapy

HSCA
Health and Social Care Act

HSE
Health and Safety Executive

HTM 01-05
Health Technical Memorandum 01-05 (decontamination)

HTM 04-01
Health Technical Memorandum 04-01 (*Legionella* prevention)

HTM 07-01
Health Technical Memorandum 07-01 (management of healthcare waste)

ICO
Information Commissioner's Office

IH
inhalation sedation (previously relative analgesia)

ILS
immediate life support

IM
intramuscular (injection)

INR
international normalised ratio (patients taking warfarin)

IOTN
Index of Orthodontic Treatment Need

IPA
isopropyl alcohol

IPR
interproximal reduction

IR(ME)R
Ionising Radiation (Medical Exposures) Regulations

IRR

Ionising Radiation Regulations

IT
information technology

IV
intravenous (injection)

LAT
local area team

LPA
Lasting Power of Attorney; Laser Protection Advisor

LPG
liquid petroleum gas

LPS
Laser Protection Supervisor

LSAB
Local Safeguarding Adults Board

LSCB
Local Safeguarding Children Board

MAOI
monoamine oxidase inhibitor

MCA
Mental Capacity Act

MCQ
multiple choice question

MF
manual focus (camera)

MFDS
Member of the Faculty of Dental Surgery

MGDS
Membership in General Dental Surgery

MHRA
Medicines and Healthcare products Regulatory Agency

MI
myocardial infarction

MIMS

Monthly Index of Medical Specialities

MJDF
Membership of the Joint Dental Faculties

mmHg
millimetres of mercury

MMR
measles, mumps and rubella (vaccination)

MO
mesial-occlusal

MOD
mesial-occlusal-distal

MOS
minor oral surgery

M Paed Dent
Membership in Paediatric Dentistry

MPE
medical physics expert

MRSA
meticillin-resistant *Staphylococcus aureus*

MSc
Master of Science

NaOCl
sodium hypochlorite (bleach) chemical formula

NCSCT
National Centre for Smoking Cessation and Training

NEBDN
National Examining Board for Dental Nurses

NHS
National Health Service

NICE
National Institute for Health and Care Excellence

NME
non-milk extrinsic sugar

N_2O

nitrous oxide chemical formula

NPSA
National Patient Safety Agency

NRLS
National Reporting and Learning System

NSAID
non-steroidal anti-inflammatory drug

NUG
necrotising ulcerative gingivitis

NUP
necrotising ulcerative periodontitis

NVQ
National Vocational Qualification

O_2
oxygen chemical symbol

OHA
occupational health advisor

OHI
oral hygiene instruction

OSCE
objective structured clinical examination

PAT
portable appliance testing (electrical appliances)

PBC
porcelain bonded crown

PCO
primary care organisation

PCT
primary care trust

PDP
personal development plan

PE
partially erupted

pH

measure of acidity and alkalinity

PIDA
Public Interest Disclosure Act 1998

PJC
porcelain jacket crown

PMC
preformed metal crown

PoM
prescription-only medicine

PPE
personal protective equipment

ppm
parts per million

PTFE
polytetrafluoroethylene (dental isolation tape)

PV
porcelain veneer

QA
quality assurance

RIDDOR
Reporting of Injuries, Diseases and Dangerous Occurrences Regulations

RO
reverse osmosis (water)

RoE
Record of Experience

RPA
Radiation Protection Advisor

RPD
Radiation Protection Division (of the Health Protection Agency)

RPS
Radiation Protection Supervisor

RQIA

Regulation and Quality Improvement Authority (Northern Ireland)

SCC
squamous cell carcinoma

SMART
specific, measurable, attainable, realistic, time-based (objectives)

SNA
sella–nasion–point A (angle)

SNB
sella–nasion–point B (angle)

SOP
standard operating procedure

SWOT
strengths, weaknesses, opportunities and threats (analysis)

TB
tuberculosis

TIA
transient ischaemic attack

TMJ
temporomandibular joint

TTP
tender to percussion

UDA
unit of dental activity

UE
unerupted

UNC
University of North Carolina (periodontal probe)

UOA
unit of orthodontic activity

vCJD
new-variant Creutzfeldt–Jakob disease

WEL
workplace exposure limit

WHO
World Health Organisation

WPA
Welfare Power of Attorney

About the Companion Website

This book is accompanied by a companion website:

www.levisonstextbookfordentalnurses.com

The website includes:

- Multiple choice questions
- Extended matching questions
- Downloadable figures

1
Structure of the Dental Profession

Key learning points

A **factual knowledge** of

- the various members that make up the dental team

An **overview** of

- the key roles of each member as well as the dental nurse
- the National Health Service and its current involvement with the provision of dental care

The dental team is now made up of dentists and six categories of registered dental care professionals (DCPs), all of whom work together to provide oral healthcare for their patients. In hospital and clinic environments, some of the dentists may have gone on to become specialists in various fields of dentistry, while dental nurses are now able to train and become competent in various post-registration qualifications as well as in several tasks referred to as 'extended duties'. Although a new system of contracting and commissioning primary and secondary care dentistry to manage the National Health Service (NHS) provision in England was introduced in April 2013, it is still in a state of flux as the final contract details have yet to be decided. However, it is clear that whatever the final version there will be much more delegation and reliance on the use of DCPs in the workplace to assist in delivering dental treatment and preventive advice to patients. Consequently, there has never been a more exciting time for dental nurses to push the boundaries of their profession and become recognised as vital members of every dental team, in every dental workplace.

This chapter provides an overview of the roles of the various registrants, while that of the dental nurse is covered in detail in Chapter 2.

The dentist

Dentists undergo 5 years of undergraduate training at a university dental school. On passing their final examinations, students are awarded the degree of Bachelor of Dental Surgery (BDS), but they cannot use the title of dentist or practise the profession until their names have been entered onto the Dentists Register. In addition, dentists who have qualified in member states of the European Union may currently also join the Register, although they must have an adequate level of written and spoken English. Dentists from non-European Union countries must have their skills and knowledge assessed for equivalence with that required for UK dentists before they may work here. Following the UK referendum in 2016 which resulted in a majority desire to leave the European Union ('Brexit'), these enhanced entry requirements may eventually apply to European dentists also.

The Register is kept by the General Dental Council and contains the name and qualification(s) of every person legally entitled to practise dentistry in the UK, but the decision was made in 2016 to end the need for registrants' addresses to also be included. Registrants may describe themselves as dentist, dental surgeon or dental practitioner – there is no difference between these titles. Dentists may also use the courtesy title of Doctor but must not imply that they are anything other than dentists. Following qualification, all dentists are legally required to continue their professional education until their retirement from practice, in order to maintain and update their skills.

Registered dentists have a wide choice of opportunities within the profession:

- General practice.
- Community dental service.
- Hospital service.
- University teaching and research.
- Industrial dental service.
- The armed forces.

They may also take additional higher qualifications and become specialists in a particular branch of dentistry. Some examples of such qualifications are as follows:

- Fellowship in Dental Surgery (FDS).
- Master of Science (MSc) in a specialty.
- Membership in the Joint Dental Faculties (MJDF).
- Membership in Paediatric Dentistry (M Paed Dent).
- Membership of the Faculty of Dental Surgery (MFDS).
- Diploma in Dental Public Health (DDPH).
- Diploma in Dental Radiology (DDR).
- Diploma in General Dental Practice (DGDP).
- Diploma in Orthodontics (DOrth).

These qualifications are provided by the joint dental faculties of the Royal Colleges of Surgery.

Having obtained the relevant higher qualifications, dentists may then join the Specialist List of the Register for their particular specialty, which includes the following areas:

- Oral and maxillofacial surgery.
- Surgical dentistry.
- Dental and maxillofacial radiology.
- Dental public health.
- Oral medicine.
- Oral microbiology.
- Oral pathology.
- Orthodontics.
- Periodontics.
- Prosthodontics.

- Restorative dentistry.

The General Dental Council

The General Dental Council (GDC) is the regulatory body of the dental profession (dentists and all DCPs) and its duties are set out in legislation. The GDC's role is to protect patients from harm and maintain public confidence in all members of the dental profession, by ensuring their adequate regulation. In the UK this regulation is achieved by the GDC carrying out the following:

- Quality-assuring education programmes for dental professionals: to ensure that the education and training delivered is sufficient to cover all the necessary learning outcomes for each category of dental professional.
- Registering dental professionals so that they may work in the UK: to ensure that only those with suitable dental qualifications are providing care to patients.
- Setting standards that all dental professionals must meet: to ensure that all dental professionals work at or above a defined level of professionalism at all times.
- Requiring all dental professionals to maintain and update their skills through continuing professional development (CPD): to ensure that all dental professionals are up to date with the latest knowledge and skills throughout their working career.

In addition, the GDC has a legal obligation to investigate serious allegations of a dental professional's fitness to practise, where their behaviour or their conduct has been called into question. To be determined as being 'fit to practise', the GDC considers that the dental professional has the appropriate hands-on skills, educational knowledge, good character and good health (both mental and physical) to practice their profession safely and effectively.

The GDC is also empowered to remove or suspend from the Register any dentist or DCP who has been convicted of a criminal offence or is guilty of serious professional misconduct. These issues are discussed further in Chapters 2 and 3.

As a regulator then, the GDC aims to promote high standards of professional education and professional conduct among all dentists

and DCPs, throughout their working career. It thereby ensures that the status of the profession in the general community is upheld and that a proper code of conduct is maintained, for the protection of the public. In essence, its remit is to:

- protect patients
- regulate the dental team.

It is the policy of the GDC for all dentists, after qualification, to complete a year of foundation training (previously called vocational training) before starting independent practice. Such training schemes are already in force in NHS general practice, the community and hospital services, and also on a voluntary basis in non-NHS practice. As soon as adequate resources and facilities are available, it is likely to be mandatory for all newly qualified dentists to undergo foundation training soon after qualification.

Apart from registered dentists, the only other persons permitted to undertake dental treatment are registered dental hygienists and dental therapists, and registered clinical dental technicians may provide and maintain full dentures to edentulous patients. The GDC is responsible for these DCPs in much the same way as for dentists. The expected level of competencies by the time of their qualification is laid out in the GDC document *Preparing for Practice*, while those additional duties possible after a period of suitable training and assessment are laid out in its document *Scope of Practice (2013)*. This latter publication has particular relevance to dental nurses, and all GDC documents can be downloaded at www.gdc-uk.org.

It must be remembered that all dentists and all categories of DCP require indemnity cover to work legally in the UK. This is a type of insurance cover which provides security against harm, loss or liability, so that if a patient is harmed while undergoing treatment they can be compensated by the insurer rather than the dentist or DCP personally.

The dental team

Dentists' training enables them to undertake, without assistance, all treatment necessary for patients, including construction of their dentures, crowns and bridges, provision of restorations and root fillings, extractions, etc. Except for the actual treatment performed within the mouth, much of the work which a dentist is qualified to do can be performed by other members of the dental team. For example, a chairside dental nurse provides an extra pair of hands for preparing and mixing filling and impression materials, and for helping with suction, retraction and illumination to keep the operative field clear and dry for the dentist and comfortable for the patient. A dental technician can make dentures, crowns and bridges ready for the dentist to fit, while dental hygienists and therapists are permitted to undertake limited forms of dental treatment.

By utilising all this assistance, a dentist becomes the leader of a team which can practise in the most efficient way. Dentists carry out all the treatment which they alone can perform, while the other members of the team – hygienist, therapist, dental nurse and technician – perform all the work which a dentist can delegate. Compared with a single-handed dentist, the dental team can provide far more treatment each day with less effort and fatigue for all concerned, and thereby give a better total service to the patient and the community. Dental team working is discussed in more detail in Chapter 3.

The full group of registered dental team members will eventually comprise:

- dental nurses
- orthodontic therapists
- dental hygienists
- dental therapists
- dental technicians
- clinical dental technicians
- maxillofacial prosthetists and technologists.

All except the last group are already required to be registered with the GDC, and must have specific training programmes, extended duties and professional responsibilities for continuing professional development and professional conduct similar to those of dentists, as well as indemnity insurance. The issue of professionalism and its relevance to all dental team members is discussed in detail in Chapter 3.

Further information is also available at www.gdc-uk.org.

Dental care professionals

This is the new professional title for all members of the dental team besides the dentist. They were previously referred to as professionals complementary to dentistry (PCDs). The full list of skills which can be undertaken on qualification for each of the DCP categories, as well as additional skills that can be developed after qualification (both post-registration qualifications and 'extended duties'), are shown in the GDC's 2013 document *Scope of Practice*.

Dental nurse

This whole text is aimed at dental nurses and their training requirements, and their invaluable role and position in the dental team are discussed in detail in Chapter 2.

Orthodontic therapist

This is a relatively new category of registered DCP, responsible for carrying out certain parts of a patient's orthodontic treatment under prescription from a dentist. The list of skills that a qualified and indemnified orthodontic therapist can undertake is limited to orthodontic treatment only, unless the DCP has a previous qualification in another DCP category, such as dental nursing. The specific skills that may be undertaken include:

- setting up instruments for a range of orthodontic procedures
- placing brackets and bands and removing fixed appliances, adhesives and cements
- inserting passive removable appliances, and those activated by a dentist
- taking impressions and casting study models
- taking intraoral and extraoral photographs
- fitting bonded retainers and tooth separators
- fitting orthodontic headgear, and orthodontic facebows which have been adjusted by a dentist.

Additional skills that may be developed include applying fluoride varnish, measuring and recording plaque indices, and removing sutures from a wound checked by a dentist.

Dental hygienist

After 2 years' training at a dental hospital or in the armed forces, hygienists used to be awarded a Diploma in Dental Hygiene and could then become registered by the GDC. Dental hygiene training has now been combined with that of dental therapists as a dual qualification, so that all those who qualify have a much wider range of skills and competencies.

Hygienists are permitted to undertake a number of dental procedures for which they have been trained, under the prescription of a dentist. These duties include:

- supragingival and subgingival scaling, root surface debridement and polishing teeth
- use of infiltration and inferior dental block anaesthesia
- providing dental hygiene care, including advice on stopping smoking
- taking, processing and interpreting various radiograph views
- taking intraoral and extraoral photographs
- applying topical fluorides and fissure sealants
- treating patients under conscious sedation, provided that a dentist is present in the room
- emergency replacement of dislodged crowns, using a temporary cement
- removal of excess cement and adjustment of restored surfaces in relation to periodontal treatment
- application of a temporary filling if one becomes dislodged while under their treatment
- taking impressions.

Additional skills that may be developed are tooth whitening (to a dentist's prescription), administering inhalation sedation, and removing sutures from a wound checked by a dentist.

Dental therapist

Dental therapists undertake a 2-year course at a dental hospital and now become qualified in both hygiene and therapy. They are awarded a Diploma in Dental Therapy and Hygiene and can carry out a wider range of treatments once they have obtained GDC registration. They are permitted to carry out all the same duties as a hygienist, and all the following additional duties:

- simple fillings on deciduous and adult teeth
- pulpotomies of deciduous teeth
- extraction of deciduous teeth
- fitting preformed crowns on deciduous teeth
- recognise anatomical abnormalities and interpret common pathology
- carry out oral cancer screening.

Dental therapists are also able to develop the additional skills listed for dental hygienists.

Prior experience as a dental nurse and possession of the relevant dental nursing qualification are requirements for admission to dental hospital training courses for dental hygiene and therapy training.

Dental technician

Dental technicians are highly skilled craftsmen and women who construct dentures, crowns, bridges, inlays, orthodontic appliances, splints and replacements for fractured or diseased parts of the face and jaws. They work to the dentist's prescription in a dental laboratory, but can also repair dentures direct to members of the public. Training consists of a full-time course in a dental hospital or technical college; or an apprenticeship with part-time attendance at a

technical college. On qualification, dental technicians may also develop additional skills when working with a dentist in the clinic, such as taking impressions and photographs, and recording facebows and occlusal registrations.

Clinical dental technician

Clinical dental technicians are specially trained to provide and maintain full dentures for edentulous patients, and may do so without the involvement of a dentist. They are also qualified dental technicians and are able to carry out the full range of skills associated with this category of DCP, as well as developing further additional skills on prescription from a dentist such as tooth whitening, providing anti-snoring devices and replacing implant abutments for removable appliances.

Maxillofacial prosthetists and technologists

Maxillofacial prosthetists and technologists are technicians who have specialised in jaw and facial reconstruction and replacement, and work closely with maxillofacial surgeons in a hospital environment.

The National Health Service

Dental treatment in the UK is provided either privately or through the NHS. In England, the current NHS system was introduced in 2013 with the abolition of primary care trusts (PCTs) and the introduction of the NHS Commissioning Board, who took over full responsibility for NHS services including all primary and secondary dental care. Private patients obtain treatment from a practitioner of their choice and pay a fee to the practitioner for professional services given, or they join one of the private registration and capitation schemes and pay a monthly or annual subscription to cover the majority of their treatment charges.

National Health Service dental treatment differs from private practice in the range of treatment provided and the method of payment for such treatment. Certain types of treatment available in private practice are currently restricted in the NHS (such as tooth-coloured fillings and crowns on posterior teeth), while payments to the dentist are set and controlled by the NHS, with patients' contributions ranging from nil to a set maximum. Currently, NHS dental care and treatment provided to the public is delivered as units of dental activity (UDA) or units of orthodontic activity (UOA), and each dentist or dental workplace will have a contracted number of UDAs or UOAs that must be delivered annually. All dental procedures that may be carried out under NHS regulations are classified into one of three bands to determine the patient charge applicable and the number of UDAs or UOAs that it attracts:

- Band 1: diagnosis, treatment planning and maintenance but excluding urgent treatment (1 UDA).
- Band 1: urgent treatment only (1.2 UDAs).
- Band 2: simple treatments such as fillings, extractions, root treatments (3 UDAs).
- Band 3: provision of appliances (12 UDAs).

Appliance repairs, suture removal and arrest of bleeding also attract 1 or 1.2 UDAs.

A set fee is charged to the patient for each of the bands, regardless of the amount of treatment carried out, so for instance the same fee is paid for one filling or 10 fillings, if provided during the same course of treatment.

Orthodontic care is similarly split into four types of treatment provision:

- Orthodontic care assessment (1 UOA).
- Case assessment and treatment up to 9 years old (4 UOAs).
- Case assessment and treatment from 10 to 17 years old (21 UOAs).
- Case assessment and treatment 18 years and over (23 UOAs).

However, the system is due to change in the near future, and while the final decision is not yet made on the replacement system to be introduced, it is highly likely that more emphasis will be placed on the role of DCPs within the dental team. The dentist will still be the only team member capable of providing all care and treatment for a patient, but much will be delegated to those DCPs with suitable training and qualifications to be carried out instead. So, dental workplaces may eventually consist of fewer dentists and more DCPs, but with the ability to carry out the same range of dental treatments between them.

Currently, various pilot and prototype contracts are being run in selected dental workplaces to determine the final version of the new contract for delivery of primary dental care in the future. The basis of the pilots and prototypes is to use care pathways to improve the quality of dental care provided, achieve good dental health for patients and increase access to dental services overall.

The cost of the NHS is borne by the state, and the government department responsible for it is the Department of Health. This delegates operational management of the service to the NHS Commissioning Board, which in turn delegates responsibility for developing and commissioning clinical groups at a more local level to its local area teams (LATs). For administrative purposes, England is divided into 27 of these LATs for overall planning. Some lead on

specialist commissioning throughout England so that services such as dentistry are run to a central policy and with consistent guidelines, rather than the old system under PCTs which varied from area to area. The clinical commissioning groups (CCGs) within each LAT have the responsibility of deciding the level of need for NHS dentistry in their area, as well as providing emergency out-of-hours dental care to the public.

Community dental service

This was formerly called the school dental service, providing examination and treatment for children and expectant and nursing mothers. It still meets the same needs but has acquired additional responsibilities. These vary according to local demand but can include treatment for special needs patients of all ages, emergency treatment for patients without access to an NHS dentist, treatment of the elderly (especially those unable to attend a dental workplace), provision for general anaesthesia and conscious sedation, and dental health programmes for the community at large.

The community dental service is administered by the NHS Commissioning Board through the area teams, and co-operates with hospital staff and general practitioners in planning and co-ordinating all dental services in the district. Salaried community dental officers provide treatment in clinics, with equipment and materials supplied by the area CCG.

Hospital dental service

Hospitals are also administered overall by the NHS Commissioning Board, again through the area CCG. Dental services are provided by consultant oral and maxillofacial surgeons and orthodontists, and in some areas specialists in restorative and periodontic treatments are also available. Together, they give specialist advice and treatment for patients referred by practitioners outside the hospital, and for patients referred from other departments of the hospital. They are also in overall charge of dental care for long-stay inpatients. In addition, most consultants provide postgraduate courses and part-time training posts for general practitioners.

General dental service

This is the general practitioner service which provides a significant share of all dental treatment in the UK. It is currently administered by the local CCG but the LAT holds dentists' NHS contracts and is responsible for NHS disciplinary procedures.

The Dental Practice Division of the Business Services Authority (previously the Dental Practice Board) authorises payment of NHS treatment fees to practitioners. It can also arrange for patients to be examined by its dental reference officers (DROs).

General practitioners set up and equip their practices at their own expense and are entitled to have private patients as well as NHS patients. However, if involved in NHS care of patients, they must also demonstrate compliance with various quality assurance measures, as follows:

- NICE guidelines
- clinical governance
- clinical audit/peer review
- information governance and data security and protection (DSP).

There is no reason why a fully private practice cannot have the same quality assurance systems in place also, although they are only required to abide by any relevant legislation, rather than having to abide by NHS rules.

NICE guidelines

The National Institute for Health and Care Excellence (NICE) is responsible for providing national guidance on the promotion of good health and the prevention and treatment of poor health in the following areas:

- public health
- health technologies (medicines, treatments and procedures)
- clinical practice.

It is an independent organisation but all NHS contractors in England and Wales are required to comply with their relevant guidelines. Those relevant to dental services include the following:

- wisdom tooth removal (Chapter 17)
- dental recall (Chapter 13)
- referral guidelines for suspected cancer (Chapter 11)
- referral for smoking cessation (Chapter 11)
- antimicrobial prophylaxis (infective endocarditis) (Chapter 5)
- sedation in children and young people (Chapter 14).

Clinical governance

This requires every NHS practice principal to have a quality assurance system for the practice, in order to ensure a consistent quality of care. It must cover the following areas to ensure the safety of its patients:

- effective infection control (Chapter 8)
- all legal obligations of health and safety law in the practice (Chapter 4)
- all legal obligations for radiation protection (Chapter 12)
- compliance with GDC requirements for CPD (Chapter 3), including clinical audit and peer review.

The practice must also:

- appoint a member of the staff to be responsible for operating the system
- display a written practice quality policy for patients
- provide the LAT with an annual report on the quality assurance system.

Clinical governance is discussed further in Chapter 3.

Clinical audit and peer review

Clinical audit is an essential feature of clinical governance that came into force for NHS dentists in 2001. Its purpose is to ensure that individual dentists assess different aspects of their practice, make changes where necessary, and thereby improve service and care for their patients. The running of quality assurance programmes within the dental workplace can often be delegated to suitably trained dental nurses, an example being retrospective clinical audits of dental radiographs.

Peer review is an optional alternative to clinical audit for dentists who prefer to undertake their practice assessments within a group of other dentists and thereby share the benefit of the group's combined experience.

As these are now clinical governance requirements, rather than optional activities, funding is no longer available to dentists for their completion.

Information governance

This is a quality assurance system that has been implemented for healthcare, corporate and information technology (IT) organisations that sets out to ensure the safety and appropriate use of personal and patient information. It is therefore linked to patient confidentiality, data protection and the freedom of information passing between various organisations and bodies.

The Department of Health has charge of the implementation of the system for healthcare organisations, including all dental workplaces, and has developed sets of information governance requirements in a toolkit (initially referred to as the IG Toolkit and now as the DSP Toolkit), which enables NHS healthcare providers to measure their own compliance.

Information governance and data security are discussed further in Chapter 3.

British Dental Association

The British Dental Association (BDA) is the professional body representing the majority of dentists in the UK. It publishes the *British Dental Journal* (*BDJ*), and many compendiums, toolkits and other literature to provide its members with up-to-date information and advice on the business of dentistry. It runs annual dental conferences which provide further update advice, as well as many CPD events aimed at the dental team rather than just dentists. The BDA also negotiates for the profession with the government and other bodies, such as local dental committees, where dental interests are concerned. Membership of the BDA is voluntary, it is open to all dentists and allows its members access to a huge source of dental literature and research material. More recently, further publications have been added to the BDA portfolio and are available in print and online:

- *BDJ Team* provides information and updates for the whole dental team
- *BDJ Student* exclusively for dental students
- *BDJ Open* for freely available research content
- *EBD* for comprehensive summaries of the latest evidence-based developments in oral health
- *BDJ In Practice* for the latest dental news stories and practical practice advice.

In relation specifically to GDC-registered dental nurses, the BDA also runs distance learning training courses for the post-registration qualifications of Oral Health Education and Dental Radiography, as summarized in the following sections.

BDA Education Certificate in Oral Health Education

This is an online course providing 40 hours of verifiable CPD that is aimed at teaching the communication skills necessary to educate patients about their oral health, and leads to this nationally

recognised qualification. On completion of the course and passing the final online examination, dental nurses are competent to work as oral health educators within their dental workplace.

The course covers the following topics:

- Diseases and conditions of the oral cavity.
- Oral health target groups.
- Delivering oral health messages.
- Oral disease prevention.
- Oral health and society.

It is delivered in 27 modules over an 8-week period, with quizzes, a practice test, and the completion of a portfolio of practical work before the final online examination. Further information is available at www.bda.org/ohecourse.

BDA Education Certificate in Dental Radiography

This is an online course providing 40 hours of verifiable CPD aimed at teaching the safe use of X-rays and how to take common radiographs, and leads to this nationally recognised qualification. On completion of the course and passing the final online examination, dental nurses are competent to take common radiographs unsupervised.

The course covers the following topics:

- Introduction to radiation and radiography.
- Intraoral radiography (bitewings and periapicals).
- Panoramic radiography.
- Other practical techniques.
- Quality assurance and the law.
- Image interpretation.

It is completed in 25 modules over an 8-week period, with quizzes, a practice test, and completion of a practical portfolio of 40 radiographs before the final online examination. Further information is available at www.bda.org/radcourse.

Resources

General Dental Council, 37 Wimpole Street, London W1G 8DQ

www.gdc-uk.org

Tel: 020 7887 3800

Fax: 020 7224 3294

British Dental Journal

www.bdj.co.uk

British Dental Association, 64 Wimpole Street, London W1G 8YS

https://bda.org/

Tel: 020 7563 4563

Fax: 020 7487 5232

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

2
The Dental Nurse

Key learning points

A **factual knowledge** of

- the General Dental Council and its role in dental nurse training, registration and regulation

A **working knowledge** of

- the overall role of the dental nurse in relation to administrative and chairside skills

A **factual awareness** of

- the National Examining Board for Dental Nurses' National Diploma examination structure

A **detailed explanation** of

- each element of the examination

An **overview** of

- available post-registration qualifications

History

Until 2008, any person wishing to work as a nurse or assistant in the dental surgery environment could do so without undertaking any form of training or passing any examination. Since 1943, the National Examining Board for Dental Nurses (NEBDN), previously called the National Examining Board for Dental Surgery Assistants, had been setting and running its voluntary examination for any persons working as nurses (assistants) in the dental workplace. Qualification in the National Certificate examination (now known as the NEBDN National Diploma in Dental Nursing) showed that successful candidates had achieved a set basic standard in dental nursing, were able to work unsupervised alongside the dentist and could call themselves a 'dental nurse' (previously a 'dental surgery assistant').

More recently, City & Guilds (C&G) introduced its Level 3 NVQ in Dental Nursing (now known as the City & Guilds Level 3 Diploma in Dental Nursing), as an alternative qualification for those students wishing to follow a vocational rather than a more academic career pathway to becoming a dental nurse. Both qualifications still run successfully alongside each other, and are open to any students wishing to take them. In Scotland, students were able to access a Scottish equivalent of the NVQ, as well as the National Certificate.

Since 2008, dental nurses, along with all other DCPs, have gradually been brought under the regulatory umbrella of the GDC. Following a period of 'grandparenting', during which unqualified but well-experienced dental nurses were allowed to register with the GDC without prior qualification, compulsory training and qualification for all have been introduced.

Registration

Nowadays, then, any person wishing to work as a dental nurse has to undergo a period of supervised training, and then pass a formal examination before being allowed to register with the GDC. All unqualified dental nurses must be supervised and 'in training' to be able to work directly with patients, and all qualified dental nurses must be registered on an annual basis with the GDC and have indemnity insurance, to be able to continue to work with patients unsupervised.

As with the other DCPs listed in Chapter 1, the necessity of registration for dental nurses has raised their role to that of a professional in the eyes of both the public and other members of the dental team. In addition, it has brought all members of the dental team into line with other healthcare professionals in the UK, so that all are now accountable to a regulatory body.

In line with other regulators, the purpose of the GDC in its regulatory role is to maintain the list – or Register – of those persons deemed suitable to work as healthcare professionals at their level of qualification. This is correctly termed their 'fitness to practise'.

As with all other GDC registrants, dental nurses are required to pay an annual retention fee to maintain their place on the Register, having behaved in a professional manner throughout the previous 12 months. In other words, the GDC has to ensure not only that anyone joining the Register is fit to practise at the point of initial qualification but that they remain so throughout their career. Consequently, the GDC's own aims are summarised throughout its publications as 'Protecting patients, regulating the dental team'.

Role of the GDC in dental nurse training and qualification

To ensure that dental nurses are adequately trained and qualified to a suitable level in their chosen dental career (i.e. they are 'competent'), the GDC describes the outcomes that each student must be able to demonstrate by the end of their training, to be able to join the GDC Register. Originally, these outcomes were published in the GDC document *Developing the Dental Team* but they are now covered in the updated publication *Preparing for Practice: Dental Team Learning Outcomes for Registration* (2015 revised edition). This updated document has also superseded the equivalent publication for dental undergraduates, *The First Five Years*. All GDC publications can be viewed or downloaded by accessing its website at www.gdc-uk.org.

In summary, then, the GDC has a vital role to play in the regulation of the whole dental team, including dental nurses, from the time that they enter a formal course of training as a student, right through their professional career until they leave the GDC Register. The GDC's functions as a regulatory body and the way that this affects the dental nurse are as follows:

- Set standards to be followed: in relation to behaviour, education (pre- and post-registration) and ethics.
- Handle fitness to practise issues: in relation to poor health, poor professional performance or professional misconduct.
- Remove individuals from the Register and prevent them from practising as dental professionals if they are considered to be 'unfit'.

In carrying out its role as a regulatory body for the dental profession, the GDC also promotes its own aims to:

- protect patients
- regulate the dental team
- promote public confidence in all dental professionals

- quality assure dental education for all dental professionals working in the UK
- ensure that all dental professionals maintain an up-to-date level of knowledge
- assist patients with serious complaints against dental professionals.

These fundamental aims of the GDC affect the working lives and careers of every dental professional on a day-to-day basis, and represent the standards that should be achieved by all. The GDC has conveniently published these principles and standards in a booklet format, *Standards for the Dental Team*, and made it available to all registrants. The Standards are discussed in detail in Chapter 3. All student dental nurses are expected to be familiar with the detailed contents of this publication as soon as they begin their training.

Learning outcomes and qualification

As mentioned previously, the GDC has set out the outcomes that dental nurses must be able to demonstrate by the end of their training period in order to become a registrant and be deemed 'fit to practise'. Within a training course, demonstration of these outcomes is met through education, training and assessment, and they are therefore referred to as 'learning outcomes'. They are derived from the GDC's own *Standards for the Dental Team* document, and include the requirements set by the GDC for lifelong learning to be achieved. In the UK, student dental nurses can meet the training requirements by following an approved course and passing either the NEBDN National Diploma in Dental Nursing examination or the C&G Level 3 Diploma in Dental Nursing examination.

The curricula developed by NEBDN and C&G have also been informed by the National Occupational Standards for dental nursing, developed by Skills for Health who in turn worked alongside the GDC to ensure the standards are fit for purpose within the qualifications that may lead to GDC registration. The Standards can be viewed at www.skillsforhealth.org.uk.

The GDC learning outcomes have been developed so that a student who achieves them can be said to be competent – they can practise safely, effectively and professionally as a dental nurse. The vast majority of the learning outcomes are actually set, word for word, for each dental professional category, from the dentist through to the dental technician. Once achieved, they demonstrate that the student has the **knowledge**, **skills**, **attitudes** and **behaviours** required to become a GDC registrant.

To understand what is required from student dental nurses during their training, education and assessment, the following interpretations of these key terms may be useful:

- **Knowledge**: the underpinning, theoretical information gained from learning or experience, which gives the student understanding of a subject.
- **Skills**: the special abilities acquired by learning and practice to be able to complete a task, often manually or verbally.

- **Attitudes and behaviours**: the moral and ethical beliefs held by the student which demonstrate their values and priorities, and guide their actions.

Students must exhibit all of these attributes to be considered as professional dental nurses after qualification, and be entered onto the GDC Register. They must then maintain and improve upon these qualities throughout their working life in order to stay on the Register.

The GDC learning outcomes are grouped into four domains for all registrants, and their specific relevance to the dental nurse is as follows:

- **Clinical**: described as the range of skills required to deliver direct care, where registrants interact with patients.
- **Communication**: described as the skills involved in effectively interacting with patients, their representatives, the public and colleagues, and recording appropriate information to inform patient care.
- **Professionalism**: described as the knowledge, skills and attitudes/behaviours required to practise in an ethical and appropriate way, putting patients' needs first and promoting confidence in the dental team.
- **Management and leadership**: described as the skills and knowledge required to work effectively in a dental team, manage own time and resources, and contribute to professional practice.

The NEBDN National Diploma curriculum has been designed to follow these domains and learning outcomes very closely, with more detail given in many areas, as necessary. Details of the qualification itself are given at the end of this chapter, together with information on the C&G Level 3 Diploma.

Student professionalism and 'fitness to practise'

The GDC's role in regulating the dental profession begins when any student enrols on a training course and is deemed to be 'in training'. This is irrespective of the category of the future registrant (whether a dentist, dental nurse and so on) or whether the training is being delivered in a dental hospital, further education college or the dental workplace. All healthcare regulators are required to ensure the safety of patients while being treated by healthcare students, and to ensure that they are fit to practise at the point of registration. While the student dental nurse would not be in a position to 'treat' a patient as such, certain standards of professionalism are quite rightly expected of them, as with any other healthcare student. These standards of conduct, performance and ethics that are expected to be followed by all dental and DCP students during their training course towards becoming a registered dental professional with the GDC are set out in the 2016–17 document *Student Professionalism and Fitness to Practise*.

Some of the areas of concern that may draw the attention of the GDC to a particular student in relation to issues surrounding their fitness to practise may come as a surprise to some, especially when events have occurred outside the training course or the workplace. While those allegations or areas of concern involving the police (whether resulting in a conviction or a caution) are bound to be considered by the GDC in fitness to practise hearings, other circumstances (such as cheating in an examination or having a poor work attitude) may be erroneously considered to have little to do with the regulator. However, actions and behaviours such as these latter examples may give an overall impression of an unprofessional attitude by the student to the public, and are therefore of great concern to the GDC. Further examples of the types of allegations or convictions that may cause concern and bring into question a student's fitness to practise are set out in Table 3.1 in Chapter 3, where the topic is discussed in greater detail.

The principles of professionalism that the student dental nurse must adhere to are clearly laid down in the GDC *Standards for the Dental Team* document (see Chapter 3 for details), and fall into the following nine categories:

1. Put patients' interests first.
2. Communicate effectively with patients.
3. Obtain valid consent.
4. Maintain and protect patients' information.
5. Have a clear and effective complaints procedure.
6. Work with colleagues in a way that is in patients' best interests.
7. Maintain, develop and work within your professional knowledge and skills.
8. Raise concerns if patients are at risk.
9. Make sure your personal behaviour maintains patients' confidence in you and the dental profession.

The responsibility is on the education provider to inform students that unprofessional behaviour or serious health problems during their training may affect their ability to register with the GDC, if they are not considered to be 'fit to practise'. The provider must have transparent processes and procedures in place to communicate and investigate concerns when they arise, and to determine whether the student could possibly put patients and the public at risk by their actions.

Full details of the guidance available from the GDC in these matters, for both education providers and students, are available from the GDC website at www.gdc-uk.org.

To ensure that student dental nurses fully appreciate the levels of professionalism expected of them as members of the dental team, examples of some of the potential areas of concern that may result in a fitness to practise investigation are shown in Table 3.1. The topic of student professionalism is discussed in detail in Chapter 3.

Dental nurses and the law

The ethical and legal issues that affect dental nurses in their workplace and day-to-day duties are covered in detail in Chapter 3, and those related to safe working practices in Chapters 4, 8 and 12.

Overall, the Acts and Orders of Parliament that govern the whole dental profession, including dental nurses, are:

- Dentists' Act 1984 (Amendment Order 2005)
- Health and Social Care Act 2008
- Health Care and Associated Professions (Indemnity Arrangements) Order 2014.

The Amendment Order to the Dentists' Act stipulates that only those persons registered with the GDC, following success in a registrable dental nursing qualification, can legally call themselves a 'dental nurse'. This may seem a minor point but a breach of the Order is viewed as a serious legal matter involving an abuse of trust, as the person is seen to be misleading the public over their implied professional status. Qualified dental nurses who have failed to maintain their registration simply by not paying the GDC annual retention fee are therefore breaking the law and can be prosecuted. Any other registrant (dentist or DCP) who employs such a person is also putting their own registration at risk.

The Health and Social Care Act was introduced in response to the apparent loss of trust in the healthcare professions (including the dental profession) by the public. This followed public inquiries into several notorious cases of serious harm being done to patients by their doctors, both in the hospital environment and in the community. The most shocking of these was probably the case of Dr Harold Shipman, a GP in Manchester who was successfully convicted of murdering 15 of his patients. His actions were only uncovered after the solicitor daughter of one of his victims became suspicious of events surrounding the death of her mother, and contacted the police. The case highlighted just how uncontrolled and unaccountable a healthcare professional could be at the time, as Shipman is alleged to have killed over 200 of his patients over the years, without raising any suspicions until that point.

The Indemnity Arrangements Order made the requirement for all registrants to have indemnity cover a legal one, rather than an ethical one as it had been previously.

Finally, in addition to the above enactments, the same professional standards of behaviour listed previously for students also apply to those who are qualified, and must be adhered to throughout their working career. Now that all DCPs are individually registered with the GDC, the onus is on each team member to take full responsibility for their own actions and to act in a professional manner at all times. The issue of 'vicarious liability' no longer applies – the dentist is no longer personally responsible for the actions or omissions of other registered members of the dental team. However, they are still responsible for unregistered staff, including trainee dental nurses.

The practical application of the professional principles laid down in the GDC *Standards for the Dental Team* document requires all members of the dental team to behave in the following manner, as professional individuals and on a day-to-day basis:

- Apply the principles in your work as a dental professional, whether or not you routinely treat patients.
- Understand that you are professionally responsible for your actions and must be able to account for them.
- Put patients' interests before your own or those of your colleagues.
- Apply these principles when handling queries and complaints from patients and in all other aspects of non-clinical professional service.
- Maintain your GDC registration and work only within the limits of your knowledge, professional competence and physical capability.
- Take effective action to protect patients if you believe they are being put at risk by your health, behaviour or professional performance, or those of a colleague, or by any aspect of the practice clinical environment.
- If in doubt, obtain advice from senior staff, appropriate professional body or the GDC.

- Treat patients with respect, courtesy and awareness of their dignity and rights.
- Understand and promote patients' responsibility for making decisions about their bodies, their priorities and their care, and obtain their consent before any treatment is undertaken.
- Provide all the information, including the risks, benefits, costs and alternative options, upon which they can make their decision.
- Ensure that there is no discrimination against patients regarding their race, ethnic origin, age, sex, disability, special needs, sexuality, lifestyle, beliefs or economic status.
- Treat all information about patients as confidential, and use only for the purposes for which it was provided.
- Ensure that such material is kept securely to prevent any accidental or unauthorised access to it.

These points are discussed in detail in Chapter 3.

General Dental Council registration completes the first stage of the dental nurse's professional career. From that point on:

- compliance with your legal obligations, knowledge, skills and professional competence must be maintained and updated by verifiable continuing professional development
- justify your professional status, and the trust of your patients and colleagues, by honesty and fairness in all your professional and personal activities
- apply all these ethical principles to clinical and professional relationships, and to any commercial or business dealings in which you may be involved
- maintain proper standards of personal behaviour in all aspects of your life, and thereby promote patients' confidence in you and public confidence in the dental profession.

Continuing professional development

CPD and lifelong learning are now statutory requirements for the continuing registration of DCPs; more recently, the concept of becoming a 'reflective practitioner' has enabled dental professionals to understand how experiences in their daily working lives should guide their CPD achievements. Carrying out CPD activities should aim to guide an individual in updating their skills and education throughout their working lives, to ensure that they stay abreast of all the changes and updates involved in their chosen career. This should then ensure that they provide the best care and service possible to patients. A summary of information and knowledge is given here, but the subject is discussed in more detail in Chapter 3.

Until January 2018 for dentists and August 2018 for DCPs, CPD was available either as verifiable or non-verifiable events. From January 2018, the GDC introduced 'enhanced CPD' which is aimed at ensuring the following:

- CPD undertaken is directly relevant to the registrant's 'field(s) of practice'.
- Reduction in the overall number of hours of CPD to be completed, by removal of the need to complete non-verifiable CPD.
- Ensure the quality of CPD events by requiring that they are each linked to specific development outcomes.
- Ensure that CPD is spread evenly over the 5-year cycle so that professional development occurs continuously rather than sporadically.

The same requirements came into place for DCPs in August 2018, but for those who were mid-cycle at these times, a transitional arrangement was put in place so that some registrants have to complete some CPD based on the old scheme as well as some on the new scheme. The new system is discussed more fully in Chapter 3.

Verifiable CPD is that offered formally, with specific learning outcomes given. Certificates of attendance and/or participation in verifiable CPD activities will be issued after the event and must be

kept as evidence of complying with the GDC's requirements; they may even have to be produced as evidence of verifiable CPD activity. Examples of verifiable CPD include:

- attendance at postgraduate courses
- attendance at local meetings organised by postgraduate tutors or deaneries
- distance learning programmes with learning outcomes
- computer-aided learning (CAL) programmes
- attendance at conferences with stated learning outcomes
- studying and taking formal examinations in dentally related subjects
- completing tests set on articles published in dental journals.

Some topics are considered essential for the safe delivery of dental care, and are therefore called 'core subjects'. The GDC stipulated the amount of CPD that must be undertaken in these core subjects over a 5-year cycle, for each category of registrant. For dental nurses, the CPD cycle runs from August to July each year and 50 hours of verifiable CPD (including the core subjects) plus 100 hours of general CPD are to be completed within the 5-year cycle. The required hours for each core subject during the 5-year cycle are as follows:

- Medical emergencies: 10 hours.
- Disinfection and decontamination: 5 hours.
- Radiography and radiological protection: 5 hours.
- Oral cancer: minimum hours not specified.
- Legal and ethical issues (if dealing with patients on a regular basis): minimum hours not specified.
- Complaints handling (if dealing with patients on a regular basis): minimum hours not specified.

The hands-on cardiopulmonary resuscitation (CPR) aspect of the medical emergencies training should be carried out every year by all

registrants.

Non-verifiable CPD was that done on an informal basis, often purely on a personal interest basis. Although new information may well be learned during these activities, it cannot be tested nor proved that specific learning outcomes have been achieved. For those in the transition arrangements as the new enhanced CPD scheme begins, the number of hours of non-verifiable CPD completed annually must also be stated in the registrant's CPD submission. For those whose 5-year cycle started in January or August 2018, non-verifiable CPD events are no longer required to be recorded on their annual CPD declaration. Examples of non-verifiable CPD activities include the following:

- Reading dental journals, with no testing of the contents of any articles.
- Reading postgraduate handbooks.
- Accessing websites and downloading information.
- Attendance at staff meetings.
- Completion of in-house training, although if aims are stated and linked to specific development outcomes, feedback is given and a certificate of attendance issued, these events can easily be turned into verifiable CPD activities.
- Completion of staff appraisals.

When carried out correctly, organised CPD events covering the mandatory areas of dental practice, as well as a wider range of subjects relevant to the role of the dental nurse, are of great benefit. It should enable recognition of areas that are of interest as well as areas where more knowledge is required, as dentistry, and therefore dental nursing, are ever-changing disciplines where new materials and techniques are introduced regularly. Completion of CPD should produce some of the following personal outcomes for all dental nurses:

- increased job satisfaction
- identification of problem areas

- improved communication with colleagues
- improved efficiency
- improved career prospects
- greater commitment to the workplace.

The planning and undertaking of CPD should be given careful thought by dental nurses to ensure not only that the mandatory requirements of the GDC are met but also that any other CPD undertaken is of use to them. While the temptation exists to only attend courses of personal interest, a broader coverage of subjects is more desirable and useful to the development of the dental nurse.

A staff training and development system must be in place in all dental workplaces, whereby the skills held by all staff are reviewed on a one-to-one basis so that individual training needs can be identified. This is usually carried out as an annual staff appraisal and is discussed further in Chapter 3.

In essence, records should be kept of the points discussed during the appraisal, as well as any needs that have been identified and any methods discussed for meeting these needs. These points should be included in the personal development plan (PDP), where the necessary CPD requirements can be looked into and successfully accessed, and the individual PDP can be updated accordingly. This is then available to the GDC, or prospective new employers, as evidence that the staff member not only has ambitions and identified training needs, but that they have successfully carried them out.

The development and use of a PDP is also a requirement for completion of the Record of Experience for the NEBDN National Diploma qualification, while student dental nurses are undergoing their formal training.

Overall role of the dental nurse

The role of the dental nurse during specific chairside, or patient-orientated, activities is discussed in detail in each of the following clinically relevant chapters. However, as a key member of the dental team, there are many overall duties that must be carried out by the dental nurse on a daily basis to ensure the efficient running of the dental workplace, as well as administrative or reception duties. This is achieved by ensuring meticulous attention to detail during completion of the many background activities that allow the workplace to run smoothly, like a well-oiled machine. These background activities have traditionally developed as dental nurse roles, while the dentist (and now also the hygienist and therapist) have concentrated more on the patient-centred, hands-on activities of delivering treatment. The actions of all members of the dental team working together in this way culminate in a pleasant and successful experience for the patient at each attendance.

The activities specific to the dental nurse can be summarised under the following three areas:

- general duties
- administrative and reception duties
- surgery duties.

General duties

- Acceptable level of personal appearance and social cleanliness, in accordance with the dress code requirements of the workplace, to give an overall appearance of professionalism.
- Maintenance of a high standard of cleanliness and tidiness throughout the premises.
- Adequate levels of heating, lighting and ventilation, to ensure a comfortable environment for patients and staff.
- Full and accurate list of all contact details for suppliers, service and maintenance personnel, patient health and welfare organisations, and laboratories.

- Ordering and correct storage of dental stock and general supplies.
- Full knowledge of, and compliance with, all health and safety directives in relation to general issues (e.g. fire drill, location of fire extinguishers, waste disposal requirements; these are discussed further in Chapter 4).

Administration and reception

- Acceptable level of personal appearance and social cleanliness, in accordance with the dress code requirements of the workplace.
- Good level of communication skills, both face to face and over the telephone.
- Reception of patients and dental company representatives.
- Ensure the visitor book is completed when anyone other than a patient attends the premises.
- Full working knowledge of all appointment systems in use.
- Arrangement of current and recall appointments.
- Recording of all attendances and treatment.
- Completion and filing of patients' records, whether manual or computerised.
- Receipt and actioning of all correspondence.
- Knowledge of NHS and private regulations and organisation.
- Management of financial records.
- Running of computer entry back-ups, on a daily basis.
- Liaison with laboratories, to ensure work is collected and delivered as required.

A large part of the successful administration and reception duties of the dental nurse is related to good patient management skills, and involve all the following areas:

- Reception of the patient into the practice.

- Appointments.
- Communication skills.
- Equality of dental care.
- Patients with special needs.
- Dental emergencies.

The dental nurse has a key role to play in ensuring that the dental experience of each patient is a pleasant one, whether working chairside or in a reception and administrative position.

Reception of patients into the practice

Most dental practices have one or more dental nurses who 'double up' as receptionists for at least part of their working week, although it is possible to have staff with purely administrative duties. However, since GDC registration of dental nurses has become mandatory, administrative staff without a dental nurse qualification or where their registration has lapsed (such as while having a career break to raise a family) can no longer 'double up' as dental nurses during periods of short staffing. The obvious problem with purely administrative staff manning reception occurs when patients are asking for dental advice or for further information about specific dental treatments, as they will have limited dental knowledge. For this reason, most practices prefer a dental nurse to carry out reception duties.

The word 'reception' illustrates the main role of these personnel – to 'receive' the patient into the practice as the first point of contact in the dental environment. It is vital that the dental nurse in this role has all the following attributes:

- pleasant disposition
- good communication skills (discussed further in Chapter 13)
- friendly and welcoming attitude
- knowledgeable about dentistry but only to the limit of their training
- efficient and accurate at reception duties

- works well under pressure, without becoming flustered
- pleasant telephone manner
- caring and considerate attitude
- well presented, and neither too loud nor too softly spoken.

As very few dental practices, and no hospital clinics, are without computerisation of at least some part of their working system, IT skills are also an imperative requirement for the modern dental nurse to acquire. However, the increasingly extensive use of computers in dentistry and dental practice management does not replace the need for the dental nurse to have legible, neat and accurate handwriting skills, and this is especially important when giving written information such as appointment details to patients.

A friendly disposition is invaluable when greeting nervous and anxious patients onto the premises, and is often all that is required to allay the fears of most patients. While this tends to come naturally when dealing with younger patients, it should be remembered that many older patients are just as anxious, whether they try to hide their feelings or not. Being friendly and welcoming to all patients should come as second nature to all the dental team, so that the patient's dental experience is of a consistently high standard for the whole visit. Some employers prefer to refer to all patients by their correct title (Mrs, Mr, Ms, etc.) while others are more familiar and refer to patients by their first name – the dental nurse must follow the preferred system of the practice at all times.

Appointments

Booking appointments for patients takes up a large part of the working day, and during busy periods it can be an area that causes many problems. When several patients are hovering in a reception area, and one or more telephones are ringing with enquiries from other patients, it is quite easy for members of the dental team to be overwhelmed by the demands of their role and for mistakes to happen. In larger practices and hospital clinics, it is usual for more than one staff member to be responsible for appointment bookings, and without a written protocol in place for the task to be carried out in a consistent manner by all, mistakes can easily be made.

A successful appointments booking system can easily be established by any dental workplace if the following points are considered and adapted for use as necessary:

- Ensure that all staff working at the reception area have been fully trained in all of their necessary duties.
- Have written protocols to be followed by all staff.
- Ensure the booking system is sensible, easy to follow, and is explained clearly during training sessions.
- If manual appointment books are used, rather than a computerised system, ensure alterations and cancellations are deleted in a tidy manner, so that the daylist is still readable by all staff.
- If possible, delegate the simpler reception duties to other staff so that one senior person remains in control of appointment bookings, as this will lead to fewer mistakes.
- Ensure all staff are aware of how each dentist and DCP prefers their appointments to be booked, especially the length of time required for various procedures.
- Be considerate but firm with patients when booking appointments; sometimes it may not be possible for them to have the time slot they request.
- Similarly, try not to allow the appointments list to develop with large gaps each day, but rather try to book appointments one after another from the first morning slot onwards wherever possible. There is nothing worse than having a lull in appointments part way through the day and then a heavily booked run towards the end of the session.
- If a problem does occur, attempt to rectify it to everyone's satisfaction as soon as possible, but try to uncover the cause of the problem so that it will not be repeated in the future – this shows maturity and common sense.

Equality of dental care

As discussed in Chapters 3 and 13, the dental nurse has a legal responsibility to behave equally towards all patients without showing any form of discrimination. This can occur in all the following areas:

- **Sex or sexual orientation discrimination**: between male and female patients, or those who are bisexual or gay/lesbian.
- **Age discrimination**: especially between elderly patients and others.
- **Disability discrimination**: between able-bodied and able-minded patients and those with a physical or mental impairment.
- **Racial and ethnic discrimination**: between any patients with a difference in colour, nationality and ethnic or national origins, especially where there is a language barrier too.
- **Religious discrimination**: between any patients with different religious beliefs, or those with no religion.
- **Socioeconomic discrimination**: between the perceived social class and economic status of various patient groups.

With particular regard to sex discrimination, the development of inappropriate relationships between members of the dental team and patients is particularly frowned upon by the profession and, more importantly, by the GDC. No favouritism should be shown towards any patient by a staff member because they are attracted to them – problems are likely to occur, which may result in dismissal or even a charge of serious professional misconduct. Staff only have to read the quarterly misconduct reports issued by the GDC to determine the seriousness of these charges.

The dental team needs to be aware of any likely cultural differences between ethnic groups, some of which are of dental relevance and are discussed further in Chapter 13. The team must accept these differences in an appropriate manner, while offering oral health advice as necessary. Religious beliefs may prevent a patient from undergoing oral examination at certain times, such as the Moslem period of Ramadan, and again the dental team must accommodate the belief to allow smooth running of the practice.

Patients with special needs

There are many patients who can be considered to have special needs in relation to dentistry and dental treatment, because of a physical, mental, social or medical problem. Some of these special needs patients who are likely to be treated in a general dental practice setting, rather than in a specialist dental clinic, include the following:

- elderly patients
- patients with a progressive mental impairment (dementia)
- patients with learning disabilities
- patients with physical disabilities
- patients with certain medical problems
- patients from low socioeconomic backgrounds.

This subject is discussed further in Chapter 13.

Dental emergencies

Even with the very best dental care, emergencies do arise from time to time. From April 2006 it was the responsibility of the PCT to provide out-of-hours emergency dental care to all patients, whether they were NHS, private, regular or irregular attenders. However, it is now the responsibility of the primary care organisation (CCG or LAT) in each area to provide out-of-hours care for all patients. The scheme may vary between areas but most provide a telephone advice and triage service, with evening and weekend open access emergency clinics for those requiring treatment before their usual practice is open, or for those with no regular dental provider. Each practice should ensure their patients are provided with information on accessing emergency care out-of-hours, usually via an answerphone message which gives the telephone advice and triage number. Each primary care organisation will determine the most severe incidents that require emergency treatment, but the following are likely to be included by all, and may warrant attendance at the local hospital accident and emergency department:

- **Severe dental pain** not controlled by analgesics.

- **Severe swelling** of the oral soft tissues, which is at risk of compromising the patient's airway.
- **Uncontrolled bleeding** after an extraction or minor oral surgery procedure.

Less severe emergencies, such as swelling with no airway implications, are passed to the on-call dentist for an opinion on whether the patient should be seen within 12 or 24 hours, either by their own dentist or by the emergency dentist. In the latter case, they will be directed to a local dental access centre for emergency treatment, such as lancing an abscess, placing a tooth on open drainage or placing a dressing, and are then advised to seek further treatment from their regular dentist or are directed to a practice which is accepting new patients.

Private patients may be members of various private dental plans, such as Practice Plan or Denplan, and member dentists will often provide emergency care for less serious incidents, such as recementing a crown or bridge. Each practice will have its own emergency protocol to follow for all eventualities, and the dental nurse has a key communication role to play when dealing with patients in these situations.

When emergency calls are received during normal working hours, it is the responsibility of the practice to provide urgent care as it deems necessary, to relieve severe pain or to prevent a significant deterioration in the patient's oral condition. Further treatment to restore oral health does not have to be provided on the same day, and the patient may choose to seek treatment at another practice if their waiting time is less than that of the original practice.

It is impossible to know in advance the number of emergency calls that are likely to be received in any one day, so it is often difficult to try to provide emergency slots without wasting surgery time if no calls are received. Various management systems for dental emergencies during working hours may be operated, and some examples are as follows:

- **Double booking appointment slots**: this saves unbooked time slots but is disruptive to the running of the appointment system and often results in the dentist 'running late'.

- **Set aside emergency time slots**: this is less disruptive but can result in unbooked surgery time occurring.
- **In-house triage system**: the practice determines what constitutes an emergency, and the dentist decides which patients require treatment that day; the patient is then slotted into any unbooked appointment time or is seen after normal hours.
- **Ad hoc system**: all emergency treatment requests are received and slotted into any available appointment slots; again this saves unbooked time but can cause disruption if a high number of calls are received.

Most dental workplaces will run a combination of these management systems, but the most effective approach for reducing the number of emergencies is for the dental team to work as follows:

- Provide consistently good-quality dental care to all patients to reduce the incidence of predictable emergencies; for instance, if a new crown does not fit well, it should be remade rather than fitted as a poor fitting crown is likely to fail.
- Have a written emergency dental call protocol for all to follow, and stick to it without exception.
- Have an accepted triage system in place that is used by the whole dental team.
- Ensure that patients are made aware that they will only receive emergency treatment initially, and will have to reattend for further treatment in a routine appointment slot.
- Be aware of the regular patients and their dental histories; an emergency call from a regular attender is more likely to be a *genuine* emergency than one from a patient who routinely fails appointments and ignores oral health advice.

The dental nurse plays a vital role in running a successful emergency management system, as this team member is the first point of call for what is often a distressed and anxious patient, and one who is quite likely to be in pain. A sympathetic and caring attitude must always be adopted, although a polite but firm manner may also be required for the successful management of those relatively few patients who will

not accept advice alone, and insist upon an immediate appointment with the dentist. If all else fails, the handling of these patients may have to be transferred to a senior staff member or the dentist. No matter what, the dental nurse should not be intimidated into breaking the emergency call protocol of the practice by any patient.

Surgery duties

As already stated, the details of the surgery role for each type of treatment are covered in the relevant chapters, but there are many points that the dental nurse should follow which are common to all 'opening up', 'during treatment' and 'closing down' procedures for all chairside activities.

Thorough preparation of the surgery is essential before the day starts, between patients and at the end of a treatment session. In addition, a clinical level of personal appearance and cleanliness is required in the surgery areas, in accordance with the uniform and personal protective equipment (PPE) requirements of the dental workplace.

Beginning of the day, after switching on all power to the equipment

- Disinfect all working surfaces.
- Fit new disposable covers where necessary.
- Discharge water for 2 minutes through three-in-one syringe and all handpieces with water spray.
- When necessary, refill the bracket table water bottle with purified water and a proprietary water line disinfectant.
- Run, and record result of, autoclave test: this can also be carried out during the first cycle of instrument sterilisation.
- Fill ultrasonic cleaner with fresh detergent solution using purified water.
- Check that all other equipment is working satisfactorily.
- Ensure that appointment book, daybook, patients' notes, radiographs, laboratory work, emergency kit and all materials for the day are ready.

- Prepare records, instruments and materials for first patient.

During treatment

- Highlight any relevant aspects of the patient to the dentist before treatment begins, such as anxiety about treatment, special medical history, nausea during impressions, fainting tendency.
- Always greet patients by name, in a friendly manner, and introduce new patients to the dentist by name.
- Seat the patient comfortably, and apply a protective bib and safety glasses if treatment is to be carried out imminently.
- Maintain an atmosphere of relaxed efficiency and friendly communication with the patient.
- Maintain patient records and charts as required.
- Process and mount radiographs, if taken or not digital.
- Maintain a clear and dry operative field throughout treatment, using good retraction and aspiration techniques.
- Provide full chairside support throughout treatment in relation to instruments and materials used.
- Monitor the patient throughout for any signs of distress, and inform the dentist where necessary.
- Act as a chaperone and witness throughout the treatment session.
- Ensure the patient is cleaned and tidied before leaving the surgery, by removing material debris and offering a mouth rinse.
- Give postoperative and/or oral hygiene advice, as necessary.
- Correctly disinfect, package and label any laboratory work, ready for collection.
- Remove all used instruments to the decontamination area.
- Dispose of all waste in the correct manner.
- Prepare the surgery for the next patient.

End of the day

- All used instruments, waste and laboratory work are handled as detailed above.
- All disposable shields are removed from equipment and put into the hazardous waste container.
- Surgery hazardous waste containers are removed from the area to their place of storage.
- All surfaces are correctly disinfected and wiped down.
- All portable equipment is switched off, disconnected and put into storage cupboards.
- All sterilised instruments are returned to their correct place of storage.
- Spittoon and suction unit is run through with the correct disinfectant solution.
- The air compressor is switched off and the air tank is drained.
- All other electrical equipment is switched off and disconnected.
- Any locking drawers and cupboards are secured.
- Any paper records are written up and then filed appropriately or returned to reception.

Dental nurse qualifications

The basic, pre-registration qualifications available to anyone wishing to become a dental nurse are provided by the NEBDN or by C&G. Although the same level of qualification is achieved by successful candidates with either awarding body, the assessment route to qualification is different. The merits of each are discussed in the following sections.

National Examining Board for Dental Nurses

For almost 60 years, the NEBDN has been the awarding body solely responsible for the provision of a dental nursing examination, the National Certificate for Dental Nurses. The organisation uses GDC-registered examiners from all branches of dentistry, both dentists and DCPs, who must be available on a voluntary basis to examine dental nurse candidates throughout the UK twice a year.

All examiners must be committed to an active involvement in the training and qualification of dental nurses during their time as an examiner, and will undergo a systematic performance review to ensure that their examiner skills are maintained at the required levels. The NEBDN National Diploma qualification only requires examiners to conduct objective structured clinical examinations (OSCEs) on the exam day, as the written paper is marked by an optical marking system beforehand.

All candidates wishing to sit the NEBDN National Diploma must have undergone a formal training course with an NEBDN-accredited training provider, while working as a trainee dental nurse in the dental workplace. In addition, every candidate must have successfully completed an NEBDN Record of Experience (RoE) portfolio before they can be entered for the written examination. The RoE is a portfolio of evidence showing the dental nurse has demonstrated their competence to perform a range of clinical tasks and is therefore used as a formative workplace assessment. This type of formative assessment is used to give feedback to the trainee dental nurse and their trainer about their progress towards developing the clinical competencies, and highlighting any possible difficulties they are experiencing, but makes no contribution to pass/fail decisions about

the trainee. The written examination followed by the practical examination some weeks later, but only for those candidates who have passed the written paper first, forms the summative assessment of the qualification. So the summative assessment element of the Diploma involves formal testing of the trainee's knowledge and skills, and provides the basis of pass/fail decisions leading to the qualification (or not) of the dental nurse.

Further information about the NEBDN National Diploma is given in the following sections, and full details of the qualification, the RoE and post-registration qualifications available from the NEBDN can be accessed at:

NEBDN, First Floor, Quayside Court, Chain Caul Way, Preston PR2 2ZP

Tel: 01772 429917

E-mail: info@nebdn.org

Website: www.nebdn.org

The National Examining Board for Dental Nurses National Diploma Examination

This updated examination is composed of a written element and a practical element. The written element is currently held twice a year, in April and November, in various large regional centres throughout the UK. The practical element is only available to those candidates who are successful in the written examination, and is also held twice a year, in June and January.

As stated previously, all entrants to the exam must have completed a formal training course first, as well as having their completed RoE 'signed off' by both their course provider and a supervising workplace colleague. There is now, therefore, no longer a requirement for students to have worked at the chairside for a 24-month period before they can receive their qualification. However, the formal examination must be passed in its entirety while the RoE is still valid – this is currently for a term of 3 years from its date of purchase.

Training courses are currently run in dental hospitals, colleges of further education or privately in dental surgeries, and may be

classroom based, blended learning, or even online; a full list of accredited course providers is available from info@nebdn.org. While there are currently no formal entry requirements imposed by NEBDN on student applicants, individual course providers may request them to have a minimum number of GCSE qualifications (or equivalent) or a minimum level of literacy and numeracy skills. In addition, as this is a UK qualification, all students must have a reasonable level of spoken and written English as well as a reasonable understanding of the English language.

An outline of the examination components is given below.

Written paper

The written paper has two sections which each contain one style of question, either one of five multiple choice questions (MCQs) or extended matching questions (EMQs). Unlike the old National Certificate examination, there are no diagrams to label, no short answer questions and no long answer questions. While there is no separate charting exercise to complete within the new examination, either section may contain questions about charting.

Multiple choice questions

The new style of MCQ has the full title 'one of five single best answer MCQ' and is written as follows:

- The question itself is usually one or two sentences long.
- The first sentence introduces the topic of the question.
- The final sentence asks the question.
- They are designed to test the application of relevant knowledge.
- Key words or phrases are not highlighted.
- There are always five answer options.
- Only one of those five will be the 'best', and therefore the correct, answer.
- The answers are always homologous – of the same form (e.g. all micro-organisms, all periodontal instruments, all filling materials).

- They are always set out alphabetically or numerically in ascending order.

As the question style always follows the same pattern, it is not possible for candidates to 'work out by elimination' or 'guess' the correct answer; they must have the relevant knowledge and the understanding to be able to apply it to the scenario of the question. Only then can the single best answer be identified.

Similarly, as a logical alphabetical or numerical order is always followed in the answers, the correct answer cannot be determined by seeing how many times, say, option (d) has been an answer and therefore not choosing it again. The single best answer will be at whichever option letter it falls alphabetically or numerically only. So it is quite feasible for an examination to have option (d) as the correct answer for every question asked, if the correct answer happens to fall at the option (d) position alphabetically or numerically. Consequently, the candidate is unable to guess the answer.

Candidates mark their single answer choice on an optical marking sheet for each question, by pencilling in a small box. Only one box must be filled in, otherwise the computer will reject that question. Similarly, the box must be filled in horizontally; drawing a circle around it or marking with a cross will also cause the computer to reject that question.

An example of the new-style MCQ is shown in Figure 2.1. The question clearly states that only the buccal gingivae of the upper premolar teeth will be involved in the procedure, so the nerve supplying this area simply needs identifying from the options listed. Only the middle superior dental nerve is relevant to the question.

A gingivectomy procedure is to be carried out on an epileptic patient. The technique will involve the removal of hyperplastic gingival tissue from the buccal side of the upper left premolar teeth. Which one of the following nerves must be anaesthetised to allow the procedure to be carried out painlessly?

(a) Greater palatine nerve
(b) Inferior dental nerve
(c) Long buccal nerve
(d) Middle superior dental nerve
(e) Posterior superior dental nerve

The correct answer is (d).

Figure 2.1 An example of the new-style MCQ.

Extended matching questions

This style of question follows a similar layout to the MCQ in some respects, and was introduced to replace the short answer style question but with all candidates having the same definitive option list provided for each set of questions in the examination paper. There is no opportunity for candidates to create an answer, as they could with the old short answer style, as only the options listed can be used. Each options list has several questions (a question set) attached to it.

The EMQ style questions are written as follows:

- The topic covered by the question set is stated, to help focus the candidate's thoughts.
- A lead-in statement is then given which explains what the candidate is required to do, and how many options they are required to choose from the list, for each question.
- The option list is then given, and will usually contain a minimum of eight options.
- The options are always homologous – of the same form (e.g. all surgical instruments, all micro-organisms).
- They are always set out alphabetically or numerically in ascending order.
- The questions are set out as several sentences giving a detailed scenario.

- They are designed to test analytical and reasoning skills, as well as requiring a more detailed and concise application of knowledge.
- Key words or phrases are not highlighted.
- Each topical option list has several questions set to it.

The candidate is required to understand the question and apply detailed knowledge to be able to reason the answer(s) from the option list.

A simple example of an EMQ style question used in the new National Diploma examination is shown in Figure 2.2. The clinical scenario describes the signs and symptoms of the condition and then states the disease that is present. The candidate must then apply their knowledge of micro-organisms that cause this condition and locate it from the option list. With a more extensive option list, the lead-in statement could ask for two appropriate micro-organisms from the list, making it a harder question still.

Topic: Dental Pathology
For each of the following dental pathology questions, select the single most appropriate micro-organism from the option list. Each option might be used once, more than once or not at all.

(a) *Bacillus fusiformis*
(b) *Candida albicans*
(c) Coxsackievirus
(d) Epstein–Barr virus
(e) Herpes simplex
(f) Paramyxovirus
(g) *Porphyromonas gingivalis*
(h) *Staphylococcus aureus*
(i) *Streptococcus mutans*

An 18-year-old patient attends the surgery as an emergency, complaining of severe gingival pain and halitosis. He admits to being a smoker, and brushing his teeth only once every few days. On examination, his oral hygiene is very poor and his gingivae are swollen and sloughing at the papillae. The dentist diagnoses acute necrotising ulcerative gingivitis. Which one of the options listed is a micro-organism associated with this condition?

The correct answer is (a).

Figure 2.2 An example of an EMQ.

Alternatively, the name of the disease diagnosed can be left out of the question, so that the candidate then has to determine it from the signs and symptoms themselves, before being able to choose the correct

option from the list – again, this would become a harder question still. These styles of assessment questions are available at www.levisonstextbookfordentalnurses.com and a full revision aid is *Questions and Answers for Dental Nurses*, 3rd edn (C. Hollins, 2012, Wiley-Blackwell, 9780470670903).

Objective structured clinical examination

The practical component of the Diploma examination is the OSCE, which is used to assess knowledge and clinical and decision-making skills. Candidates must pass the written paper first, before being allowed to take the OSCE element of the examination. Therefore the written paper and the OSCEs are held several weeks apart, so that the written papers can be optically marked first and a list of successful candidates produced for the OSCEs.

The OSCE has replaced the practical and oral sections of the old examination, where examiners had to ask candidates questions throughout both sections. However, candidates could be asked different questions, possibly at different knowledge levels, by whichever examiner they were allocated to within an examination centre. The old tests were therefore unstructured and were subjective rather than objective, so a candidate's performance was graded according to the opinion of the examiner at the time, rather than against set criteria.

The new style of practical examination, the OSCE, is completely different and provides a far more accurate and fairer assessment of every candidate. It is a multi-station examination (typically between 15 and 18 OSCE stations) in which the candidates are allowed a set period of time at each station before moving on to the next, usually about 5 minutes at each one. The stations are set up as a one-way rotational block and all candidates must go through every station during the examination time cycle. Large examination centres will have several station rotations running at the same time in different rooms, but they will be exactly the same tests in each block, as they will be in every other exam centre throughout the country. Some candidates may complete the required task at a station before the set time is up – this is perfectly acceptable, but they must remain at the station until instructed to move on by the examiner. If a candidate believes they have not performed the set task to the best of their

abilities, they may carry it out again for the examiner within the allowed time period, but must stop their actions immediately when the time is up. As the name suggests, OSCEs are both objective and structured in the way that they assess the candidates – the examiner does not ask any questions but simply grades the dental nurse's clinical performance against a set of written criteria as the candidate carries out the task. The set criteria are the same for every candidate, throughout every examination centre, and cannot be altered in any way by the examiner.

Other than to welcome the candidate into each test area, and ask if they have read the candidate instructions for the test beforehand (which are available for the candidates outside the station), the examiner merely observes their performance and records their assessment against the written criteria.

There are four general types of practical assessment that the OSCE will cover, and each is designed to test both the professional and practical skills of the candidate. Simplistic examples are given below.

- **Communication skills**: such as giving specific oral hygiene advice to a patient (who will be a professional actor).
- **Medical emergency**: such as an asthma attack scenario (again, possibly involving a professional actor).
- **Mixing**: any material from within the curriculum.
- **Clinical**: such as setting up instruments for a specific dental procedure or completing a charting exercise.

The candidate instructions will give the scenario relevant to the station, and the candidate is able to read these instructions before the 5-minute timing starts. The instructions will be clear and concise, so that the task to be carried out is obvious.

Where a patient (actor) is involved in the scenario, the candidate will be scored by both the examiner and the patient.

The system used by NEBDN to ensure that every candidate is assessed objectively is summarised below.

- Every examination centre will carry out exactly the same OSCE assessments, using exactly the same resources.
- All candidate and patient instructions will be worded exactly the same, in every centre.
- All candidates will be marked against the same performance criteria, and in the same way, as the examiners have been trained and calibrated to each other.
- All candidates will rotate through the OSCE stations in a set order until they have completed the full cycle.
- There will be at least one rest station in the cycle, with no task to perform but a chair and refreshments provided for each candidate to have a 'time out' period before moving on to the next station.
- A single timer is used for each cycle of stations (usually a bell), so candidates cannot have too little, or too much, time at any station.
- All candidates are allowed 1 minute to read the scenario and candidate instructions for each station, before entering the station and beginning the assessment when the bell rings.
- No candidate is allowed to enter the station until the start of the 5-minute session.
- The candidate may repeat the assessment within the 5-minute time period if they wish.
- The examiner will not ask any questions of the candidate.
- The candidate may carry out the task while talking their way through it, if they wish – they will only be graded on the performance criteria listed on the examiner's mark sheet.
- There are no 'killer stations', where the candidate must pass that one station or be failed for the whole OSCE examination.

A diagrammatic overview of a typical OSCE cycle is shown in Figure 2.3.

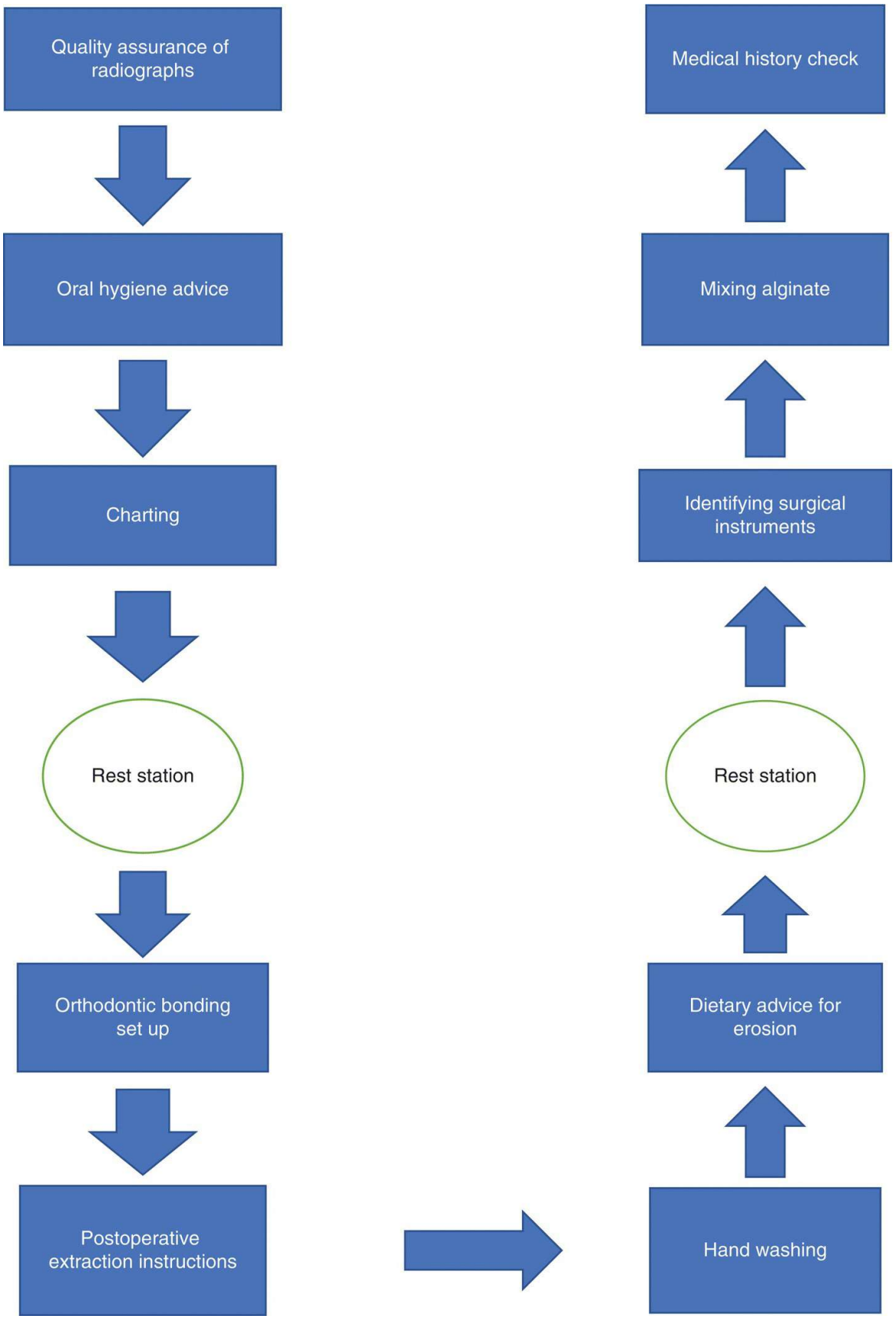
Quality assurance of radiographs
Oral hygiene advice
Charting
Rest station
Orthodontic bonding set up
Postoperative extraction instructions
Hand washing
Dietary advice for erosion
Rest station
Identifying surgical instruments
Mixing alginate
Medical history check

Figure 2.3 An example of an OSCE cycle.

City & Guilds Level 3 Diploma in Dental Nursing

This is the alternative training pathway for students wishing to become qualified dental nurses, and is different in that it follows a more vocational, less academic route to qualification. The same curriculum topics are covered, but the C&G Diploma is entirely different in the way that knowledge is tested. Whereas the NEBDN National Diploma examination covers the vast majority of the learning outcomes, takes place in two parts (the written paper then the OSCEs), and only after the RoE portfolio has been completed, most of the learning outcomes of the C&G Diploma are covered in the workplace, by the witnessed completion of a portfolio.

The C&G Diploma students attend a training course too, but only some of the learning outcomes for the qualification are covered by a formal examination, currently consisting of the old-style (one of four) MCQs and short answers. The written paper examination is currently held three times per year, in March, June and December, and students can be entered numerous times to sit the examination.

The learning outcomes covered in the workplace are witnessed by personnel holding a C&G Assessor award, at prearranged workplace visits. As the student carries out their dental nursing duties, the assessor 'signs off' the performance criteria covered to a satisfactory standard as they are witnessed. Qualification is not given until the whole portfolio has been completed, and the candidate has also passed the written paper. There is currently no limit to the number of times that the examination can be taken, and the portfolio has no restriction on its period of validity.

A companion textbook for the C&G Diploma is *Diploma in Dental Nursing Level 3*, 3rd edn (C. Hollins, 2014, Wiley-Blackwell).

Further details of the C&G Level 3 Diploma in Dental Nursing are available from:

City and Guilds, 1 Giltspur Street, London EC1A 9DD

Tel: 020 7294 2468

Fax: 020 7294 2400

Website: www.cityandguilds.com

Post-registration qualifications

Once qualified (by whichever training route) and registered with the GDC, the dental nurse can access various post-registration qualifications run by the NEBDN, in a variety of specialised areas of dental nursing. Currently, these higher level qualifications cover the following areas:

- **Dental sedation nursing**: for those students working in hospitals, clinics and practices where conscious sedation techniques are used (intravenous and inhalation).
- **Oral health education**: for those students wishing to take responsibility for advising and instructing patients on improving their oral health.
- **Special care dental nursing**: for those students working with patients who have special needs.
- **Dental radiography**: for those students involved in all aspects of dental radiographic techniques, including positioning and exposing patients.
- **Orthodontic dental nursing**: for those students working in hospitals, clinics and practices where orthodontic treatment is carried out.
- **Dental implant nursing**: for those students working in hospitals, clinics and practices where dental implants are placed.

Other specialised areas of dental nursing are being considered for future post-registration qualifications, including mentoring in the dental workplace and endodontic dental nursing.

Further details of any of these courses, including a list of accredited training providers for each qualification, are available from info@nebdn.org.

In addition, the British Dental Association also runs online training courses for the Oral Health Education and Dental Radiography qualifications, with candidates taking a final online examination at

the end of an 8-week course (see Chapter 1 for further details). The BDA also now run a short online certificate course for dental nurses called ‘Essentials of decontamination’, which covers all the essential knowledge and information required to implement effective decontamination procedures within the workplace. Further details are available from:

British Dental Association, 64 Wimpole Street, London W1G 8YS

Tel: 020 7563 4563

Fax: 020 7487 5232

Website: www.bda.org

Extended duties

Since dental nurses have become GDC registrants, their roles and those of other dental team members have been assessed to determine if any additional duties could be safely carried out once additional training has been given in the workplace, but without having to sit an examination first. Various duties fall into this category and are collectively known as 'extended duties' – they do not include the specialised area of study and examination required for a dental nurse to position and expose a patient to ionising radiation. This skill can only be achieved by acquiring the dental radiography post-registration qualification.

In allowing dental nurses to acquire these extended duties, the GDC released its updated publication *Scope of Practice (2013)* to give guidance on how they can be achieved without the dental nurse working beyond their level of skill. Obviously, those skills that are specifically provided by other dental team members as part of their registrable qualification training are excluded as skills available to the dental nurse, without undertaking that additional formal training and qualification.

In all areas of possible extended duties, the GDC publication states that 'The scope of your practice is a way of describing what you are trained and competent to do'. The key words in this statement are 'trained' and 'competent'. To achieve both in an extended duty, a senior work colleague must provide supervised guidance and training in the chosen topic, produce a written record of the training given, and sign to say that in their opinion you are competent to carry out the duty.

Examples of extended duties available to the dental nurse include:

- impression taking (alginate)
- shade taking
- suture removal
- casting of study models from alginate impressions
- construction of tooth-whitening trays

- pressing the X-ray machine exposure button under the direct supervision of the operator
- intraoral photography.

Further information and advice is available from the GDC website (www.gdc-uk.org).

The impact of the *Scope of Practice* publication on the dental nursing profession and the relevance of extended duties for dental nurses are covered in more detail in Chapter 3, while an additional chapter (Chapter 18) has been included to provide information on a selection of extended duties for use by workplaces, to assist in providing suitable in-house training for their qualified dental nurses.

Finally, as mentioned in Chapter 1, the dental nurse may also go on to study and become qualified as a dentist, therapist, clinical dental technician or orthodontic therapist. Qualification as a dental nurse beforehand is not always a requirement but it does give the student an excellent level of knowledge from which to expand their career.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

3
Legal and Ethical Issues

Key learning points

A **factual knowledge** of

- the professional obligations of dental nurses, both as students and registrants
- continuing professional development requirements and becoming a reflective practitioner

A **working knowledge** of

- the GDC's expectations in relation to duty of care, student professionalism and fitness to practise
- the GDC's professional standards guidance in relation to the dental team
- all aspects of patient records, including issues of confidentiality, data security and protection, and patient access to records
- patient consent to treatment
- raising concerns in the workplace

A **factual awareness** of

- the issues of protecting children and vulnerable adults
- patient complaints and their correct handling

Until 2006, dentists were the only individuals who could carry on the business of dentistry, and although others (including dental nurses) were involved in the dental care of patients up to this point, the dentist was solely responsible for all acts and omissions on behalf of their staff. So, if anything was below standard or harmful to a patient, the dentist alone was held responsible.

The GDC is the regulatory body of the dental profession (see Chapter 1), and in 2006 it opened the Dental Care Professionals Register so that all other persons involved in the dental care of patients had to become registered with it. Dental nurses joined the register in 2008 and have become a profession in their own right, along with other registrants such as therapists, hygienists and dental technicians. However, with registration comes professional responsibility and compliance with professional standards; registrants are now responsible for their own acts and omissions in relation to patient care, unless it is proven that their employer knowingly prevented the member of staff from acting professionally.

To become a registrant, the dental nurse must first qualify by passing a recognised examination in dental nursing; currently these are the NEBDN Diploma in Dental Nursing or the City & Guilds Diploma in Dental Nursing Level 3. Until qualification, the staff member is a trainee dental nurse (but must be on an accredited training course and studying towards qualification) and their employer is still responsible for them.

Once initially registered, the dental nurse must meet the following criteria to ensure their annual re-registration, and therefore be legally entitled to work as a dental nurse in the UK:

- Comply with all relevant legislation and regulations to ensure they act both ethically and legally at all times.
- Maintain a professional standard of behaviour at all times.
- Comply with verifiable CPD requirements in recommended topics and minimum hours over a 5-year cycle.
- Maintain indemnity insurance cover from one of the dental protection organisations.
- Pay the annual retention fee (ARF).

The relevant legislation and regulations are covered throughout this text, particularly in Chapter 4, and the text as a whole covers the full curriculum requirements for the NEBDN Diploma qualification. The C&G Level 3 Diploma in Dental Nursing curriculum requirements are covered in the alternative textbook, *Diploma in Dental Nursing Level 3* (C. Hollins, 2014, Wiley-Blackwell).

To assist students and registrants to maintain compliance with their professional requirements, the GDC has published an updated booklet *Standards for the Dental Team* (Figure 3.1) for use by all registrants, and trainee dental nurses are expected to become familiar with the contents as soon as their training begins. This single publication replaces the previous set of six booklets collectively titled *Standards Guidance*. In 2016 the GDC also published the document *Student Professionalism and Fitness to Practise* (Figure 3.2) which sets out the standards of conduct, performance and ethics that should be followed by all students training to become a dental professional, whether as a dentist or as any category of dental care professional.

Standards for the Dental Team
www.gdc-uk.org

Standards

General Dental Council

protecting patients,
regulating the dental team

Figure 3.1 GDC publication *Standards for the Dental Team*.

Student professionalism and fitness to practise

Standards for the dental team
Guidance for students

Figure 3.2 GDC publication *Student Professionalism and Fitness to Practise*.

The *Standards Guidance* and *Student Professionalism and Fitness to Practise* publications and their relevance to the trainee dental nurse will be discussed in detail here. Other useful GDC publications for consideration throughout the training course include the following:

- *Preparing for Practice* (2015 revised edition): formerly called *Developing the Dental Team* and giving details of the expected level of skills and knowledge of each registrant group upon qualification (Figure 3.3).
- *Scope of Practice* (2013 revised edition): gives details of the additional skills, after qualification, that may be achieved by the various groups of registrants, following a period of suitable and recorded training, and forming the basis of the extended duties and post-registration qualifications available to registered dental nurses (Figure 3.4). Further information on extended duties is covered in Chapter 18.

www.gdc-uk.org

General Dental Council

protecting patients, regulating the dental team

Preparing for practice

Dental team learning outcomes for registration (2015 revised edition)

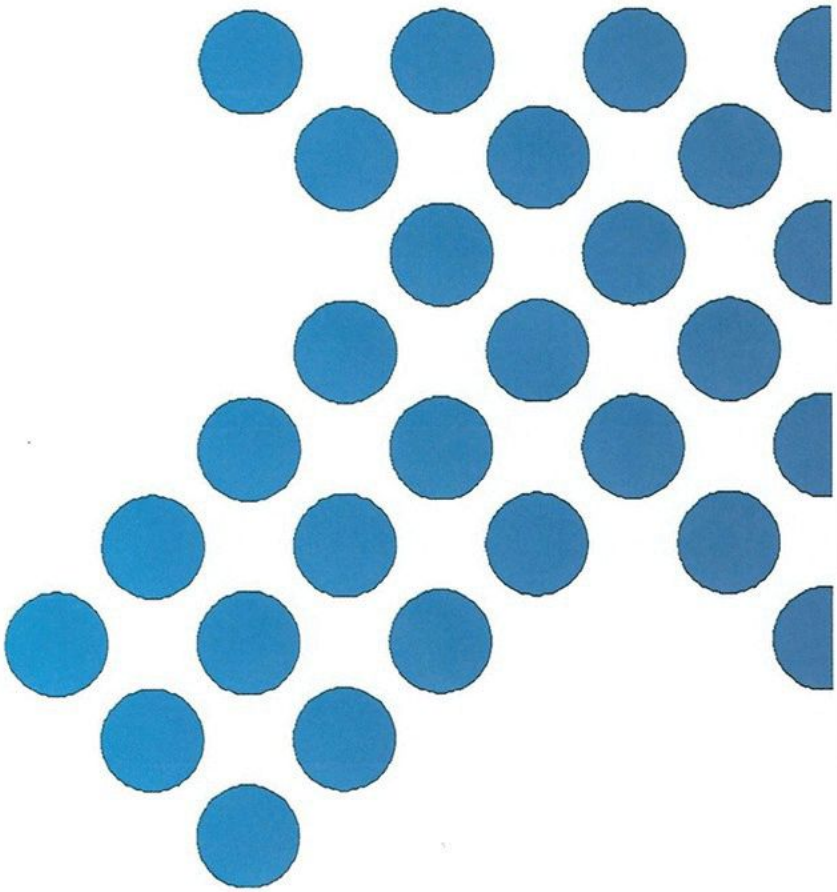

Figure 3.3 GDC publication *Preparing for Practice*.

www.gdc-uk.org

SCOPE OF PRACTICE

GENERAL DENTAL COUNCIL

General Dental Council

protecting patients,
regulating the dental team

Effective from 30 September 2013

Figure 3.4 GDC publication *Scope of Practice*.

Further details of all these publications can be found at www.gdc-uk.org.

In summary, the ethical and legal implications of the following topics will be discussed here, with those of particular relevance to the duties of the dental nurse being covered in greater detail.

- Duty of care and student professionalism.
- Fitness to practise guidance.
- GDC *Standards Guidance*: overview and notes on its relevance in other sections.
- Communication skills.
- Consent to treatment.
- Record keeping:
  - confidentiality of patient records
  - data security and protection.
- Complaints handling.
- Team working, management and leadership.
- Continuing professional development:
  - reflective practice
  - lifelong learning using a personal development plan
  - clinical governance.
- Raising concerns:
  - disclosure and barring checks
  - reporting untoward incidents
  - safeguarding children and vulnerable adults.
- Professionalism.
- Care Quality Commission (CQC) registration and its impact on dental workplaces.

Duty of care and student professionalism

Duty of care

It is the responsibility of the employer to ensure that the dental workplace and its day-to-day running comply with all the legislation and regulations pertinent to the practice of dentistry, but every registrant working in the premises also has a duty of care to their colleagues and the patients to work safely and responsibly at all times. This requirement comes under the Health and Safety at Work Act, and is covered in greater detail in Chapter 4.

In line with our medical colleagues whose professional responsibilities include the maxim 'First, do no harm', the dental professional's first duty of care can be said to be 'always act in the patient's best interests'. This theme runs throughout the various sections of this chapter, and it will be seen that at all times the guidance from the GDC with regard to the expected standards of dental professionals (whether a student or a registrant) is to always put the patient's interests first, and act to protect them. This is the duty of care that all dental professionals must uphold towards all patients.

The professional obligations of registrants are discussed in greater detail later, but can be summarised as the following:

- Maintain their professional registration.
- Ensure that all patients have equal rights.
- Work within their professional level of competence.
- Undertake lifelong learning in their areas of competence.
- Be able to demonstrate their fitness to practise.

To ensure that dental students also realise that they are expected to behave in a professional manner during their training period and not just once they have qualified and become a registrant, the GDC has published the informative guidance document *Student Professionalism and Fitness to Practise*. This clearly sets out the principles of professional behaviour that all students are expected to

follow during their training period, whether they are training to become a dentist or any one of the dental care professionals. The document gives information on the following points:

- What is expected of the student by both patients and training providers.
- What happens if concerns about behaviour or performance arise.
- What help and support is available to the student during training.

The GDC clearly states that it expects training providers to go through this guidance document with their students and explain its application during their training course.

Student professionalism

All those persons training in the healthcare sector, whether medical or dental, are in a unique position compared to students in other professions in that they have direct access to patients and confidential information about them and their health status. In addition, their skills often involve hands-on care of those patients and it is unsurprising that the public therefore considers healthcare workers to be in a position of trust and responsibility. Patients allow students to be involved in their dental care and treatment as they recognise it is an important part of their training, but the patients also expect those students to put their safety and health first, and to respect the individual choices that the patients make – the patients expect students to have certain attributes and behaviours that they see as professional 'standards'.

The GDC has formalised these professional 'standards' in the publication *Standards for the Dental Team* (see later), and achieving student professionalism involves all of the following:

- correct response to the standards required during training
- demonstration of appropriate attitudes and behaviour towards patients and colleagues at all times

- recognition of personal knowledge, work, and health limitations and ability to know when to seek help and support from others
- knowledge of how to respond appropriately when performance issues have been raised, including how to accept help and support when offered.

Although throughout the training course the training provider will offer guidance and advice on student professionalism and how to achieve it, it is important to understand that ultimately students must take responsibility for their own actions. Guidance will be given on how to develop the decision-making skills to be able to apply the principles laid out in the *Standards* document correctly, but it must be realised that those skills are to be applied at all times and not just in the training environment. Whether in the workplace, the classroom, at social events or when using social media, students are expected to demonstrate professional levels of personal conduct, performance and ethics by their colleagues, patients and their regulator at all times. Maintaining this level of student professionalism is an important part of meeting student fitness to practice requirements.

Fitness to practise guidance

No one factor determines whether a registrant is 'fit to practise' or not – whether a dental nurse is suitable to work in the dental workplace is not solely based on their academic achievements. Their qualification indicates that they are competent to do so – they have demonstrated an adequate ability to carry out the duties of a dental nurse – but suppose they are consistently rude to staff and patients, or lazy and neglectful, or dishonest and untrustworthy, or have serious health issues. Are they still fit to practise simply because they have a qualification in the required subjects? Of course, the answer is no.

The qualities required to be fit to practise as a GDC registrant are to have good personal skills and acceptable attitudes and behaviour, as well as successful academic qualifications; together they produce the professional dental nurse. The same personal qualities are required for students too, although as they are not registrants the GDC has no direct authority to deal with fitness to practise or disciplinary issues concerning students. However, the GDC requires all training providers to have a fitness to practise policy in place and to use it as necessary, to ensure that issues are addressed and resolved before the student is able to put patients at risk. Once the student has achieved qualification and is applying to become a registrant, any fitness to practise investigations or proceedings must be declared on the GDC application form and failure to do so may invalidate the student's registration. The seriousness of this situation cannot be over-emphasised, as effectively the person will be working illegally as a DCP.

One definition of the word 'professional' as a descriptive term for a person is to be 'characterised by or conforming to the technical and ethical standards of a profession', so by becoming professional members of the healthcare team, all are expected to behave in a suitable manner in public, whether working or not.

It may be surprising to some that both students and registrants are expected to follow a high standard of behaviour not just in the workplace but while not at work too. So it is not acceptable to be seen as 'pillars of society' from 9 a.m. to 5 p.m. and then become drunk and disorderly or antisocial while out with friends in the evening, for example. However, most fitness to practise issues revolve around

poor or inappropriate communication, including those using social media (Facebook, Twitter, specific dental forums, etc.). The GDC has recently published guidance on this issue to help students and registrants avoid the many pitfalls of its usage (Figure 3.5). The professionalism and standards expected during face-to-face and traditional communications are the same when using social media, as students and registrants have a responsibility to behave professionally both online and offline.

Guidance on using social media

Social media

Social networking sites and other social media are effective ways of communicating with others on both a personal and professional level.

Social media covers a number of internet based tools including, but not limited to, blogs, internet forums, content communities and social networking sites such as Twitter, YouTube, Facebook, LinkedIn, GDPUK, Instagram and Pinterest.

Professional social networking websites aimed solely at dental professionals are also forms of social media and are covered by this guidance.

Professional standards

4.2.3 of the Standards for the Dental Team states:

'You must not post any information or comments about patients on social networking or blogging sites. If you use professional social media to discuss anonymised cases for the purpose of discussing best practice you must be careful that the patient or patients cannot be identified.'

The standards expected of dental professionals do not change because they are communicating through social media, rather than face to face or by other traditional media. As a dental professional you have a responsibility to behave professionally and responsibly both online and offline.

However, because anything that is said on social media is instantly made public, it creates new circumstances in which the standards apply. Your professional responsibilities, such as patient confidentiality and professional courtesy, are still fundamental when you use social media.

When using social media, you must:

a) Maintain and protect patients' information by not publishing any information which could identify them on social media without their explicit consent;

b) Maintain appropriate boundaries in the relationships you have with patients and other members of the dental team;

c) Comply with any internet and social media policy set out by your employer.

Figure 3.5 GDC publication *Social Media Information*.

Students and registrants are advised not to post or share any personal or work-related information including photographs, videos and comments which may damage public trust in dental professionals. No matter how high the security settings of a system or device are expected to be, it should be presumed that anything posted on social media is in the public domain permanently and may be accessed, copied or forwarded without the knowledge of the DCP involved.

As a professional, the student or registrant's conduct, behaviour and personal qualities are open to scrutiny by the public at all times, and the public quite rightly expects anyone who is regarded as a professional to behave correctly and to set an example of good behaviour and conduct that others aspire to achieve. Any registrant who falls short of these expectations may have their fitness to practise called into question – by the public, their colleagues, their employer and ultimately by their professional regulator, the GDC. The student will have to answer to their training course provider rather than the GDC until the time of their registration.

If the registrant is called before the GDC to attend a conduct committee and is found to be unfit to practise, they may be suspended, or even erased, from the Register. It is then illegal for that registrant to work as a dental nurse again in the UK until such time as the GDC allows them to re-register, and that may require further training and requalification in some cases. Effectively, to be erased from the Register, the registrant would be considered to have brought the profession into disrepute.

Table 3.1 lists the potential areas of concern that would highlight a registrant and their behaviour to others, including the GDC, and prompt an investigation into their fitness to practise. Examples of the types of allegations that fall into each area are given, but they must not be assumed to be exhaustive. These examples describe some of the types of poor behaviour or poor attitude that would draw attention to the registrant, or student, in the first instance. All the examples range from disappointingly unexpected and unacceptable behaviour by a so-called professional (such as having an undeclared health issue that may affect their capability to deliver a good standard

of care to patients) to actual criminal activity (such as abuse, fraud, drink driving).

Table 3.1 Fitness to practise issues.

Potential areas of concern	Examples of allegations
Criminal conviction or caution	Child pornography Theft Financial fraud Possession of illegal substances Child abuse Any other abuse Physical violence including domestic violence
Drug or alcohol misuse	Drink driving or driving under the influence of drugs Alcohol consumption affecting clinical work or environment Dealing, possessing or misusing drugs (with or without legal proceedings)
Aggressive, violent or threatening behaviour	Assault Physical violence including domestic violence Bullying Abuse
Persistent inappropriate attitude or behaviour	Uncommitted to work Neglect of administrative tasks Poor time management Non-attendance
Cheating or plagiarism	Cheating in exams or logbooks Passing off another's work as own Forging a supervisor's name on assessments
Dishonesty or fraud, including outside the professional role	Falsifying research Financial fraud Fraudulent CVs or other documents

Potential areas of concern	Examples of allegations
Unprofessional behaviour or attitudes	Breach of confidentiality Misleading patients about their care or treatment Culpable involvement in a failure to obtain proper consent from a patient Sexual harassment Inappropriate physical examinations, or failure to keep appropriate boundaries in behaviour Persistent rudeness Unlawful discrimination
Health concerns	Failure to seek medical attention or other support Refusal to follow medical advice or care plan including monitoring/reviews Failure to recognise limits and abilities

However, there are also issues that may affect a student's performance detrimentally but which are out of their control. Enrolling on a dental nurse training course is a rewarding experience for the vast majority of students, with the opportunity to acquire new knowledge and clinical skills, meet colleagues with similar aspirations, and develop responsibility for patient care. Sometimes though, there are factors beyond the student's control which may affect their behaviour and their ability to study effectively during the training course. Some examples include:

- poor health affecting the student, a family member, or a close friend
- family commitments, including a role as carer or parent
- bereavement of a family member or close friend
- serious relationship issues, including domestic abuse or violence
- financial or academic stress
- bullying, harassment, or discrimination issues

- drug, alcohol, or addiction issues.

The crux of the matter is that the public would not expect to see these types of attitude and behaviour in a professional person. Professionals are assumed to 'set a standard' of behaviour and attitude that others should admire, rather than be seen to be behaving in an irresponsible fashion.

While in training, and therefore before becoming a registrant under the regulation of the GDC, students may believe that their previous poor behaviour will go unnoticed. However, several sections of the registration documentation ask for declarations of good character and good health, to be signed by other professionals, and failing to declare any relevant details at the very start of the newly qualified dental nurse's professional career would not be advisable.

General Dental Council *Standards for the Dental Team*

The GDC has published an updated *Standards for the Dental Team* document – available to all registered dental professionals – which sets out nine ethical principles of practice that all students and registrants are expected to follow at all times. As new team members train and become qualified, and are then entered onto the Register by the GDC, their own copy of the *Standards* will be issued to them. However, all dental nurses are expected to be familiar with the content of the *Standards* by the time they begin their formal training (indeed, some examination questions will be based on the content) so students are advised to access the document directly from the GDC website (www.gdc-uk.org) or ask their training provider to do so on their behalf.

The *Standards for the Dental Team* booklet, shown in Figure 3.1, explains the nine core ethical principles of professionalism and practice that every dental registrant should follow, and how they should be applied to their day-to-day working life. Each of the nine principles has a list of associated standards which must be followed by all members of the dental team, and then each standard has guidance information supplied to assist them in meeting and maintaining those standards at all times. The one area that is deliberately not covered by the document is clinical standards.

The nine core ethical principles of practice and the issues each cover are as follows:

1. Put patients' interests first (duty of care, safeguarding).
2. Communicate effectively with patients (communication skills, duty of candour).
3. Obtain valid consent (consent).
4. Maintain and protect patients' information (confidentiality, data security and protection).
5. Have a clear and effective complaints procedure (complaints, improving performance).

6. Work with colleagues in a way that is in patients' best interests (team working).
7. Maintain, develop and work within your professional knowledge and skills (continuing professional development, lifelong learning using a personal development plan, scope of practice).
8. Raise concerns if patients are at risk (safeguarding, raising concerns, whistle blowing).
9. Make sure your personal behaviour maintains patients' confidence in you and the dental profession (professionalism).

Each of the nine principles has a set of standards attached that must be followed and met by every GDC registrant. However, the *Standards* is one publication for all dental professionals, including students during their training period and before becoming registrants, so some of the standards cover areas that are more relevant to team leaders rather than students. Similarly, other areas are more pertinent to those team members who actually provide hands-on treatment to patients – dentists, therapists, hygienists and clinical dental technicians. As students train and prepare to become dental professionals, the GDC expects them to begin learning how to embed the nine principles into their daily routines, especially in relation to patients and their care. The standards are therefore based on the reasonable patient expectations of the dental professionals they come into contact with during their treatment.

The document contains considerable guidance to enable dental professionals to meet the standards, or to be able to use their own judgement and insight when necessary to justify any variation from the guidance. However, it is clearly stated that when the word '**must**' is used, the duty is compulsory and is therefore not open to interpretation or variation. Only when the word '**should**' is used will it be accepted that the duty may not apply in all situations and that alternative action may be appropriate.

The nine principles and their accompanying standards are discussed in the following sections, and then are followed by expanded information on the relevant issues attached to each of the principles.

Principle 1 Put patients' interests first

This is the overall principle that all dental professionals must aspire to, and be seen to do so, at all times. Every team member has a duty of care towards their patients to ensure that their best interests are at the forefront of all decisions made about them – their treatment and all aspects of its safe delivery, their rights as individuals, their expectations with regard to correctly priced and painless treatment, and their right to redress if they suffer harm during the delivery of that treatment.

In particular, patients have a right to expect that the team will always put their best interests before those of financial gain and business need.

Standard 1.1 Listen to your patients

1.1.1 Treatment options must be discussed in a way that the patient can understand, and they must have the opportunity to ask questions and discuss their own expectations and concerns.

Standard 1.2 Treat every patient with dignity and respect at all times

1.2.1 You should be aware of how your tone of voice and body language might be perceived, so develop good communication skills and use them throughout your working life (see later and Chapter 13).

1.2.2 You should take patients' preferences into account and be sensitive to their individual needs and values, irrespective of whether you agree with them or not.

1.2.3 You must treat patients with kindness and compassion. Few patients attend the dental workplace without some level of anxiety, and all staff should show empathy towards them.

1.2.4 You should manage patients' dental pain and anxiety appropriately. There is nothing more belittling or frightening to a fearful patient than to be ridiculed by a blasé member of staff.

Standard 1.3 Be honest and act with integrity

1.3.1 You must justify the trust that patients, the public and your colleagues place in you by always acting honestly and fairly in your dealings with them; this applies to business and educational activities, as well as professionally.

1.3.2 You must make sure you do not bring the profession into disrepute (further information about fitness to practise issues is available by following the links at www.gdc-uk.org).

1.3.3 You must ensure that any advertising, promotional material or other information that you produce is accurate and not misleading, and complies with the GDC's guidance on ethical advertising. In particular, the words 'specialists in' or 'experts in' should be avoided, as they tend to imply a higher level of expertise than is often the case.

Standard 1.4 Take a holistic and preventative approach to patient care which is appropriate to the individual patient

1.4.1 A holistic approach means you must take account of patients' overall health, their psychological and social needs, their long-term oral health needs and their desired outcomes.

1.4.2 You must provide patients with treatment that is in their best interests, providing appropriate oral health advice and following clinical guidelines relevant to their situation. You may need to balance their oral health needs with their desired outcomes, while accepting that their desired outcomes may not always be achievable nor in their best interests. In these instances the risks, benefits and likely outcomes must be explained fully to help the patient reach a decision.

Standard 1.5 Treat patients in a hygienic and safe environment

1.5.1 You must find out about the laws and regulations that apply to your work role (further relevant detail is given in Chapters 4, 8 and 12).

1.5.2 You must make sure that you have all necessary vaccinations and follow guidance relating to blood-borne viruses.

This is to prevent cross-infection from patients to staff and from staff to patients.

1.5.3 You must follow the guidance on medical emergencies and training updates issued by the Resuscitation Council UK (further relevant detail is given in Chapter 6).

1.5.4 You must record all patient safety incidents and report them promptly to the appropriate national body (further detail is given in Chapter 4).

Standard 1.6 Treat patients fairly, as individuals and without discrimination

1.6.1 You must not discriminate against patients on any grounds, irrespective of your own personal beliefs and values.

1.6.2 You must be aware of and adhere to all your responsibilities as set out in relevant equalities legislation.

1.6.3 You must consider patients' disabilities and make reasonable adjustments to allow them to receive care which meets their needs. In some instances, this may require the patient to be referred to a colleague or to the community services for treatment.

1.6.4 You must not express your personal beliefs (political, religious, or moral) to patients in any way that exploits their vulnerability or could cause them distress.

Standard 1.7 Put patients' interests before your own or those of any colleague, business or organisation

1.7.1 You must always put your patients' interests before any financial, personal or other gain.

1.7.2 Patients must be clearly informed of those treatments they may receive via the NHS (or other equivalent health service) and those which are only available on a private basis. This is relevant in a mixed practice, where treatment is available by either route.

1.7.3 You must not mislead patients into believing that treatments available via the NHS are only available privately. If

the practice only provides private treatment, the patient must be made aware of this before they attend.

1.7.4 Patients must not be pressurised into having treatment privately if it is also available on the NHS.

1.7.5 You must refuse any gifts, payment or hospitality if accepting them could affect (or appear to affect) your professional judgement.

1.7.6 Referrals to another team member must be in the best interests of the patient only, not in yours or another colleague's interests.

1.7.7 If you believe that patients might be at risk because of someone's health, behaviour or performance, you must take prompt and appropriate action.

1.7.8 If a professional relationship with a patient has to be ended, it must not be solely due to a complaint against you, and steps should be taken to make arrangements for the continuation of the patient's treatment elsewhere.

Standard 1.8 Have appropriate arrangements in place for patients to seek compensation if they have suffered harm

1.8.1 You must have appropriate insurance or indemnity in place, relevant to your duties. This is a requirement for all registered members of the dental team, and further advice is available from dental companies offering indemnity insurance or from www.gdc-uk.org.

1.8.2 You should ensure you follow the terms and conditions of your personal indemnity insurance at all times, and contact your insurer as soon as possible when a claim is made.

Standard 1.9 Find out about laws and regulations that affect your work and follow them

1.9.1 Further detail is given in Chapters 4, 8 and 12.

Principle 2 Communicate effectively with patients

This principle covers the necessity for good communication skills by all members of the dental team. If these skills are so poor that the patient cannot understand what is being said to them, for whatever reason (use of jargon, language barrier, no information given, no opportunity to ask for clarification, and so on) then the patient cannot be said to have given consent for the proposed treatment.

Standard 2.1 Listen to them and give them time to consider information, taking their views and individual needs into consideration

2.1.1 You must treat patients as individuals and respect any cultural values and differences.

2.1.2 You must be sufficiently fluent in written and spoken English to communicate effectively with patients, their relatives, the dental team and other healthcare professionals in the UK.

Standard 2.2 Recognise and promote patients' rights and responsibilities for making decisions about their health priorities and care

2.2.1 You must listen to patients and communicate effectively with them at a level they can understand, including explaining treatment options, risks, benefits and costs.

2.2.2 You should encourage patients to ask questions about their options and treatment.

2.2.3 You must give full and honest answers to any questions asked, especially to avoid influencing patients in their choices.

Standard 2.3 Give patients the information they need, in a way they can understand, so that they can make informed decisions

2.3.1 You must introduce yourself to patients and explain your role so that they know how you will be involved in their care. Some dental workplaces expect more formality with names than others.

2.3.2 Involve any colleagues or patient carers in discussion with patients where appropriate. This must be in line with patient

confidentiality requirements.

2.3.3 You should recognise patients' communication difficulties and try to meet their needs, for example by using an interpreter or avoiding professional jargon.

2.3.4 You should ensure that patients have understood the information given, by asking questions and summarising the main points.

2.3.5 You should make sure that patients have enough information and enough time to ask questions and make a decision.

2.3.6 You must give patients a written treatment plan before their treatment starts, and retain a signed copy in their notes.

2.3.7 The plan must include the proposed treatment, a cost indication, and whether the treatment is via NHS or private services where necessary. Where both services are relevant, the plan should indicate which is which for each item.

2.3.8 The plan and costs should be reviewed during treatment and the patient should be informed if any changes occur. A written updated plan should then be provided.

2.3.9 You must provide patients with clear information about emergency and out-of-hours arrangements.

2.3.10 You should make sure patients have the necessary details to contact you.

2.3.11 You should provide patients with clear information about referral arrangements.

Standard 2.4 Give patients clear information about costs

2.4.1 You must display a simple price list where patients can see it.

2.4.2 This information must also be available in practice literature and on websites.

2.4.3 You should inform patients of your rules on guaranteed work. This should include any circumstances leading to

exclusions, such as a lack of care on their part.

Principle 3 Obtain valid consent

This principle simply covers the patient's right to expect to be asked if they wish to proceed with the treatment they require, before it begins and throughout the course of the treatment. To provide any treatment to a patient without their consent is actually deemed to be an assault. The principle therefore explains why the treatment proposed must be fully explained in a manner that the individual patient (or their carer) can understand, before they are able to agree to it or to decline it. A dental professional can advise the patient (or their carer) what they consider to be their best treatment option, but it is entirely up to the patient to decide whether they wish to proceed or not, irrespective of the professional advice given – that is the patient's right. They must never be bullied or coerced into accepting treatment which they do not really want, nor must they be misled or deceived into choosing one option of treatment over another.

Standard 3.1 Obtain valid consent before starting treatment, explaining all the relevant options and the possible costs

3.1.1 You must make sure you have valid consent before starting treatment, and do not assume that someone else has obtained the patient's consent beforehand (see later for further details).

3.1.2 You should document the discussions you have with patients in the process of gaining consent, as well as gaining a signature.

3.1.3 You should find out what your patients want to know as well as what you think they need to know.

3.1.4 You must check and document that patients have understood the information you have given.

3.1.5 You must acknowledge the patient's right to refuse treatment, withdraw their consent, or request that treatment is stopped after it has started, and follow their wishes. Possible consequences should be explained and any discussions must be recorded in the notes.

3.1.6 You must obtain written consent where treatment involves conscious sedation or general anaesthesia.

Standard 3.2 Make sure that patients (or their representatives) understand the decisions they are being asked to make

3.2.1 You must provide patients with sufficient information and give them a reasonable amount of time to consider that information in order to make a decision. They must not be hurried or coerced into making a decision about their treatment.

3.2.2 You must tailor the way you obtain consent to each patient's needs, by giving them information in a format they can easily understand.

3.2.3 You should encourage patients with communication difficulties to have a trusted person present when gaining consent, so that relevant questions can be asked and your answers explained.

3.2.4 You must always consider whether patients are able to make decisions about their care themselves, rather than assume so (see later and Chapter 13 for further details).

3.2.5 You must check and document that patients have understood the information you have given them. The easiest method is to ask them to repeat back to you what their understanding of your discussions have been.

Standard 3.3 Make sure that the patient's consent remains valid at each stage of investigation or treatment

3.3.1 Gaining consent is an ongoing process of communication between patients and all members of the dental team involved in their care.

3.3.2 You must make sure you have specific consent for the treatment to be carried out at each appointment.

3.3.3 You must tailor the way you confirm ongoing consent to each patient's needs, and check that they have understood the information you have given them.

3.3.5 All ongoing consent discussions must be documented.

3.3.6 If the treatment or costs are likely to differ from the originals, you must gain consent for the changes from the patient and document that you have done so.

Principle 4 Maintain and protect patients' information

This principle covers patients' expectations with regard to the personal and clinical information that the workplace holds for them, which must now comply with the General Data Protection Regulations (GDPR) 2018. They do not expect any third party to be able to gain access to their personal information without their knowledge or agreement (although legal precedents do exist), but they do expect to be able to access their own information if necessary – clinical records should not be kept secret from patients themselves. With this in mind, it is therefore obvious why the accuracy of the records is of paramount importance to the dental team, and that no defamatory or derogatory comments are ever included – this is grossly unprofessional.

Standard 4.1 Make and complete contemporaneous, complete and accurate patient records

4.1.1 You must make complete and accurate patient records, including an up-to-date medical history, each time that you treat patients. If the dental nurse is to write up a patient's notes, wherever possible they should be dictated by the clinician.

4.1.2 You should record as much detail as possible about the discussions you have with your patients.

4.1.3 You must follow appropriate national advice on retaining, storing and disposing of patient records (see later for further details).

4.1.4 You must ensure that all documentation is clear, legible, accurate, and can be readily understood by others, including the initials of the treating clinician where appropriate. This is only

relevant where computer records are not held and hand-written records are made instead.

4.1.5 Any amendments to the records must be clearly marked and dated; again, computer records will record this automatically.

4.1.6 Any referral to another health or dental professional must be accurately recorded in the patient's notes, ideally with a copy of the referral maintained.

Standard 4.2 Protect the confidentiality of patients' information and only use it for the purpose for which it was given

4.2.1 You must keep patient information confidential, including all information you have learnt in your professional role (see later for further details).

4.2.2 You must ensure that all non-registered members of the dental team are aware of the importance of confidentiality, and that they maintain it at all times too.

4.2.3 Professional social media must not be used to discuss cases unless the patient cannot be identified, and social networking or blogging sites should be avoided (visit www.gdc-uk.org for further guidance).

4.2.4 You must not discuss patients or their treatment where you can be overheard by others who should not have access to this information. This is particularly relevant in the reception area.

4.2.5 You must explain to patients the circumstances in which you may need to share information with others involved in their healthcare, and record whether or not they gave their permission.

4.2.6 You should ensure anyone you share information with understands that it is confidential.

4.2.7 If patient information is required by others for teaching or research, the patient must be informed and their consent gained, and wherever possible their details must remain anonymous.

4.2.8 Patient information must remain confidential even after the patient's death.

4.2.9 The duty of confidentiality also applies to patient images and recordings, and these must not be made without the patient's permission.

Standard 4.3 Only release a patient's information without their permission in exceptional circumstances

4.3.1 This may be necessary if it is in the best interests of the public or the patient, although recorded attempts should be made to gain their permission anyway (see later for further details).

4.3.2 You should obtain advice from your defence or professional organisation before releasing information without the patient's permission.

4.3.3 You must inform the appropriate social care agencies or the police if you believe that a patient is or could be at risk of significant harm or abuse (see later or visit www.nice.org.uk, www.cqc.org.uk or www.gdc-uk.org for further guidance and advice).

4.3.4 You should only release the minimum amount of information necessary to comply with a court order or statutory duty to do so without a patient's permission.

4.3.5 You must document your reasons for releasing confidential information and be prepared to explain and justify your decisions and actions.

Standard 4.4 Ensure that patients can have access to their records

4.4.1 Patients have a right of access to their dental records under data protection legislation, and if they request access you must comply promptly and in accordance with the law.

4.4.2 You should request guidance from your national Information Commissioner's Office before charging patients for

access to their records, as routine charging is no longer possible under GDPR.

Standard 4.5 Keep patients' information secure at all times, whether your records are held on paper or electronically

4.5.1 You must store all patients' information securely at all times (see later for further details).

4.5.2 You must use a secure method of sending confidential information, including encryption if the information is stored electronically.

4.5.3 Back-up copies of computerised records should be made, so that the information is not lost on failure of the hardware or software.

Principle 5 Have a clear and effective complaints procedure

This principle covers what the patient expects if they do ever have a complaint about an issue. They expect their complaint to be taken seriously and investigated thoroughly even if it becomes apparent that the complaint is spurious or even malicious. Genuine complaints are useful learning tools for the dental team to improve service to their patients, while other complaints that are handled correctly provide unshakeable evidence that the team are not at fault and that no further action is necessary. Essentially, it prevents unnecessary and costly legal action proceeding against a blameless dental team or one of its members, while also giving recourse to patients when appropriate.

Standard 5.1 Make sure that there is an effective complaints procedure readily available for patients to use, and follow that procedure at all times

5.1.1 You must deal with complaints properly and professionally, by following the written complaints procedure of the workplace at all times (see later for further details).

5.1.2 All staff must be trained in handling complaints.

5.1.3 Where NHS or other health service treatment is provided, you should follow the procedure set down by that organisation.

5.1.4 Where private treatment is provided, you should make sure that the provision for handling complaints should set similar standards and time limits to those of the NHS.

5.1.5 You should have a well-written and understandable complaints procedure on display which allows complaints to be investigated fully, dealt with promptly, and used to improve your future services where possible (see later for full details of these requirements).

5.1.6 You should analyse any complaints received to help improve your service where relevant

5.1.7 You should keep a written record of all complaints together with all responses, and separate from the patient records

Standard 5.2 Respect a patient's right to complain

5.2.1 You should not react defensively to complaints, but listen carefully and discover what outcome the patient wants.

Standard 5.3 Give patients who complain a prompt and constructive response

5.3.1 You should give the patient a copy of the complaints procedure so that they understand the stages involved and the timescales.

5.3.2 You should deal with complaints calmly and in line with procedure.

5.3.3 You should aim to resolve complaints as efficiently, effectively and politely as possible.

5.3.4 You must respond within the time limits.

5.3.5 You should inform the patient if more time is required to investigate.

5.3.6 You should give the patient regular updates on progress when the timescales cannot be followed.

5.3.7 You should deal with all the points raised and offer solutions to each where possible.

5.3.8 You should offer an apology and a practical solution where appropriate, but also make the point that an apology is not an admission of liability where appropriate.

5.3.9 You should offer a fair solution when a complaint is justified.

5.3.10 You should respond to the patient in writing, in an accurate and legible manner.

5.3.11 You should inform the patient of how to proceed further if they are not satisfied with your complaint handling and decision taken.

Principle 6 Work with colleagues in a way that is in patients' best interests

This principle covers teamwork, and the way that patients expect the dental team to perform when providing their treatment, so that everyone pulls together in the best interests of the patient at all times. Each team member should always work to the best of their abilities but not beyond them – they should be efficient in their actions, support each other during the provision of care to a patient, and only work within the remit of their qualifications and training.

Standard 6.1 Work effectively with your colleagues and contribute to good teamwork

6.1.1 You should ensure that any team you are involved in works together to provide appropriate dental care for your patients. This is a basic requirement of professionalism.

6.1.2 You must treat colleagues fairly and with respect, as you would wish to be treated by them.

6.1.3 You must treat colleagues fairly in all financial transactions.

6.1.4 You must value and respect the contribution of all team members.

6.1.5 You must ensure that patients are fully informed of the names and roles of the dental professionals involved in their care, for example by team member photographs, name badges, or simply by verbal introduction.

6.1.6 You should ensure that all non-registrants that you work with are appropriately trained and competent, as you may be held responsible for their actions.

Standard 6.2 Be appropriately supported when treating patients

6.2.1 You must not provide treatment if you feel that the circumstances make it unsafe for the patient.

6.2.2 You should work with another appropriately trained member of the dental team at all times when treating patients in a dental setting. Exceptions to this are when providing out-of-hours emergency care, during a public health programme, and in exceptional (unavoidable, non-routine and unforeseen) circumstances such as sudden illness.

6.2.3 You must assess the possible risk to the patient of continuing treatment when exceptional circumstances occur.

6.2.4 You should be supported by a GDC registrant (or other healthcare registrant) when working in a hospital setting.

6.2.5 You should be supported by a GDC registrant or an appropriately trained healthcare professional in a domiciliary/care setting.

6.2.6 You must make sure there is at least one other person available within the workplace to deal with medical emergencies when you are treating patients. This may have to be the patient's escort in exceptional circumstances.

Standard 6.3 Delegate and refer appropriately and effectively

6.3.1 You can delegate the responsibility for a task, but not the accountability, if you delegate to someone who has not been appropriately trained (see the *Scope of Practice* document at www.gdc-uk.org for further details).

6.3.2 You must not pressurise a colleague into accepting a delegated task if they feel unable to carry it out.

6.3.3 You should refer patients elsewhere if the treatment required is outside your scope of practice.

6.3.4 You should make any request for treatment on referral or clinical advice from a colleague clear and give them full information.

6.3.5 You must explain the referral process to the patient and record it in their notes.

Standard 6.4 Only accept a referral or delegation if you are trained and competent to carry out the treatment and you believe that what you are being asked to do is appropriate for the patient

6.4.1 You must be clear about what you are being asked to do and that you have the knowledge and skills to do it.

6.4.2 You should only proceed with the treatment if you are satisfied that what you are being asked to do is appropriate, following any necessary discussion with the colleague. If not, you should seek advice from your defence organisation.

Standard 6.5 Communicate clearly and effectively with other team members and colleagues in the interests of patients

6.5.1 You should document any discussions you have with colleagues about a patient's treatment in the notes.

Standard 6.6 Demonstrate effective management and leadership skills if you manage a team

6.6.1 You should make sure that all team members have:

- proper induction when they first join the team
- performance management (such as appraisal)
- opportunities to learn and develop
- hygienic and safe working environment

- non-discriminatory working environment
- opportunities to provide feedback
- ways to raise concerns.

6.6.2 You should ensure that relevant team members are appropriately registered with the GDC (or other regulator), or in training before registration, and indemnified.

6.6.3 You should encourage all team members to follow the guidance in the GDC *Standards* document.

6.6.4 You should make sure that you communicate regularly with all team members.

6.6.5 You must encourage, support and facilitate the CPD requirements of your team (see later).

6.6.6 You must ensure that all staff are sufficiently trained and prepared to be involved in managing a medical emergency during a treatment session, and that sufficient staff are present to do so.

6.6.7 You should ensure your team has:

- good leadership
- clear, shared aims
- an understanding of their roles and responsibilities.

6.6.8 Their roles and responsibilities include knowledge of their scope of practice.

6.6.9 You should discuss all new policies and procedures to ensure full staff compliance.

6.6.10 You should display information about team members in a patient area.

6.6.11 You should display your GDC registration and the nine principles of the GDC *Standards* document in a patient area.

Principle 7 Maintain, develop and work within your professional knowledge and skills

This principle lays out the dental professional's duties with regard to ensuring that their knowledge and skills are kept up to date at all times, so that patients receive the best care possible at all times. Patients have a right to expect that the team members providing their care have reached and maintained the required level of professional competence to deliver their care safely and within their personal limits, and that they will refer them on to others when care is required above and beyond those limits.

Standard 7.1 Provide good-quality care based on current evidence and authoritative guidance

7.1.1 You must find out about current evidence and best practice which affect your work, premises, equipment and business and follow them.

7.1.2 You should record the reason for any deviation from established practice and guidance, and be able to justify your reasons for doing so.

Standard 7.2 Work within your knowledge, skills, professional competence and abilities

7.2.1 You must only carry out a task or a type of treatment if you are appropriately trained, competent, confident and indemnified. This includes for any extended duties that a dental nurse may carry out.

7.2.2 You should only deliver treatment and care if you are confident that you have had the necessary training and are competent to do so.

7.2.3 You must only work within your mental and physical capabilities.

Standard 7.3 Update and develop your professional knowledge and skills throughout your working life

7.3.1 You must make sure that you know your CPD requirements to maintain your registration and that you carry it out within the required time.

7.3.2 You should take part in CPD activities that improve your practice (see later).

Principle 8 Raise concerns if patients are at risk

This principle covers patients' expectations with regard to their likely actions when the welfare of someone is at risk by the acts or omissions of a dental professional, whether that vulnerable person is a child patient, an adult patient, or another team member. Patients do not expect professionals to 'stick together' and attempt to cover up the failings of one of their colleagues when problems come to light; they quite rightly expect the opposite to occur – an open and robust investigation of what went wrong, how it went wrong, who was involved (or to blame) and how to avoid a recurrence of the event in the future.

Standard 8.1 Always put patients' safety first

8.1.1 You must raise any concern that patients might be at risk for any reason, even if you are not in a position to control or influence your working environment, and this duty overrides any personal or professional loyalties you have.

8.1.2 You must not enter into a contract or agreement which contains a 'gagging clause' that would prevent you from raising concerns, or restrict what you could say when raising concerns.

Standard 8.2 Act promptly if patients or colleagues are at risk and take measures to protect them

8.2.1 You must act on your concerns promptly, and if in doubt you must raise a concern rather than leave the issue.

8.2.2 You should not have to prove your concern for it to be investigated, and if the investigation shows there was no problem this should not be held against you as long as you were acting in the best interests of the patients at the time.

8.2.3 You should raise your concern initially with your employer or manager, unless they are the source of your concern.

8.2.4 In this case, you must raise the issue with your local health commissioner, defence organisation, or with one of the following bodies:

- Care Quality Commission (England)
- Healthcare Inspectorate Wales
- Regulation and Quality Improvement Authority (Northern Ireland)
- Healthcare Improvement Scotland.

8.2.5 You must raise your concern with the GDC if you believe the patients or the public need to be protected from a registered dental professional (see later).

8.2.6 You must refer concerns about other healthcare professionals to the relevant regulator.

Standard 8.3 Make sure if you employ, manage or lead a team that you encourage and support a culture where staff can raise concerns openly and without fear of reprisal

8.3.1 You must promote a culture of openness in the workplace so that staff feel able to raise concerns.

8.3.2 You should include this culture in your policies and procedures, starting with staff training and induction procedures.

8.3.3 You should encourage all staff to raise concerns about the safety of patients.

8.3.4 You must not offer staff a contract that contains a gagging clause.

Standard 8.4 Make sure if you employ, manage or lead a team, that there is an effective procedure in place for raising concerns, that the procedure is readily available to all staff and that it is followed at all times

8.4.1 You must make sure that there are written procedures in place to enable staff members to raise concerns.

8.4.2 When a concern is raised it must be taken seriously and investigated promptly and in an unbiased manner.

Standard 8.5 Take appropriate action if you have concerns about the possible abuse of children or vulnerable adults (including the elderly)

8.5.1 You must know who to contact for further advice in these situations, and how to refer your concerns to an appropriate authority such as your local social services department.

8.5.2 You must be aware of the local procedures available for the protection of children and vulnerable adults, and follow them if it becomes necessary to raise a concern.

Principle 9 Make sure your personal behaviour maintains patients' confidence in you and the dental profession

This principle covers what the patients have a right to expect from people they look up to as 'professionals'. It sets out the behaviour that they consider appropriate for a professional member of the team both during work time and at all other times. It is not considered appropriate to behave in a less than exemplary manner when away from the workplace or outside of normal working hours – patients expect professional standards to be maintained at all times.

In particular, team members should be very careful of their use of social networking sites; the medium is called 'social' because it is accessible to many, including patients, colleagues and the GDC. The medium is monitored, and those team members making inappropriate or derogatory comments are quite likely to find themselves at a fitness to practise hearing with the GDC.

Standard 9.1 Ensure that your conduct, both at work and in your personal life, justifies patients' trust in you and the public's trust in the dental profession

9.1.1 You must treat all team members, colleagues and members of the public fairly, with dignity, and in line with the law. Put

simply, as you would wish to be treated by others yourself.

9.1.2 You must not make disparaging remarks about another member of the dental team in front of patients, but use the proper channels to raise any concerns where necessary.

9.1.3 You should not publish anything that could affect patients' and the public's confidence in you or the dental profession in any public media. This includes social networking sites, blogs and other forms of social media (visit www.gdc-uk.org for further guidance).

9.1.4 You must maintain appropriate boundaries in the relationships you have with patients, and not take advantage of your position as a dental professional in these circumstances. In particular, intimate relationships with a patient should not be entered into.

Standard 9.2 Protect patients and colleagues from risks posed by your health, conduct or performance

9.2.1 You must consult a suitably qualified colleague immediately if you believe you may be putting people at risk, and follow the advice given.

9.2.2 You must not rely on your own assessment of the risk you pose to patients, but seek occupational health advice as soon as possible.

Standard 9.3 Inform the GDC if you are subject to criminal proceedings or a regulatory finding is made against you, anywhere in the world

9.3.1 Criminal proceedings brought against you anywhere in the world may bring your professionalism into question, and as a registered professional with the GDC you have a duty to inform them so that if found guilty, your continuing registration may be reconsidered if appropriate.

9.3.2 You must inform the GDC immediately if you are subject to the fitness to practise procedures of another healthcare

regulator, either in the UK or abroad, for the same reason as stated above.

9.3.3 Similarly, you must inform the GDC immediately if a finding has been made against your registration by another healthcare regulator, either in the UK or abroad.

9.3.4 You must inform the GDC immediately if you are placed on a barred list held by either the Disclosure and Barring Service (DBS, formerly the Criminal Records Bureau) or Disclosure Scotland.

Standard 9.4 Cooperate with any relevant formal or informal inquiry and give full and truthful information

9.4.1 You must respond fully and in a timely manner if you are contacted by the GDC in connection with concerns about your fitness to practise, and take advice from your defence organisation over the matter.

9.4.2 You must cooperate with any legally appointed organisation or body during an inquiry, including healthcare regulators, coroners (or procurator fiscal in Scotland), lawyers, or commissioners of health.

Ultimately, along with all other dental professionals (and all other healthcare workers), the dental nurse has a duty of care to the patients that attend their workplace to follow these nine principles at all times to ensure that recognition as a member of their profession is always justified.

While Principle 1 and its subsections of the GDC *Standards* document run throughout the whole publication, it is pertinent to mention at this point the 'fundamental standards' of service provision that should be met by all organisations providing health and social care services, including the 'duty of candour'. These fundamental standards were established after the investigation into the Mid Staffordshire NHS Foundation Trust's failings in basic patient care at Mid Staffordshire Hospital were reported in the Francis Inquiry. Many patients died for want of basic care at the hospital over a period of time, but the issues involved were not highlighted or reported by staff. Instead, relatives of several of the deceased patients formed an

action group and forced an investigation into the hospital, and it was discovered that there had been an active cover-up of the situation. The Francis Inquiry recommended that a culture of honesty and openness be encouraged amongst organisations providing health and social care in future, and the duty of candour came into effect in April 2015.

The duty requires all members of the dental team to be open and honest with patients and their representatives/guardians when providing care, and in particular it must inform them when that care or treatment goes wrong. The dental workplace must have a procedure in place to investigate the incident and prevent it from happening again, support the patient where required, and offer an apology. In addition, action should be taken against any staff member who obstructs another from exercising their duty of candour.

Further information about the relevant issues associated with the other eight principles is given in the following sections.

Principle 2 and communication skills

The GDC *Standards* document in relation to Principle 2 states that when a patient attends any dental workplace (dental practice, access clinic, dental hospital department, etc.) they will have the following expectations:

- to be given enough information about their dental treatment to make informed decisions, including the cost of the treatment and any changes to the plan of action
- introduction to those involved in their dental care
- to be communicated with effectively (directly or via a carer, interpreter or other representative) by all personnel
- to receive an explanation of the treatment, its possible outcomes and what to expect as the treatment is carried out
- to have the opportunity to ask questions about their dental care, and receive appropriate answers.

Good communication between the patient and the dental team is vital if the patient is to give informed consent for their treatment (see later) but also if they are to take an active part in managing their own oral health and maintaining it at a reasonable standard. From the dental team's perspective, good communication is necessary to:

- put the patient at ease with the team so that the appointment is a positive experience
- allow the team to provide the best care for that patient at that time and in those circumstances
- assist the team in instructing the patient on their oral healthcare, to their benefit for the future.

In some workplaces the dental team will be on first-name terms with their patients, while others will retain a more formal address (Mr, Mrs, Dr, and so on). All team members should abide by their current workplace's system at all times but should introduce themselves appropriately and explain their personal role in the patient's care. An open relationship between patients and the team ensures that the

patient feels able to ask for advice, query treatment options given, or explain why they do not wish to have certain treatments at the time, but the relationship must remain on a professional level at all times.

When discussing dental treatments with the patient they must receive a clear explanation (understandable at their level) of the proposed treatment, alternative options, possible outcomes (including if they do not proceed with treatment), what they can expect during and after the treatment, costs, and any changes to the treatment as it progresses. It is the clinician's duty to give this information initially, but the patient may seek clarification of various points from another team member, including the dental nurse. Written treatment plans including itemised costs are a requirement under Principle 2 of the GDC *Standards* document, but it is also good practice to provide written information about the types of proposed treatment, so that the patient can take the information away and peruse it at their leisure. Well-written treatment sheets should provide understandable information to the patient, and often answer most of the frequently asked questions too. Unnecessary jargon, complicated terminology and acronyms should be avoided, and the patient should be encouraged to reiterate the information they have received to confirm that they have understood it. Full and honest answers to all patient questions should be given by all team members, always.

Additional resources that may be required for some patients include the following:

- interpreter for patients whose first language is not English, and appropriate alternative language information leaflets where necessary (available from NHS England)
- carer, family member, or other representative to also attend, especially for elderly patients and those with memory issues
- representative who can use sign language to relay information accurately
- hearing induction loop for those patients with hearing difficulties.

Communicating means 'to give or exchange information' and this can be done both verbally and non-verbally. Examples of subtle and less

obvious methods of communication that may occur in the workplace when dealing with patients are listed here.

- **Talking**: either directly with the patient face to face or by telephone, using a calm, clear voice and especially without 'talking over' the patient.
- **Written explanations**: reiterate any verbal information given.
- **Information leaflets or posters**: can be read in the patient's own time and then discussed verbally as necessary.
- **Body language**: can be open and friendly, or defensive and stand-offish.
- **Eye contact**: maintaining eye contact shows attentiveness, while breaking eye contact indicates the patient is being dismissed by the listener.
- **Facial expressions**: again, these can be friendly or not (smile, frown, querying, laughing, etc.).
- **Body position**: sitting to listen to the patient is more attentive than standing, especially if the body position of the listener is turned away from the speaker. This may particularly happen when the patient is seated in the dental chair and the staff member is sitting behind them at the computer console.
- **Touching**: this is sometimes used to reinforce points, although it is not acceptable in some situations and with some patients, and should only be used where there is a friendly and well-established rapport between the patient and the team member concerned.

A friendly staff member will obviously appear more approachable to patients than one who seems unfriendly, but often an unfriendly demeanour occurs without the staff member realising it. When unexpected situations arise, such as an equipment failure or a very busy appointments session, staff can seem abrupt, harried or even dismissive towards patients as they try to deal with the unexpected situation.

Continuing to carry out tasks while being spoken to, especially if eye contact is not maintained, can appear extremely rude and dismissive

to patients. On the other hand, standing too close to a patient ('invading their personal space') or making inappropriate physical contact may be construed as threatening or offensive by the patient. Some individuals have naturally good communication skills, but for other dental staff a training course or in-house experiential learning, by following the lead of good communicators, is vital in the development of their own skills.

Principle 3 and consent to treatment

The GDC *Standards* document in relation to Principle 3 states that patients will expect to be asked for their consent to treatment before it starts.

The need to obtain consent from a patient (or their representative or guardian) before providing dental or medical treatment arises from the ethical principle that clinicians must respect a person's independence and their right to make their own decisions in all healthcare matters. The clinician has the professional knowledge to explain and advise about health treatments but the decision whether to undergo that treatment or not is the patient's alone, or that of their representative or guardian.

The law concerning issues of consent to treatment is complicated and subject to change, so just a simplified overview of the topic and the issues it raises in relation to dental professionals and their working lives is given here. Further detailed information is available from the various dental defence organisations, and from the British Dental Association (BDA). The main points to be clarified here are as follows:

- What is consent?
- The key definitions of consent.
- Who can give consent?

Consent is effectively the patient, or their legal guardian, giving permission to the dental professional for treatment or physical investigation to be carried out. It is a legal and ethical principle that consent must be first given, and reflects the right of patients to decide what happens to their own bodies. It cannot be assumed that their attendance at the workplace is a signal for any type of hands-on treatment to be carried out; indeed, without gaining consent to do so first before touching the patient may amount to a claim of assault and be seen as a breach of the patient's human rights. The GDC would consider this occurrence as serious professional misconduct, and may suspend or erase the dental professional from the Register.

To gain consent to proceed with a dental procedure, three key principles must be addressed:

- **Informed**: the patient must be given enough information to be able to make a decision, and in issues of treatment options this must include a host of information, as discussed in subsequent sections.
- **Voluntary decision**: the patient alone must make the decision to proceed, without coercion or threat.
- **Ability**: the patient must have the ability to make an informed decision.

These principles form the basis of the guidance issued by the GDC, and they are discussed in more detail later.

Key definitions

Legally, various definitions are used depending on the type of consent required, but the three of relevance in this text are informed consent, specific consent and valid consent.

Informed consent

- The patient must be given full information about the treatment offered to be able to make an informed decision as to whether they wish to proceed or not:
  - the nature of the treatment (e.g. filling, crown, extraction)
  - the purpose of the treatment (e.g. restore function, alleviate pain, remove infection source)
  - the risks of the treatment (e.g. what can go wrong, what further treatment may be required)
  - the consequences of not having the treatment (e.g. effect on oral health, effect on general health)
  - the risks and benefits of any alternative treatment available
  - the longevity of success (will further treatment be required in weeks or months, or not for years if at all?)
  - the cost of the treatment, whether NHS or private.

- The information must be given in a way that the patient understands, and this may involve the use of visual aids, an interpreter or sign language.
- The patient must have all their questions answered in a way that is understandable, without the use of dental terminology if it is not appropriate (communication skills have been discussed in an earlier section and see also Chapter 13).

Specific consent

This is the consent gained expressly for each stage of the treatment; it should not be assumed that consent has been granted for the full course of treatment without the patient being aware of what is involved at each stage. For example, a symptomatic fractured tooth is to be restored initially with a filling, but it may also require endodontic treatment and then restoration with a crown within 6 months – the patient must give specific consent for each stage before it is carried out.

Valid consent

For consent to be considered valid, it must be:

- informed
- specific
- given by the patient or their parent or guardian (if too young to give informed consent).

Consent does not have to be given in writing, especially for minimal and non-invasive procedures, but for more complicated treatment plans and for treatment provided under conscious sedation, a signed consent form is appropriate. Oral consent is adequate otherwise.

Although dental staff can be very helpful in assisting discussions to help the patient make a decision about whether they wish to proceed with treatment or not, it is the responsibility of the dentist alone to obtain that consent from the patient. It is not the duty of the dental nurse or any other DCP to do so. Where a patient is receiving treatment from a hygienist or other therapist that has been prescribed by the dentist, the dentist must first obtain the consent and then the

DCP must check with the patient that they are still happy to proceed, before starting the treatment.

Who can give consent?

For consent to be valid, it must be both informed and specific. However, for consent to be informed, the patient must:

- be able to understand what is wrong
- be able to understand that it requires treatment to make it right
- be able to understand the consequences of undergoing or declining the treatment
- be able to communicate their decision (not necessarily by speech).

In essence, the patient must be deemed **competent** to give consent and to have the **mental capacity** to show they have a full understanding of the situation.

Competency and mental capacity

Under the circumstances listed above, it is perfectly feasible for some children under the age of 16 to be able to give informed consent for their own treatment. This is called 'Gillick competence' and is accepted by law as the right of the child to make the decision to proceed with treatment, which cannot be overruled by the parent or guardian. A child under 16 may also be perfectly capable of refusing to undergo treatment in contradiction to the wishes of their parent or guardian, but this can be overruled by the parent.

Similarly, a child under the age of 16 who is judged by the dentist to be mature and intelligent enough to understand the situation, and competent to make their own decisions, can also refuse the disclosure of their health records to their parent or guardian.

Children over the age of 16 and of sound mind can legally consent to undergo any treatment and cannot be overruled by their parent or guardian, but theoretically they can be overruled if they refuse treatment. However, in view of the complexity of the legal issues involved, the dentist would be advised to make an application to court

for a decision in these cases. Alternatively, where a parent or guardian refuses treatment that is in the child's best interests, a court can be asked to make an order for the treatment to be carried out anyway, and lawfully.

In Scotland, the Age of Legal Capacity (Scotland) Act 1991 is quite specific and provides that a person under 16 who, in the dentist's opinion, is capable of understanding the nature and possible consequences of the procedure or treatment shall have legal capacity to consent on his or her own behalf to any dental procedure or treatment. In Northern Ireland the age of consent for medical and dental treatment is 16 years.

Once a person reaches the age of 18 years and also has the capacity to reach decisions on their own behalf, they are judged to be a competent adult and can give or withhold consent. 'Capacity' in this context means the patient has the ability to:

- be able to understand, believe and retain the information provided about treatment
- consider the information appropriately in order to choose whether or not to proceed.

No one else is able to consent to treatment on behalf of a competent adult, and all adults must be assumed to be competent and able to make their own decisions unless they demonstrate otherwise. Indeed, this does happen and there are some adult patients who may not have the capacity to give informed consent – these patients are referred to as 'incompetent adults'. Incompetent adults are those who, for reasons of mental incapacity or illness, cannot give informed consent to treatment because they do not have the capacity to reach an informed decision on their own behalf. Incapacity may arise from any of the following conditions or events:

- stroke (cerebrovascular accident or CVA), whether due to a brain haemorrhage or a brain thrombosis (blood clot)
- traumatic head injury causing permanent brain damage
- congenital or acquired mental health problem

- dementia, whether due to age-related brain deterioration (such as Alzheimer's disease) or following a brain injury
- some learning disabilities
- long-term cerebral effects of substance misuse (drugs or alcohol)
- short- or long-term ill health issues (unconsciousness, confusion, drowsiness).

However, not all mentally ill or incapacitated patients are incompetent, and the dentist has to assess the patient at that time and determine the validity of any consent that the patient has given. Sometimes the opinion of a second professional is required to determine the validity. In addition, patients may have planned ahead and made advance wishes for a nominated person or persons to be formally appointed to make decisions about their health if they subsequently lack the capacity themselves. In England and Wales this is termed a Lasting Power of Attorney (LPA) and in Scotland a Welfare Power of Attorney (WPA) and the health decisions made cannot be overruled by the dentist, but in each case the appointed attorney(s) have a duty of care to always act in the best interests of the patient and abide by the relevant legislation of each country.

Whatever the situation, the dentist carrying out the treatment must also always act in the best interests of the patient, and they must be able to justify their actions if necessary. Further information should be sought by viewing the provisions available under the Mental Capacity Act 2005 Code of Practice (for England and Wales), or the Adults with Incapacity (Scotland) Act 2000 Code of Practice. There is currently no similar legislation in force in Northern Ireland, although general ethical principles mean that similar criteria should be applied here when dealing with incapacitated adults.

In summary then, those who can give consent are:

- parent or guardian of a child to the age of 16
- 'Gillick-competent' child to the age of 16 in England and Wales
- Scottish equivalent
- 16–18 years old of sound mind, in England and Wales

- 16 years old in Scotland and Northern Ireland
- competent adult
- dentist on behalf of an incompetent adult, when in the patient's best interest and with an agreeing second opinion from another professional
- attorney holding an LPA or a WPA.

Principle 4 and record keeping, confidentiality and data security and protection

The GDC *Standards* document states that patients have a right to expect the following in relation to Principle 4:

- dental records are kept up to date (contemporaneous), complete, clear, accurate and legible
- personal details of the patient are kept confidential by the dental workplace
- patients can access their dental records by written request
- records are stored securely in the dental workplace premises.

The relevant legislation of the Data Protection Act 1998 has been updated to include the GDPR 2018, which introduced the need for organisations (including dental workplaces) to be more accountable in the way that they collect, use, store and dispose of personal information. The new regulations are aimed at reducing, or ideally preventing, personal information from being shared or transferred between organisations without the person's knowledge or consent, as often happened previously in areas such as marketing and consumer research.

Record keeping

The purpose of dental records is to provide an up-to-date case history of each patient's condition, and includes the examination findings and treatment given on each attendance at the surgery. By referring back to previous visits, the dentist can assess the results of earlier courses of treatment and thereby decide the best line of treatment on future occasions. Adequate records also facilitate the transfer of patients between dentists in the practice when absence or staff changes occur. When recorded correctly, another dentist should be able to determine all previous treatments for a patient and continue that care safely, without any risk of errors or omissions due to incomplete information.

In effect, the records are a communication tool which allows anyone reading them to determine what treatment was carried out, when and by whom, and how it was achieved. So the fullness and accuracy of the records are required for:

- patient safety
- evaluation of treatment
- basis for patient accounts
- monitoring of the provision of care
- probity enquiries.

Recording methods will be either manual or on computer, and the amount of detail recorded may vary considerably from practice to practice, but patients' records consist basically of personal and clinical information. They should include all the following:

- patient name, address, date of birth and telephone numbers
- doctor's details and contact information
- full medical history
- dental history
- contemporaneous clinical notes of each attendance (i.e. written at the time or as soon as possible after, so that they are in date order)
- tooth and periodontal chartings
- soft tissue assessments
- details of all appointments with other staff, such as the hygienist, therapist or oral health educator
- all legally required NHS or private paperwork
- consent forms
- copies of all referral letters and response correspondence
- correctly identified and mounted radiographs
- photographs

- laboratory slips
- records of all payment transactions
- copies of all patient correspondence
- information on failed or cancelled appointments.

Where two or more patients exist with the same name or date of birth, the record should be clearly marked to alert all readers that a similar patient exists, otherwise there is a risk that one patient will receive treatment required by another.

For new patients, the personal details, reason for attendance, and medical and dental history are conveniently recorded by giving or sending a medical history form, such as the BDA Confidential Medical History Form, for home completion before their first visit. At that visit it would be assessed by the dentist, signed and dated, and placed in the patient's file. Clinical details of the visit, and subsequent ones, are entered on a dental chart and kept in the file.

A separate record of all attendances and treatment each day is kept in the daybook, or its computerised equivalent, and forms a valuable cross-reference system with the charts.

Apart from clinical records, those relating to practice administration are just as important. Such records concern the supply and purchase of equipment, materials and drugs used for treatment, batch numbers of drugs and medicaments over a set time period (so that those used on a certain date can be traced back where necessary), details of despatch and receipt of work done by dental laboratories, and staff personnel records.

Most practices use computers for dealing with:

- stock records
- accounts
- patient recall systems
- standardised patient correspondence, such as account letters or appointment cancellation and rearrangement letters.

Importance of records

Accurate dental records are essential to ensure that patients receive necessary, appropriate and safe treatment. The information they contain is personal to that individual patient and is therefore confidential, but the patient has a legal right of access to their own records under the following statutes:

- Data Protection Act 1998: governs how public bodies (this includes all dental practices, whether NHS or private) may handle and process personal data such as health records.
- Access to Health Records Act 1990: this only applies to the health records of a deceased patient, and advice should be sought from the clinician's indemnity insurers if a request for access is received under this Act.
- Access to Health Records (Northern Ireland) Order 1993: the equivalent statute for access to records for a deceased patient in Northern Ireland.
- Freedom of Information Act 2000: obliges public bodies to release information relating to government activity to the public, but excludes the release of personal information about patients or employees. Other exceptions to access apply and advice should be sought from the clinician's indemnity insurers if a request for information release is received under this Act.
- Freedom of Information (Scotland) Act 2002: the equivalent statute for information release in Scotland.

Poor record keeping often forms the basis of patient complaints that cannot be defended, and the dentist is ultimately responsible for their errors and omissions unless the notes were written to record treatment provided by a DCP (therapist or hygienist). Errors or omissions in recording information may result in incorrect treatment being carried out, or failure to provide necessary treatment to maintain oral health. The dental nurse must accurately record information given by the patient or dictated by the dentist, ensuring that records are filed properly, made available at each appointment, and signed as necessary by the patient and the dentist. Dental nurses should not be responsible for writing entries in a patient's records unless they are dictated by the clinician.

Dental records are also extremely valuable as a means of establishing identity. In fatal accidents where facial features are destroyed, the teeth are often unaffected and can be compared with dentists' records to identify a victim.

Proper records allow correct treatment planning and provide a check on details of past treatment. They form the basis on which fees are calculated and accounts rendered to patients. Failed appointments and refusals of treatment are noted and the patient's attitude to oral health, as well as any risk factors to good oral health, can be assessed. Appropriate recall arrangements can then be made for each patient, in line with NICE guidelines.

Adequate records allow the practice to run with the greatest efficiency for all concerned, and should be retained for at least 11 years after completion of treatment for adults, or to the age of 25 years in the case of children's records, under the Data Protection Act. Many difficulties concerning individual patients can be prevented altogether if complete records are available which document all patient attendances at the practice, while no time is wasted in putting such information at the dentist's disposal. Recording and filing systems may vary considerably in different practices but whichever method is used, records must always be accurate, legible, comprehensive and easily accessible.

Clinical records

Clinical records consist of the past and present appointment and daybooks, as well as records of each patient attending the practice, and contain the information specific to the delivery of oral healthcare to that patient. They include the medical history, dental history, present oral health status (including chartings), treatment received on each date, and the required estimate, consent and account paperwork. The relevance of each area of information to be recorded is discussed in the following sections, and further information on record keeping is available in the Faculty of General Dental Practice UK (FGDP) 2016 publication *Clinical Examination and Record-Keeping* (see www.fgdp.org.uk).

Medical history

The importance of a full medical history in successful oral disease prevention and treatment planning is discussed in detail in Chapter 13, and summarised here.

Full details of any past and present illnesses and other medical issues must be regularly updated, ideally at every recall appointment with a thorough run-through and update of the medical history form itself, which is then signed and dated as being updated at that time. A verbal confirmation of no changes at each treatment appointment is then satisfactory. The assessment of any updated entries or declarations is solely the responsibility of the dentist, although the information can be collected by the dental nurse. Medical history forms vary considerably, but the basic areas of questioning should include the following:

- Currently receiving any medical treatment: if yes, full details must then be given.
- Any history of steroid use within the last 2 years.
- Details of any current medications, including non-prescription ones: any unfamiliar drugs can be checked in the *British National Formulary* directly or at www.bnf.org.
- Any allergies, with details.
- Any reactions to local or general anaesthetics.
- Currently pregnant or a nursing mother.
- Human immunodeficiency virus (HIV)-positive status.
- History of rheumatic fever, liver or kidney disorders.
- History of any heart or circulatory disorders.
- History of any respiratory disorders.
- History of diabetes, epilepsy or arthritis.
- Details of any medical warning cards issued, especially the use of anticoagulants.
- Smoking, tobacco and alcohol history.

In order to ensure complete confidentiality, a medical history must be taken and discussed in private where it cannot be overheard. Patients cannot be expected to provide full details unless they are satisfied about privacy. Confidentiality of patient records is discussed later in this chapter.

Many conditions or drugs may influence the dental treatment plan.

- The method of pain control used may depend on the condition of the patient's heart, lungs and liver, and whether drugs are being taken for medical treatment (Chapter 14).
- If a patient has suffered from certain heart conditions it may be necessary to give antibiotic cover before extractions or subgingival scaling, as a precautionary measure against infective endocarditis and if requested in writing by the patient's cardiologist.
- Extractions may be inadvisable while a patient is being treated with certain drugs such as anticoagulants and corticosteroids, or after irradiation treatment of the jaws.
- Patients prescribed bisphosphonates for osteoporosis may also be unsuitable for extractions in the practice setting, especially those who receive the drug via intravenous routes.
- Special care is needed for patients with bleeding disorders such as haemophilia, and it is likely that these patients would receive dental treatment in hospital.
- Allergy to certain drugs and other products may cause a severe anaphylactic reaction (Chapter 6).
- Adverse reactions can occur because of an interaction between drugs being taken for medical treatment and drugs administered during dental treatment (Chapter 6).
- Patients may be allergic to certain dental materials such as latex rubber, and a medical history of eczema and/or hay fever will alert the dentist to a potential risk of allergic reactions.
- Special care is necessary during pregnancy.
    - There must be no contact with staff or other patients who are rubella (German measles) contacts.

    - Local anaesthesia is safe but general anaesthesia and drugs of any other kind should be avoided, including sedatives and analgesics.
    - In the late stages of pregnancy, patients should not be treated in the supine position as they are likely to be extremely uncomfortable.
- Patients who have been in contact with infectious diseases such as mumps and rubella should not attend the surgery while these illnesses are still active.
- Careful observation of patients will detect signs which may affect treatment: breathlessness and pallor are suggestive of anaemia while cyanosis (blue complexion) and jaundice (yellowing of the skin and eyeballs) are indicative of heart and liver disease, respectively.
- Special precautions are necessary for treatment of known hepatitis and HIV carriers, and for immune-compromised patients (Chapters 4 and 6).

The name of the patient's doctor should always be included in the records so that if any doubts arise, the doctor can be consulted before treatment is undertaken.

Dental history

Diagnosis of the present condition and determination of the treatment plan may depend on details of earlier dental disorders and their treatment. Knowledge of previous difficulties such as excessive bleeding, poor response to anaesthetics, difficult extractions, allergy to dental materials, latex gloves or rubber dam, or any other complications, will help the dentist to avoid their reoccurrence.

Present oral health status

The present condition of the teeth is recorded on the dental chart, and any other conditions, such as the state of existing restorations and dentures, level of oral hygiene, periodontal disease, malocclusion and tooth discoloration, which may affect treatment are also noted. The dentist can then assess the patient's general attitude towards their oral health and accordingly advise the most appropriate treatment.

Much of this information is conveniently set out in the oral health assessment documents that are currently being used by pilot and prototype dental practices involved in developing the future NHS contracts likely to be implemented in the future, and the points contained in the assessment can be used as prompts to gather the required information.

As described in Chapter 13, pertinent questions are asked and responses recorded about all issues that may affect the patient's oral health, especially diet, alcohol consumption and tobacco usage.

Treatment

Full details of dental treatment received and the date on which it was provided are recorded on the dental chart and in the notes. These will include the results of any special procedures carried out or events that happened, such as:

- radiographs, vitality tests, periodontal status, oral cancer check and orthodontic study models
- local anaesthesia, type of filling and lining, shades used for fillings, artificial teeth and crowns
- drugs and dosage and any prescriptions issued
- complications that occurred, for example excessive bleeding or retained roots after extractions
- treatment plans and options, cost estimates and the patient's choice of treatment
- missed appointments and refusals of treatment
- any accidents or complications, such as retained roots following extractions or breakage of an instrument, for example a root canal file, must be explained to the patient and its occurrence recorded, together with the measures and options offered, and emergency treatment arrangements.

National Health Service records

The NHS provides a large number of forms for detailing treatment plans, costs, emergency visits, orthodontic and periodontal treatment,

exemption from payments and many other aspects of NHS procedure. Currently, the most commonly used forms include the following:

- A standard chart (Form FP25) for recording patient visits, and treatment required and provided, together with a folder (Form FP25a) to hold subsequent treatment forms and details.
- Form FP17 DC/GP17DC is given to the patient. It outlines treatment required and the NHS charges, as well as the details and costs of any agreed private treatment.
- The Dental Estimates Form FP17 is used by practitioners to record details of treatment required, and subsequently given, and provides a form of account for payment claimed.
- Form FP10D, for prescriptions.

With the expected introduction of the new NHS contract over the next few years, these details may well change.

Many practices are now partially or fully computerised with regard to patient records, but all the information held must be accessible to the dental team, the authorities and the patient, as necessary. Several software systems are available and the NHS records detailed above are compatible with many of them. Whichever system is used, whether manual or computerised, the records must be written, handled and stored in full accordance with all relevant legislation. A good knowledge of the use of computers and information technology is required by, and expected of, the modern dental nurse.

Confidentiality of patient records

All members of the dental team have both an ethical and a legal duty to keep patient information gained in the course of their professional relationship confidential, and not to release it to others without the patient's permission, or in accordance with strict protocols if they do so without their permission.

As with the setting of minimum standards in clinical issues within the NHS under clinical governance requirements, a similar quality assurance process exists in relation to record keeping and maintenance of record confidentiality. This was previously referred to

as information governance but is now referred to as data security and protection and is discussed later.

The specific legislation that applies to issues of patient health information and confidentiality is as follows:

- Data Protection Act 1998 and GDPR 2018
- Access to Health Records Act 1990 (and Northern Ireland 1993 equivalent)
- Freedom of Information Act 2000 (and Scotland 2002 equivalent).

The Data Protection Act and GDPR apply to living, identifiable people and aim to protect the confidentiality of sensitive personal data (including the personal health information held by the dental workplace) relating to both patients and employees, by placing obligations on the data controller (the dentist or organisation responsible for the data) only to make third party disclosures under the conditions of the Act and Regulations, and to otherwise keep the data secure.

Data may be legally shared with certain organisations such as the Business Services Authority, the dental department of the local hospital or the salaried community dental services, but only on a 'need-to-know' basis. It must also only be shared in order to provide the patient with appropriate care and treatment, and for the provision of general health services.

The data must be kept for no longer than is necessary, and although NHS regulations require dental records to be retained for only 2 years (6 years in Northern Ireland), medico-legally they should be held for 11 years or to the age of 25 with child patients, whichever is the longer.

When in the dental workplace, all dental staff must adhere to the workplace confidentiality policy, but inadvertent breaches involving patients' health information can all too easily occur if common sense is lacking. Examples of ways to avoid these non-deliberate breaches include the following:

- Patients must not be discussed in front of other patients: even when names are not used, some unusual or unique circumstance may make it possible to deduce a patient's identity, so such conversations must never take place in the hearing of others.
- Patients or incidents within the workplace must never be discussed or referred to via any type of social media, for the same reasons as above. This has become such an issue that the GDC has now published clear guidance on the safe use of social media, which can be accessed at www.gdc-uk.org (see Figure 3.5).
- Privacy must be maintained when discussing any personal matters with patients: this may involve taking them away from the reception area if other patients are around and using another room for private discussions.
- Attendance at the practice is private, and cannot be revealed to other patients, employers or schools, so phone calls asking for confirmation of a patient's attendance by an employer or a school must not be responded to by the staff. An appointment card may be issued to the patient to confirm the details instead.
- All written communications with patients should be sent in sealed envelopes: this includes examination reminders that traditionally were sent on postcards, as they reveal the confidential fact that the patient attends a certain practice.
- The use of an SMS text messaging service or a no-reply email service to remind patients of their appointments must only be done with their written consent and by using dental computer software that is encrypted, to prevent patient information and contact details being accessed by others.
- Dental records must be kept for the correct length of time by the practice and not be destroyed beforehand, either partially or wholly.

Disclosure without patient consent

Under normal circumstances, information about a patient can only be disclosed to a third party with the patient's written consent. However, there are some circumstances under which the dentist has a statutory

obligation to disclose the necessary information, or has a legal right to do so.

- To assist in the identification of a driver or passenger(s) involved in a road traffic accident where facial trauma prevents identification otherwise: disclosure is allowed under the Road Traffic Act 1988.
- When requested to do so by the Dental Practice Division of the Business Services Authority (formerly known as the Dental Practice Board): this is when an audit of patient records is to be carried out, rather than when a course of treatment is under way.
- To provide information about a child to their parent or legal guardian, although issues of age of consent to disclosure must also be considered (see previously).
- When it is in the public's interest, such as with suspected or known criminals.
- When disclosure is requested by court order.
- When disclosure is requested without court order but under the Police and Criminal Evidence Act 1984, and now under the Terrorism Act 2005.
- When disclosure is necessary to a solicitor or debt collecting agency, to enable them to pursue a legal claim against the patient on behalf of the dentist.

Access to health records

Patients also have the right of access to their own manual or computerised health records, under the Data Protection Act 1998 (and the recent regulatory update under the GDPR 2018, which will eventually replace the Data Protection Act once the data protection rules have been fully overhauled), and the Access to Health Records Act 1990 (and the Northern Ireland equivalent) for deceased patients. Third parties are excluded from gaining access to a patient's records under these Acts unless the patient has signed a mandate to authorise the release of their personal information to a third party – this may be a solicitor or a relative. The relevant information available covers all

the patient's medical and dental records written since November 1991, with the following provisos:

- Only the dentist, as the record holder/data controller, can approve access.
- The patient request must be made in writing, and a fee to cover administration costs can only be charged if the request is deemed excessive (such as several requests for the same information) under GDPR.
- The dentist must respond within 1 month of the request (this used to be within 40 days).
- Patient identity must be checked before releasing their records, and records must be released to the patient only or their legal representative.
- Once viewed, the patient can request that any inaccuracies in their records are amended, but they do not have to give a reason for the access request.
- Any dental terminology, abbreviations or jargon must be explained on request.

The dental nurse must therefore not release any records or parts of records themselves, nor alter them in any way before they are to be released. They must be true, accurate and contemporaneous (as written at the time), and contain no derogatory comments. If the dental nurse is responsible for writing the notes, they should be written exactly as dictated by the dentist and not altered in any way. However, it is the responsibility of the dentist to check that they have been recorded accurately.

There are certain instances when the dentist can refuse to disclose the patient records to the patient:

- When disclosure would cause serious harm to the patient.
- When a second person is mentioned by name and has not given consent for disclosure (does not include the dental team).
- When access to their records after their death has specifically been refused by the patient beforehand.

The Freedom of Information Act obliges NHS dental practices (as public bodies) to release information relating to government activity only, and excludes the release of personal information regarding patients or employees. The information which may be released is likely to be used for statistical purposes only.

Data security and protection: GDPR

Previous to the introduction of GDPR in 2018, this topic was covered under 'information governance'. As with information governance, the Department of Health now has a Data Security and Protection toolkit to be undertaken and complied with by all NHS organisations. Further information is available at www.gov.uk.

GDPR 2018 introduces the need for organisations to be more accountable in the way that they collect, use, store and dispose of personal information. It also gives individuals (patients, employees and self-employed staff) more control over their personal information. Although a main aim of the regulations is to control the unauthorised passing of personal information between organisations for marketing and 'cold calling' purposes, they have had a huge effect in the healthcare sector too.

Under GDPR, all healthcare organisations, whether NHS, mixed or solely private, must be able to explain the following:

- what information they hold about individuals (patients and staff)
- why it is held
- how the information is used by the organisation
- who it is shared with.

In the run-up to the introduction to GDPR in May 2018, the Information Commissioner's Office (ICO) produced the invaluable guidance document *GDPR: 12 steps to take now*, which summarised the changes being made and the additional requirements that organisations would need to adhere to under GDPR. All members of staff in the dental workplace are involved in handling the personal information of their patients, including all dental nurses whether qualified or not. This information includes the patient's name, date of

birth, address, and contact details, their medical and dental histories, their treatment history, their financial details, access to correspondence and referral information, and so on. Consequently, it is a requirement under GDPR that all healthcare personnel understand the regulations and how to comply with them. Indeed, data security and protection are recommended CPD topics for all dental staff once qualified, as they involve the issues of confidentiality and consent.

The ICO 12 steps are summarised below and further information is available at www.ico.org.uk. For NHS dental workplaces, specific information about the rights of NHS patients and staff, and how the NHS processes the information it holds, is available at www.nhsbsa.nhs.uk.

1. **Awareness**: all staff must be made aware of GDPR and its requirements, as well as how to comply with them. Initially this is best achieved by a staff meeting to discuss the issues, before further knowledge and understanding is gained by CPD activities.
2. **Information held**: the information held about both patients and staff should be considered here, including where it came from and who it is shared with. A simple audit will help identify this information initially, and then regular checks can be carried out to ensure the information remains accurate, or is updated accordingly, such as by staff information checks at annual appraisals and patient information checks at the start of each course of treatment.
3. **Privacy**: clear and easy to understand privacy notices must be available for both patients and staff which include the following information.
    a. The 'lawful basis' of the information held: why it is being collected and held.
    b. How long it will be held.
    c. The complaint process to follow if the patient or staff member believes the privacy notice is not being followed by the dental workplace.
4. **Individual rights**: patients have specific rights under GDPR.

a. Right to be informed: about how data is processed (used), held and shared with others.
b. Right of access: to the specific information held, free of charge (by completing a 'subject access request' which must be responded to within 1 month by the dental workplace).
c. Right to rectification: if the information held is inaccurate or incomplete, it must be corrected or updated in a timely fashion.
d. Right to erasure: also known as the 'right to be forgotten', patients can request that their personal data (but not their clinical data) is deleted by the dental workplace; for example, if they move to another dental workplace and do not wish to be contacted by the former dental provider.
e. Right to restrict processing: in certain circumstances, the extent to which personal data is processed can be restricted.
f. Right to data portability: a copy of the personal information held can be safely forwarded in a readable format to another dental workplace, upon request.
g. Right to object: personal information held cannot be processed for certain things by the dental workplace if the patient objects, such as for direct marketing; the patient must 'opt in' to receive marketing information.

5. **Subject access requests**: patients have the right to request a copy of the information held about them by the dental workplace, and when complying with this request the dental workplace must undertake the following.
    a. Cannot usually charge the patient to copy or provide the information requested.
    b. Must provide the information within 1 month of receiving the access request.
    c. Can refuse or charge for requests that are manifestly unfounded or excessive (such as repeated requests for the same information).

d. Must tell the patient their reason for refusing the access request within 1 month, and that they have the right to complain to the ICO and seek legal advice to remedy the situation.

6. **Lawful basis for processing personal data**: there must be a legal reason for the dental workplace to hold the personal information it has for both patients and staff – there must be a valid reason for them to have the information. One or more of the following six lawful bases must be stated as the reason(s) for holding personal information.

    a. Consent: only relevant if marketing is to be carried out, as a patient's personal information is integral to the provision of their dental care and that of staff is integral to their safe employment within the healthcare sector. Patients cannot be treated anonymously and staff must prove they are qualified to work in the healthcare sector.

    b. Contractual: whether treatment is provided on the NHS or privately, dental workplaces have a legal obligation to know who they are treating and the full history of that person. Similarly, staff are legally required to prove they are qualified and safe to work within the healthcare sector.

    c. Legal obligation: all dental workplaces must comply with statutory requirements to work safely and effectively, and this includes compliance with the GDC *Standards*, CQC (and national equivalent) requirements, tax laws, NHS regulations, and so on.

    d. Valid interest: this lawful basis is not relevant to dental workplaces as it is only necessary to protect someone's life.

    e. Public interest: this is relevant to NHS workplaces only, where information can be released under the Freedom of Information Act where it is in the public interest, such as a hospital having a higher than average mortality rate for a certain procedure, for example.

    f. Legitimate interest: it is necessary for dental workplaces to hold personal information for business continuity purposes, such as being able to send recall and appointment reminders

to patients. Staff members must also be contactable by the dental workplace.

7. **Consent**: this is a separate entity from a patient's consent to treatment, but rather is about consent to how their information is used by the dental workplace. It is especially relevant in the area of marketing of both the dental workplace and its activities (such as particular procedures like tooth whitening, implants or adult orthodontics). Patients must opt in to have their personal information (including photographs and testimonials) used to market the dental workplace, and also to receive marketing information about certain products or procedures provided by the dental workplace.
8. **Children**: systems must be in place to verify the age of child patients and to obtain parental or guardian consent for obtaining and using their personal information. This is of particular relevance if commercial internet services ('information society services') are used and is therefore of little relevance in the provision of dental care to children.
9. **Data breaches**: all dental workplaces have a duty to hold personal information concerning both patients and staff securely at all times, but if there is a data breach there must also be systems in place to detect it, investigate it and, where necessary, report the incident to the ICO. Under GDPR, data breaches that could result in any of the following must be reported to the ICO and any individuals affected by the breach: discrimination, reputational damage, financial loss, loss of confidentiality, or any other significant economic or social disadvantage to the individuals affected.
10. **Data protection by design and data protection impact assessments**: the systems in place regarding the collection, processing and storage of personal information in the dental workplace should be designed to automatically protect it from being accessed by anyone without specific authority to do so. Data protection impact assessments (DPIAs) must also be carried out in certain circumstances where a new technology is introduced which may compromise that security if not planned for accordingly, the obvious examples being where new computer

software is introduced in the dental workplace that requires the transfer of patient and/or staff information, or where CCTV is introduced in the workplace. Computer software companies should provide a DPIA at the time of upgrade which explains the security measures they have in place to prevent data security breaches during the software update or transfer, and patients and staff must be made aware of the introduction of CCTV systems by visible notices to that effect. The use of CCTV in the workplace cannot usually be carried out covertly.

11. **Data protection officers**: any dental workplace providing care under the NHS is currently defined as a public authority and must appoint a data protection officer (DPO) to take responsibility for data protection compliance. The role can either be outsourced, or a member of staff can receive specific training to carry out the role effectively and in an independent manner.
12. **International**: this requirement is only relevant if an organisation operates in more than one European Union (EU) member state and carries out cross-border data processing. The situation may alter post-Brexit, but in the meantime dental workplaces should check with their IT providers that personal information is not sent outside the EU, for 'cloud' storage for example.

Compliance with GDPR has involved dental workplaces working through the 12 steps and then ensuring that they have the correct policies and procedures in place. This includes all the following:

- GDPR policy: how GDPR compliance will be achieved.
- Data protection and information security policy: how the dental workplace operates post-GDPR to maintain the security and protection of the data it holds.
- Confidentiality policy (patients): explains to patients how their confidentiality is maintained.
- Confidentiality policy (staff): rules applicable to all staff to maintain the confidentiality of patient information, staff information and business information.

- Records management policy: rules of the dental workplace in relation to handling, processing, storing and disposing of patient and staff data.
- Access to information policy: rules of the dental workplace in relation to releasing patient information.
- Confidentiality agreement: signed by all staff members and giving written agreement to abide by the above policies.
- Privacy notice for patients: explains the code of practice that the dental workplace adheres to in order to maintain the security of the patient information it holds.
- Privacy notice for staff: to be included in their work contract and explains the code of practice of the dental workplace in relation to the security of personal information of staff.
- Data processing and confidentiality agreements: for all other data processors having access to patient information from the dental workplace, such as laboratories, IT consultants, software support organisations and referral recipients.
- Privacy impact assessment: where necessary and as detailed at step 10 above.
- Full information in relation to any data breaches.
- Evidence of all CPD training in relation to data security and protection, for all staff.

In all dental workplaces there must be a written record of the name of the data controller (usually the business owner or senior dentist) who is also the information governance lead, and currently a named record of the DPO for every NHS dental workplace. The certificate showing the registration details of the data controller with the ICO should also be on display in the dental workplace.

Principle 5 and complaints handling

The GDC *Standards* document states that patients have a right to expect their concerns or complaints to be acknowledged, listened to and dealt with promptly.

All dental workplaces undertaking NHS dental treatment for their patients must handle complaints about NHS care according to a formal procedure that complies with the regulations, and those working in the private sector should follow similar standards and time limits for resolving complaints. Dental professionals offering both NHS and/or private treatment must comply with the GDC's guidance on complaints handling. Also, since April 2015 all organisations providing health and social care to patients must operate a duty of candour, so that when care and treatment goes wrong issues are properly investigated and corrected, and the patient or their representative/guardian is kept fully informed and supported throughout (see Principle 1).

A complaint is any expression of dissatisfaction by a patient about a service or treatment, whether it is justified or not, so a complaint often results from the patient feeling that their expectations have not been met. Complaints can be about any part of the service the workplace provides, and many may not be about the technical skill of the dentist or the quality of care that the patient has received. When the patient feels that their expectations of a good level of service have not been met, more often than not it is merely due to a lack of communication. Good communication skills have been discussed previously and are considered in detail in Chapter 13.

There have been changes to the legislation concerned with handling NHS complaints over the last few years, and unfortunately there are now slight differences between what is required in each of the four countries of the UK. A general overview of what is required from an in-house complaints procedure is therefore given here, and is relevant to the level of knowledge required for dental nurses. The current relevant legislation for each country is listed below, and further information is available from the Health or Public Services Ombudsman in England, Wales, Scotland or Northern Ireland, if required.

- **England**: Local Authority Social Services and National Health Service Complaints (England) Regulations 2009.
- **Wales**: National Health Service (Concerns, Complaints and Redress Arrangements) (Wales) Regulations 2011.
- **Scotland**: National Health Services (General Dental Services) (Scotland) Regulations, amended April 2012.
- **Northern Ireland**: Complaints in Health and Social Care – Standards and Guidelines for Resolution and Learning.

In-house complaints procedure

The GDC requires all dental practices (NHS and private) to have an in-house patient complaint handling procedure, which should aim to fully resolve any complaint received to everyone's satisfaction and as quickly as possible. The procedure to be followed should be displayed where patients can see it in the workplace, written in plain language and available in other formats where needed. Ideally, complaints should be resolved in-house and without the need for other authorities, such as the primary care organisation (PCO) or the GDC, to become involved. The procedure should include the points listed in Table 3.2.

Table 3.2 Complaints procedure.

Procedure point	Action and necessity
Responsibility	A 'responsible person' must be delegated within the workplace who ensures that the complaints procedure is followed correctly; this should be a senior dentist. A complaints manager should also be delegated to receive any complaints on a day-to-day basis; this can be a dental care professional who liaises with the responsible person, or both roles can be carried out by the same person
Acknowledgement	Receipt of a complaint should be acknowledged within a few working days, and the complainant must then be kept informed of how the complaint will be dealt with, who will be involved, and the expected timescale
Investigation	A thorough investigation must be carried out, and the essential point to consider is 'What is the complaint about?' Gathering this information may involve a meeting with the complainant to discuss the details, a meeting with those staff involved, and reading all relevant patient records. A resolution meeting with the complainant and the relevant member of staff present together may be very useful, and with someone else present to take notes. Notes from the meeting should then be confirmed with all concerned afterwards
Timescale	The whole procedure should be completed promptly, and if delays occur due to the involvement of a defence organisation, the complainant should be kept informed of any likely extensions to the timescale

Procedure point	Action and necessity
Report	A written report should be sent by recorded delivery to the complainant when the investigation is complete. It should contain the following information: • How the complaint was considered • Conclusions reached: ◦ No basis for the complaint ◦ No blame attributable, but explain what happened and why (e.g. regulations prevented a different course of action) ◦ Blame attributable: explain what happened and apologise, indicate measures taken to prevent a recurrence, offer reasonable redress (e.g. re-do treatment for free). Make it clear that the offer of redress is not an admission of liability but a goodwill gesture only
Appeal	If the complainant is not satisfied, information should be given about the bodies to which a formal complaint can be made: • NHS commissioning body or PCO • Health Service Ombudsman for NHS patients • Dental Complaints Service for private patients

Procedure point	Action and necessity
Records	Full written details of the procedure followed must be kept, from the point at which the complaint was made onwards. These records should be kept in a secure central complaints file, and not in the patient's records. Make a note in the patient's records that a complaint was received on a certain date. As always, the records must be contemporaneous, legible, accurate and remain unaltered in any way. NHS complaint reports must be submitted to the commissioning body on an annual basis in England, Wales and Scotland, and quarterly in Northern Ireland

The GDC requires a procedure to be in place so that every complaint is handled in a consistent fashion, rather than in an ad hoc manner. This is the same whether the complaint appears initially to be spurious in nature, or is unfounded and no action is required, or becomes a serious matter that is referred to the PCO or the GDC; until the complaint has been investigated, no one knows what the end result will be. It is therefore very important that a system is in place to be followed in the same way each time, so that no information is lost and requirements such as acceptable timelines are adhered to. If the complaint is taken further by the patient after going through the in-house procedure, evidence of a suitable complaints procedure being rigorously followed by the workplace will show that the situation has been taken seriously, and has been fully and correctly investigated. This avoids the workplace being left open to criticism for its handling of the situation. The written records of the investigation procedure should be kept in a 'complaints file' rather than in the patient's records, although a reference to them in the patient records is acceptable.

Any patient complaint, if not spurious in nature, can be used by the dental team as an opportunity to learn, review and change workplace procedures if necessary, with the aim of improving the standard of service being offered to patients.

Even if the workplace does not receive any complaints or negative comments, it is a CQC requirement of good governance to allow patients to comment on the care and service they have received, using a patient survey or feedback process. These should be kept as a log and reviewed regularly so that recurring issues and developing trends are identified. They can then be acted on and the service improved, often without a serious complaint being received beforehand. If a serious complaint is received however, the professional relationship desired, with patients as customers, requires that complaints are answered satisfactorily so that the matter can be put right, and the information provided is then used to improve the service and therefore the patient's future dental experience.

Good communication skills and an open honest approach in line with duty of candour requirements are important when dealing with a complaint, and a sympathetic and understanding manner will often diffuse what could be a tense situation. All complaints should be resolved at the earliest opportunity, and often all that is required by the patient is an apology. This can be given without fear of admitting liability or negligence.

Many patients do not make a complaint because they wish to receive financial compensation, but when a complaint is investigated and found to be valid it is usual to reimburse their costs or offer free replacement treatment. These potential remedies to a complaint which is valid are covered under the Consumer Rights Act 2015, which covers the provision of services to customers, including dental treatment.

More usually, the patient wants an apology and an explanation of the following points:

- What happened/what went wrong?
- Why did it happen?
- What will be done to correct it?
- Is anyone at fault/to blame and if so what action will be taken?
- What will be done within the practice to prevent a recurrence of the event?

With an effective complaints' handling process in place the workplace can use that process, while investigating a complaint, as a positive management tool to learn how the team and the service they provide to patients is perceived by them. It is in the best interests of the team to know whether patients are unhappy with the treatment or the service they have received, so that issues can be identified and corrected as necessary. The alternative is for unhappy patients to seek treatment elsewhere, telling all why they have done so, and the original workplace losing the opportunity to apologise, correct the issues, and learn valuable lessons for the future.

Principle 6 and teamwork, management and leadership

The GDC *Standards* document states that patients expect to know the various roles of all dental professionals involved in their care, and that the staff will work together to provide that care as an effective team.

The guidance notes explain that good dental care is not delivered by just one individual but by a dental team, and the quality of the teamwork is reflected in the quality of care that the team provides to the patient. Those members of the dental team who can currently be involved in patient care but who must be registered to work legally in the UK comprise:

- dentists
- dental nurses
- hygienists
- therapists
- dental technicians
- clinical dental technicians
- orthodontic therapists.

In line with the information contained in the GDC publication *Scope of Practice* (see Figure 3.4), each category of registrant has a list of duties that they can perform – those that their relevant qualification entitles them to carry out having received the knowledge, skills and experience provided by their training. This is known as their 'scope of practice' and it describes what they have been trained to do, and their qualification indicates that they are competent to do so. Over time and as advances in technology and techniques occur, registrants will develop additional skills that expand their particular scope of practice. In relation to dental nurses, these are often referred to as 'extended duties' (see Chapter 18), where in-house training from a more senior registrant in a particular skill is provided in a structured manner so that the dental nurse is able to carry out additional tasks (such as impression taking, intraoral and extraoral photography).

More formal training in other complex skills, involving a structured path of study and assessment by an approved educational provider, will result in recognised post-registration qualifications to further boost the dental nurse's repertoire (such as dental radiography, dental implant nursing).

The aim of registrant groups having a set of skills, whether basic, extended or post-registration qualifications, is to allow various members of the dental team to have duties delegated to them by more senior registrants in the team. This enables the more highly skilled team members to spend their time carrying out treatments only they can provide, while the less complex tasks can be carried out by one of several suitably trained team members instead. This enables work time to be used much more efficiently throughout the day, as several patients can receive differing levels of care at the same time and therefore more patients can be attended to within the day. This is the basis of good teamwork.

Although dentists are able to carry out all the skills laid out in the document and could therefore provide all the oral care a patient is likely to require without the aid of another registrant, the GDC standards insist that all registrants must be appropriately supported by another team member while treating patients, not only for the safety of the patient but also to act as a chaperone. This also applies to other registrants who are competent to provide direct hands-on care for patients – dental hygienists and dental therapists. The only circumstances that are acceptable for this requirement not to apply are as follows:

- out-of-hours emergency treatment
- public health programme of treatment (such as school visits and fluoride application)
- exceptional circumstances (unavoidable and unforeseen instances which are not routine occurrences, such as a short-notice staff absence due to illness).

If exceptional circumstances do occur, the registrant is expected to risk assess the situation and determine whether it is safe for the patient to continue to receive the treatment. It is possible to carry out

simple treatments without assistance and to work in certain quadrants of the mouth safely, but the registrant must never provide treatment alone if they feel the situation is unsafe for the patient.

The other risk to consider if an exceptional circumstance occurs and the registrant has to work alone is that of a medical emergency. Obviously, these can occur anywhere at any time, not just in the dental workplace environment; again, the risk has to be assessed as to whether treating severe dental pain without another registrant to assist outweighs the safety of the patient if an, albeit unlikely, medical emergency occurs in these circumstances. Ideally the situation would not arise, and other persons present such as administration staff or persons accompanying the patient could act as a second person if a medical emergency did occur.

Effective teamwork

Good teamwork involves several people working together safely and in harmony so that the end result of their actions is greater and more productive than if they each worked alone. To be effective, each member of the team should personally strive to achieve the following while working as part of that team:

- Always work together to provide dental care, rather than against each other.
- Always treat all other team members fairly, including when dealing with financial transactions (salary and wages).
- Always respect other team members and their individual role in delivering dental care to patients. No single team member is more important than another as they are only effective when working as part of a team (sometimes proverbially expressed as ‘there is no “I” in the word “team”!’).
- Never bully, unfairly discriminate, or harass another team member.
- Always introduce team members to the patient and ensure they are informed of the individual role each team member will play in the patient’s dental care. This prevents misunderstandings

when treatments are delegated, and allows the patient to hopefully develop a bond of trust with each team member.

- Always ensure that non-registrant team members (such as some administration staff) are appropriately trained and competent to carry out their selected duties, but do not work outside their remit; for example, a non-registrant receptionist who attempts to advise patients on dental care and treatment.

Delegation and referral

As explained previously, although more senior team members are often able to carry out all dental care for a patient, it is far more efficient if they spend time providing that treatment which is exclusive to their registrant category and scope of practice, and allow the patient to receive simpler treatment from another team member; this is called delegation. Common examples of delegation include the following:

- Dental nurse providing general oral health instruction (OHI), or specific advice after a course of treatment (such as a bridge fit or a removable appliance).
- Orthodontic therapist providing specific items of orthodontic treatment, such as removing a fixed appliance and all residual cement/adhesives.
- Dental hygienist providing advice on the prevention and treatment of periodontal disease, including completing a periodontal examination and measuring plaque indices.
- Dental therapist providing direct restorations to both primary and secondary teeth.
- Dental technicians constructing custom-made dental devices to prescription, such as dentures and crowns.

The full list of duties that each category of registrant can perform is shown in the GDC document *Scope of Practice,* and includes additional skills that may be developed over time as well as knowledge and skills that can be achieved following suitable training and post-registration qualification. No task may be carried out by any

registrant unless they have been suitably trained and are competent to do so, and hold suitable indemnity cover to do so.

Consequently, the team member who delegates a task must accept the following considerations:

- Only delegate a task to someone who is trained, competent and indemnified to carry it out.
- Do not pressurise a team member to carry out a task if they are unable to do so due to lack of training or competency (they will therefore not be indemnified).
- To do so will not transfer the accountability for mistakes and mishaps to the other team member; it remains with the member who delegated inappropriately.

Similarly, the team member who is asked to carry out a task outside their scope of practice must not proceed if they feel that they do not have the skills and knowledge to do so. To proceed under these circumstances would be to take responsibility for their actions.

When a patient requires treatment or clinical advice which is beyond a team member's scope of practice or competence, they should be referred to a suitable professional who may be outside the workplace team. Common examples are the referral of patients to specialist practitioners (orthodontists, implantologists, maxillofacial surgeons, etc.). The reason for the referral should be made clear (usually in writing) with all the relevant information given to help the colleague provide treatment successfully. The patient should also be notified of the referral and have the process explained to them, with all discussions being recorded in their notes.

Good communication is the key to good teamworking, and all members must communicate clearly and effectively with others in the interests of patients at all times. This is necessary so that patients can give informed consent for their proposed treatment, as well as for other team members to be clear about their roles and duties while providing that treatment.

To summarise, the team must:

- be open and honest about their skill levels with each other, and the limits of their scope of practice
- be fair and respectful of each other
- work with another colleague when treating patients at all times, so that a witness/chaperone is present (except under the recognised exceptional circumstances discussed)
- delegate appropriately to other team members and record the request in the patient notes
- refer appropriately to other team members or other professionals, ideally with a written request
- keep patients fully informed of all team members, their roles in patient care, and the process of delegating or referring their care as necessary
- keep written records of all discussions with other colleagues concerning a patient's care and treatment.

Management and leadership

For the team to work together effectively, they must receive guidance from a member who is in overall charge – a senior registrant who oversees the whole running of the workplace and has responsibility for ensuring its correct management. They act to direct and organise the team so that the workplace runs efficiently and each member carries out their roles and responsibilities correctly. The manager may not necessarily be involved in clinical decisions when managing the team, and therefore may not be a senior dentist but a practice manager instead. In these instances, leadership skills tend to become a clinical role and are usually carried out by a senior dentist, while the more administrative related duties are carried out by the practice manager but both work together to provide good management and leadership for the rest of the team.

The specific roles required to achieve good management of the dental team are set out as guidance in the GDC *Standards for the Dental Team* document.

- All members of the team (whether registrants or not) should receive the following:
    - Induction when first employed, so they are aware of the correct functioning of the workplace.
    - Performance management, including regular appraisals so that they have the opportunity to discuss issues as well as giving and receiving feedback on their performance.
    - Opportunities to learn and develop, such as encouragement and time out to take further qualifications or training, as well as the facility to complete their CPD requirements.
    - Hygienic and safe working environment: the manager ensures the workplace complies with all the necessary health and safety regulations and legislation.
    - Equality and diversity in the workplace, so that the work environment is not discriminatory and all team members are enabled to achieve their own potential.
    - Process in place to raise concerns, particularly in relation to the performance or activities of another team member, but also in relation to the safeguarding of patients (see Principle 8).
- Relevant team members produce the following documentation for inclusion in their personnel file, to enable them to work on the premises:
    - Current GDC registration (must be updated annually).
    - Current registration with another healthcare regulator if they are not a dental professional.
    - Indemnity certificate for GDC registrants (must be updated annually).
    - Evidence of appropriate enrolment on a training course leading to GDC (or other healthcare regulator) registration.
- Ensure that regular communication occurs between management and team members, such as in staff meetings attended by all personnel.

- Appropriate training is made available for all team members to manage medical emergencies, with sufficient staff present to do so when treatment is being carried out.
    - All team members know their role in the event of a medical emergency: who is to contact the emergency services, who is to collect the defibrillator/emergency drugs, who is to perform CPR, etc.
    - Regular practice sessions are run as simulated emergencies for team members to attend, with written records kept as evidence.
- Team should have the following:
    - Good leadership (see later): this is usually the role of the senior dentist.
    - Clear, shared aims of the way the workplace functions.
    - Knowledge of their roles and responsibilities within the team.
    - Knowledge of the limits of the decisions and actions which have been delegated to them within the team, and the agreement not to work outside those limits.
- All new policies and procedures which are introduced into the workplace are discussed with all team members.
    - To ensure their understanding of their individual responsibilities.
    - To ensure their individual compliance.
    - To ensure the workplace complies with the relevant legislation and regulations at all times.
- Ensure that the following information is displayed at the workplace in an area accessible to patients (usually a waiting room):
    - Names, roles and registration numbers (where appropriate) of team members.
    - The workplace is regulated by the GDC.

- The nine principles contained in the GDC *Standards* document.

Leadership

Good leadership is to act as the role model for others to desire to follow and emulate, especially by setting good examples of how to behave and conduct oneself, both professionally and otherwise. While good management skills are more methodical and practical and may be acquired or learned over time, good leadership skills are more of an innate, instinctive ability to influence others to want to perform well and to 'do their best'. A person can have the ability to be both a good manager and leader, or they can be best suited to one or the other role.

In the dental workplace the senior dentist may assume both roles or not, but tends to set the precedent for interactions with patients and the overseeing of their dental care, with other team members following suit. It is essential then that they provide good leadership.

Examples of good leadership skills include the following:

- The ability to be a natural leader who inspires others to push themselves to achieve their goals.
- The ability to maintain a good level of professionalism at all times, and to set an example for others to follow.
- The ability to communicate well at various levels: to patients of different ages, to other team members, and to other colleagues.
- To be capable of naturally taking control in difficult situations and directing others to work successfully as a team to resolve the situation.
- To be honest, open and fair.
- To take criticism where it is due, use it as a learning experience and act on it positively for the future.

In summary, then, although many team leaders will be dentists, the team as a whole needs to work as a well-oiled machine to provide the best possible care for their patients at all times. Each team member is one important cog in that machine, without which it cannot properly

function. A happy and well-functioning team is one that feels valued by its employers, respected by its patients, and treated as professionals while members carry out their day-to-day duties.

Principle 7 and continuing professional development and quality assurance

The GDC *Standards* document states that patients expect:

- to receive good quality care
- that all dental team members:
  - are appropriately trained and qualified
  - keep their skills up to date
  - know their professional limits and refer patients as appropriate
  - work within current laws and regulations.

Continuing professional development

At the point of qualification for any dental professional, the memorised knowledge of their curriculum will be at a maximum, while their practical experience of the job will be at a minimum. Throughout their working career, each team member will then automatically retain information about topics they cover on a daily basis, while forgetting some of the more obscure facts that they were taught as trainees. Similarly, practical skills used daily will become routine and well performed, while those used infrequently will diminish.

None of the curriculum content for each professional group is taught unnecessarily (and cannot then just be forgotten), so the only way to retain the more obscure facts and skills and therefore have an acceptable level of competence is to undergo update training on a regular basis, with the aim of retaining knowledge and improving skills, as well as being made aware of new information since qualification. To avoid team members having to constantly retake examinations to achieve this, the GDC introduced a system of continuing professional development for all registrants in 2008. In January 2018 for dentists, and August 2018 for DCPs, the GDC launched their 'enhanced CPD' scheme to replace the previous scheme involving verifiable CPD with 'core topics' that had to be

updated by all registrants, and non-verifiable CPD undertakings. For those registrants who were mid-cycle at these times, a transitional arrangement allows them to record their CPD activities under both schemes. For those registrants who fall into the transitional arrangements period, a very useful transition tool is available on the GDC website which provides an individual calculation to show a registrant's specific CPD requirements over the transition period (access the tool at www.gdc-uk.org/professionals and follow the link at 'continuing professional development').

Enhanced CPD

The aim of both the old CPD scheme and the new enhanced CPD requirements is to ensure that all registrants have regular opportunities to refresh or update their knowledge, especially in what used to be referred to as the 'core topics' as these are all linked to issues of patient and staff safety. While some were tempted to cram the verifiable requirements into as few sessions as possible to 'get it over with', they were at risk of missing the whole purpose of CPD – to provide registrants with the opportunity to receive regular updates on legislation, regulations, new dental techniques, and new developments in dentistry. These updates do not occur once in a 5-year cycle but are constantly ongoing; indeed updates and developments happen so quickly in some years it is difficult to stay abreast of them.

The GDC quite rightly expects all registrants to constantly maintain and update their skills, knowledge and competence throughout their working career in order to be regarded as a dental professional. This is clearly reflected in the changes the GDC has made from the old CPD scheme to the new enhanced CPD requirements, and revolves entirely around the need for all dental registrants to provide 'safe and appropriate services' to the public. The GDC has published an excellent document called *Enhanced CPD guidance*, which is available to download from its website, and it is highly recommended that all registrants access it to ensure they comply with the new CPD scheme.

The changes that have occurred after the introduction of enhanced CPD are as follows:

- Overall reduction in CPD hours for all registrants by the removal of the need to declare non-verifiable CPD.
- Increase in verifiable CPD hours for most registrants, and the requirement to spread the hours to be undertaken evenly across the 5-year CPD cycle.
- Flexibility to undertake CPD activities that are specifically suitable to each registrant's professional needs and 'field(s) of practice'.
- Use of a **PDP** to successfully plan and achieve their CPD requirements (see later).
- Need to align CPD activity with the GDC's development outcomes (see later).
- Need to include an element of written reflection on the CPD activity, essentially stating how the activity has benefited the registrant's daily work (see later).
- Need to record all CPD hours undertaken, and their specific development outcomes, and submit the information annually to the GDC.

The changes in the hours of verifiable CPD to be undertaken for each registrant group per 5-year cycle is shown in Table 3.3.

Table 3.3 CPD hours requirements by registrant group.

Registrant group	CPD hours (old scheme)	Enhanced CPD hours
Dentists	75 verifiable, 175 non-verifiable	100 verifiable
Dental therapists	50 verifiable, 100 non-verifiable	75 verifiable
Dental hygienists	50 verifiable, 100 non-verifiable	75 verifiable
Orthodontic therapists	50 verifiable, 100 non-verifiable	75 verifiable
Clinical dental technicians	50 verifiable, 100 non-verifiable	75 verifiable
Dental nurses	50 verifiable, 100 non-verifiable	50 verifiable
Dental technicians	50 verifiable, 100 non-verifiable	50 verifiable

There has been little change in the 'core topics' requirements for each registrant group, although they are now referred to as 'highly recommended topics' by the GDC. However, this does not mean these topics are optional – they have been identified by the GDC as being relevant to almost all registrant groups, and recommend that they are undertaken on a regular basis in the interests of patient safety. The recommended topics and minimum hours per 5-year cycle comprise the following:

- Medical emergencies (minimum of 10 hours per cycle, at least 2 hours every year).
- Disinfection and decontamination (minimum of 5 hours).
- Radiography and radiation protection (minimum of 5 hours): dental technicians can swap this requirement with an equivalence of 'materials and equipment' CPD.
- Oral cancer and its early detection.

- Legal and ethical issues.
- Complaints handling.
- Safeguarding children and young people.
- Safeguarding vulnerable adults.

The last five topics listed have no minimum hours specified, but registrants are expected to keep up to date in them over the CPD cycle. In reference to the hands-on aspect of cardiopulmonary resuscitation of medical emergencies, using a manikin to simulate chest compressions and rescue breathing should be undertaken by all registrants each year, as part of a basic life support (BLS) course.

Enhanced verifiable CPD requirements

Under the old CPD scheme, there were sometimes concerns expressed about the quality of the event or activity and its usefulness and relevance to some participants, and as many events had fees attached this caused some discontent. The GDC has therefore stipulated the evidence that must be provided at any enhanced CPD event for it to be considered as verifiable – the onus is on both the CPD provider to ensure this, and the participant to obtain this information as evidence of having completed the activity. In the vast majority of circumstances, the information will be provided in full as a certificate from the CPD provider, which is received by the participant either as a hard copy on the day or electronically to download after the event.

The information it must contain is as follows, with new requirements in bold:

- The subject, learning content, aims and objectives.
- **The GDC development outcome(s) linked to the CPD**.
- The date of the event, and the number of hours of verifiable CPD provided.
- The name and GDC number of the participating registrant.
- **Confirmation that the CPD is subject to quality assurance, and the name of the person/body providing**

it.

- **Confirmation from the CPD provider that the information given is full and accurate**.

For those interested in providing enhanced verifiable CPD events, the GDC produces a very informative document entitled *Enhanced CPD guidance for providers*, which is available to download from www.gdc-uk.org.

Examples of enhanced verifiable CPD events include the following, although each must provide the information listed above to meet the GDC criteria:

- Attendance on postgraduate courses.
- Attendance at local meetings/lectures organised by postgraduate tutors or deaneries.
- Hands-on clinical training sessions/workshops.
- Clinical audit activities.
- Distance learning programmes with learning outcomes.
- Computer-aided learning (CAL) programmes.
- Attendance at conferences with stated learning outcomes.
- Studying and taking formal examinations in dentally related subjects.
- Taking post-registration qualifications.
- Attending training events in other than the CPD 'recommended topics'.

Although there is no longer a requirement to declare non-verifiable CPD activities to the GDC, they are important and likely to be undertaken still and on a regular basis, and should be used to help identify topics where more formal up-to-date knowledge or skills are required. A likely example is to read an article in one of the dental journals out of personal interest only (so non-verifiable), but to discover that some of the information contained in the article was new to the reader personally – so a knowledge gap has been identified

which could impact on their daily work in their field of practice. Consequently, it can be included in their personal development plan as a topic to be covered by an enhanced verifiable CPD event that year. Alternatively, information about a new topic may stimulate sufficient interest to warrant an expansion of their field of practice, and again this can be entered in their personal development plan as a future area of study.

Similarly, topics that are discussed in regular staff meetings (such as updates in regulations or legislation, or the results of a risk assessment analysis) may highlight a knowledge gap for one or more individuals, and a suitable enhanced verifiable CPD event can be sourced and attended.

Thus the overall aim of the enhanced CPD scheme is to help all registrants to gain the maximum benefit from their CPD activities, by allowing enough flexibility so that CPD can be personalised and by linking every event undertaken to the *Standards for the Dental Team* document as development outcomes, to ensure patient safety.

Completion of enhanced verifiable CPD should produce some of the following for all registrants, including dental nurses:

- Increased job satisfaction: updated or new areas of knowledge can be introduced into the workplace, making routine work more interesting.
- Identification of problem areas: gaps in knowledge may become obvious during events at work, and relevant CPD undertaken to correct the situation.
- Improved communication with colleagues and patients: greater depth of knowledge increases the topics that may be discussed with colleagues and patients, within the scope of practice.
- Improved efficiency: knowing the correct methods of completing duties and the reasons for carrying them out allows the workplace to run smoothly.
- Improved career prospects: dental nurses with additional skills and/or qualifications are much sought after as employees.
- Greater commitment to the workplace: supportive workplaces that encourage learning and career development are enjoyable

workplaces.

In their guidance document, the GDC suggests the use of a 'plan, do, reflect, record' model when registrants are considering their enhanced CPD cycle, so that everyone tailors their cycle to their professional needs and their field(s) of practice. This should result in every CPD event undertaken being meaningful and directly applicable to their professional circumstances, rather than just 'something that has to be done' or a 'tick-box' exercise.

- **Plan**: use the personal development plan to identify personal CPD needs in relation to the GDC development outcomes.
- **Do**: complete the identified CPD activities, adjusting accordingly throughout the cycle.
- **Reflect**: evaluate the CPD activities and their worthiness in relation to the benefits gained to knowledge and skills.
- **Record**: correctly log all CPD activities completed and the development outcomes they link to as a summarised table, as well as maintaining the personal development plan, and collecting documentation for each event (such as a certificate) from the CPD provider.

Personal development plans

A PDP is a personal tool which is used to self-evaluate and reflect on the registrant's personal training needs, the reason these needs have been identified, and when and how they will be fulfilled. When used correctly, it gives structure and formality to the process of lifelong learning, and its usefulness has resulted in its inclusion in the RoE document for completion during the course of training for dental nurses. There are no set design rules for a PDP, although very useful templates are available from the GDC, the BDA, and other organisations. Information on the GDC website is particularly useful in showing how to link the CPD requirements identified to their development outcomes. Effectively, the PDP is used to look at the following points on a personal basis:

- Professionally, where am I now, what is/are my field(s) of practice?

- What qualifications, knowledge and special interests helped me to achieve this position?
- What learning needs do I have now, if any? Recommended topics for CPD requirements should be included here, as well as any identified from personal reading, staff appraisal, staff meetings, etc.
- Do I wish to acquire new knowledge or skills?
- What is preventing me? Carry out a SWOT analysis (see below).
- What can be done to overcome any obstacles identified?
- Collate all the information to develop a PDP with achievable timescales, although these may require alteration as time progresses (the PDP is for personal use and should be reviewed regularly and modified as necessary).
- Link your maintenance and learning needs to the GDC's development outcomes, then plan how you will meet these needs throughout the CPD cycle.
- Consider the CPD events on offer to determine the necessity and relevance of them to your field(s) of practice and your personal learning and development needs.
- Evaluate the PDP at least annually to determine whether the development needs that were identified have been met, and to what extent, by reflecting on the outcomes of all CPD activity undertaken: has anything been learned and does this influence your daily duties and activities?
- Summarise the progress made, and use it to determine your desired future learning and development needs.
- Keep a written record of all CPD events for each year, as a CPD activity log.

A strengths, weaknesses, opportunities and threats (SWOT) analysis is an excellent method of determining whether the obstacles to future learning and development are identified as being of a personal nature or involve external pressures (Figure 3.6).

Strengths
These are personal to the individual, and may include previous achievements as well as points such as reliability or ambition

Weaknesses
These are personal, and may include a personal lack of ambition, or home circumstances that make studying difficult

Opportunities
These are beneficial external factors which will influence success, and may include a supportive employer who encourages and funds further training

Threats
These are harmful external factors, or obstacles to future success, and may include an unsupportive employer, or lack of training opportunities

Figure 3.6 SWOT analysis.

Once the relevant points have been identified and recorded, efforts can be made to determine how to overcome the obstacles to future development. In some instances, this may be as dramatic as determining that an unsupportive employer is holding you back, and that a change of workplace is required.

Staff appraisals

Private reflection carried out using PDPs can be distorted, however, because by definition they record our own perception of ourselves. Of far more value is the input of our professional colleagues, such as that provided by a system of staff appraisal where the employer or a senior colleague reviews the performance of the staff member in the workplace, to achieve the following aims:

- Identify the strengths and weaknesses of the staff member.
- Identify any learning needs of the staff member.
- Identify the strengths and weaknesses of the running of the workplace, to give valuable information for good workplace development.
- Disclose any barriers to the efficient working of the dental team.
- Improve communication amongst the dental team.

- Encourage problem solving.
- Reduce any negative tensions between staff members.
- Improve practice morale.

Annual reviews in the form of staff appraisals are a requirement of the CQC, and provide evidence of good practice in the workplace by the employer. Several areas of appraisal can be carried out at one time during an annual review, or just one area can be highlighted. Common areas to consider are the following:

- **Personal**: hygiene, attitude, punctuality, adherence to dress code.
- **Administrative**: policies and protocols, regulations, filing, knowledge of paperwork, checklists, etc.
- **Clinical**: infection control, mixing techniques, nursing skills, patient management.
- **Teamwork**: ability to function as a team member, acceptance of authority, ability to take responsibility.
- **Communication**: interpersonal, telephone manner, patient management.
- **Development**: self-evaluation, self-study, attendance at courses, learning by experience.

Once the relevant areas to be appraised have been selected, discussed and agreed upon, an appraisal sheet can be drawn up which gives the dental nurse the opportunity to self-evaluate their performance in these areas, before being compared with the recorded comments of the workplace evaluation (Figure 3.7).

Areas of appraisal	Self-appraisal	Practice appraisal	Notes
Personal hygiene Dress Punctuality			
NHS procedures Rules/regulations Medico-legal knowledge			
Materials techniques Infection control Patient management X-ray procedures Equipment handling			
Courses of study Self-study Experiential learning Problem-based learning Peer group learning			
Teamwork experience Innovation Originality			
Communication skills Interpersonal skills Administrative accuracy Telephone manner Complaints handling			
Appraisal summary Signed..... Signed..... Date.....			

Figure 3.7 A sample staff appraisal sheet.

Differences of opinion on performance can be explored and resolved, and then an action plan can be developed to determine future goals and aims. All details should be recorded on the appraisal sheet and then copied so that both the dental nurse and the practice can refer back to it in future, to assess the level of success of that appraisal.

It should also serve as a record of the dental nurse's self-development and progression within the practice, and expose any areas which continue to cause problems in future appraisals. The areas can be adjusted to suit individual workplaces as necessary. The frequency of appraisal will also differ between workplaces as well as for different staff members, although annual appraisals are a CQC requirement in England. Younger, less experienced staff members are likely to require more frequent appraisal while learning all the relevant practice policies and protocols, and how to put them into practice. More experienced staff will need to be supportive and non-judgemental during this period.

When run correctly, appraisals can be an invaluable tool for the development of the whole dental team, so that the end result is a happy, well-managed and efficient team who strive to provide the best possible treatment and care outcomes for the patient. An appraisal should identify the strengths and weaknesses not only of the staff members but also of the workplace environment itself, indicating routes that can be taken for good workplace development. By relying on feedback and constructive criticism, it should remove any inter-staff communication barriers and improve problem-solving techniques. Overall, appraisals should improve workforce morale by providing an opportunity for discussion without recrimination by all.

Implementation of personal development plan

When a staff appraisal has determined that an improvement in performance is necessary, or that a learning need has been identified, this should be recorded in the PDP as a maintenance and learning need within your field(s) of practice, and considered as follows:

- What actions are needed to improve performance?
- How can identified learning needs be met?
- Which particular work activity or learning need is the most important to be tackled first? What is the priority?
- How do they relate to the GDC development outcomes?
- Set out the development plan as achievable events, using SMART (specific, measurable, attainable, realistic, time-based) objectives

(see later).

- What development opportunities are available and how can they be accessed?

By following this ordered process, the registrant is more likely to be successful in their efforts to improve their own performance. The help and support available from their employer are likely to vary between workplaces, ranging from obstructive, through indifference, to fairly or fully supportive. As shown previously, a SWOT analysis may have already determined that the registrant's biggest threat to success in self-improvement and career prospects is their own employer or employing organisation.

Actions needed

These will need to be identified before progressing through the implementation of the development plan, and input from others may be crucial at this point if the self-improvement attempts are to be successful. As stated previously, self-analysis can often provide a skewed or biased opinion of oneself, and constructive criticism from colleagues is of far greater importance in determining our abilities and shortfalls.

The actions needed to be undertaken will depend on the work activity or performance area that the registrant wishes to improve upon, with particular reference to dental nurses as follows:

- More experience: the dental nurse has received the necessary theory and underpinning knowledge to perform a task, but has had little opportunity to put it into practice yet (such as aspirating effectively for a certain procedure). This is most likely to be achieved in the workplace.
- More knowledge: the dental nurse has received some basic information about the topic but requires more depth of knowledge to perform the task adequately (such as knowing what affects the consistency of a dental material during its mixing, so that every mix is satisfactory). This is most likely to be a CPD activity.

- More training: the dental nurse has a gap in knowledge and/or skills which will require further training to fulfil their needs (such as taking a post-registration qualification, or updating current knowledge with new information). This is most likely to be a CPD activity.
- More support: the dental nurse has the knowledge and skills required but needs support to recognise their abilities and achieve success. This can be achieved in the workplace or as a CPD activity.

Prioritising and linking to field(s) of practice

The dental nurse may **desire** to improve their performance for personal reasons, because they are particularly interested in a certain area of dental nursing or they simply have a thirst for knowledge. Alternatively, they may **require** improvement in their performance to enhance their career prospects, or they may need to update their knowledge to meet their registration requirements with the GDC. Required improvements must take precedence over desirable ones – there is little point in gaining a desired post-registration qualification if the 'recommended' CPD subjects have not been updated as required by the GDC, as the dental nurse will then be unable to work safely anyway.

Similarly, if the area requiring a performance improvement is fundamental to the job role of the dental nurse, such as the ability to aspirate effectively during a chairside procedure, then this skill requires enhancement as a matter of urgency otherwise the dental nurse will be unable to carry out their full range of work activities; this may even compromise their employment. The dental nurse must also link any CPD activity to their field(s) of practice, in line with the enhanced verifiable CPD requirements. For example, when working in a general dental practice where orthodontic treatment is not carried out, there is little point in undertaking orthodontic-related CPD activities, as they do not link to the dental nurse's current field of practice and there is no professional need to undertake it.

Input from other colleagues will be invaluable at this stage to help the prioritisation process. Indeed, a staff appraisal may have highlighted an issue in the first instance and then the subsequent action plan may

well have indicated the way forward. It will also have identified any necessary help and support that the workplace can provide, such as providing funding or study leave, and accessing training courses or local CPD events.

The dental nurse can also use available resources to access this information for themselves, such as from:

- flyers to the workplace advertising relevant events
- adverts in dental journals
- information on the postgraduate deanery website
- information from the local commissioning body
- flyers from the local training establishment advertising new courses and updates
- information on NEBDN or City & Guilds websites.

SMART objectives

Using the available resources, the dental nurse can then develop their SMART objectives to assist in the formulation of the development plan. SMART is an acronym used in business and education which helps the user to focus their efforts when considering their career development pathway and how to achieve their desired/required goals – it makes their personal development plan achievable. It is similar to but not the same as setting goals for oneself; setting objectives is more specific and should outline how the goal achievement will be measured, and how it links to the GDC development outcomes. So, a goal statement could be the broad phrase 'improve my dental nursing skills', while the objectives to support this goal will detail the specific actions to be taken to achieve it (such as by attending a specific training event), determine the set timeline in which it is to be achieved (such as over two attendances), and indicate how the successful outcome will be measured (such as by gaining a certificate of competence in the specific area of training and which indicates the relevant GDC development outcomes covered).

When used correctly SMART objectives should help to identify the specific targets that the dental nurse is to aim towards, and therefore

also identify the training and development opportunities that are available to achieve their aims.

It is used as follows:

- Specific: the objectives stated must be clear and well defined, related to their field(s) of practice, and in a manner that is understood by the dental nurse's colleagues and employer.
- Measurable: there must be a method available to measure the outcome of the activity, so that it is known when the objectives have been achieved; for example, by the passing of an assessment test or the gaining of a proficiency certificate which states the relevant GDC development outcomes that have been covered.
- Attainable: there must be a realistic pathway to achieving the objectives, so the end goal must be within reach of the dental nurse.
- Realistic: achieving the objectives must be possible with the use of any available resources, within the knowledge levels of the dental nurse, and achievable within the time available.
- Time based: there must be a realistic time frame within which the objectives should be achieved; this must be neither too short nor too long, and must be agreed with the employer if it is likely to affect the work performance of the dental nurse

The SMART objectives can then be included in the PDP and the appraisal document, and discussed with the employer, mentor, or a senior colleague for their input before the performance plan is implemented. They will then also provide a documented record of the outcomes to be achieved, which is accessible to both the dental nurse and to the person responsible for evaluating their performance and achievements.

Development opportunities

Depending on the area of performance to be improved upon and the actions needed, the dental nurse must determine what resources are available that can be accessed and utilised as development opportunities. These may range from a simple mentoring or coaching agreement with a work colleague or other professional, through

attendance at a CPD event, to a formal educational programme of study.

A mentor is usually a more experienced work colleague who is able to instruct, advise and support a junior staff member as they develop their professional skills within the workplace. A coach is one term given to a fellow professional who is able to instruct or train the dental nurse in a specific topic, and may be someone outside the workplace. They may also be referred to as a tutor.

The majority of suitable development opportunities for the dental nurse are likely to be provided as CPD events, or as formal educational programmes and training courses.

Linking CPD activities to the GDC development outcomes

The development outcomes referred to have been developed from the GDC document *Standards for the Dental Team* (see Figure 3.1), as a condensation (or summarisation) of the nine ethical principles that all registrants should adhere to in their daily working practice. By requiring each enhanced CPD activity to be linked to these outcomes (and therefore the standards), registrants should be able to follow these ethical principles more easily and embed them into their working life and field(s) of practice. The new enhanced CPD requirements enable CPD providers to indicate the anticipated learning (development) outcome(s) that their event provides for its participants, and ideally all four outcomes (A, B, C, or D) should be covered in each 5-year CPD cycle (although this is not compulsory). However, each planned and completed CPD activity must have at least one of the development outcomes linked to it.

Table 3.4 shows the four development outcomes in the left-hand column, and examples of CPD content which are relevant to each in the right-hand column (the list is not exhaustive). Some CPD activities may link to several development outcomes.

Table 3.4 Information on development outcomes.

Development outcome	Example of linked CPD content
A Communication	
Effective communication with patients, the dental team and others across dentistry, including when obtaining consent, dealing with complaints, and raising concerns where patients are at risk	Communication skills Referral protocols Consent Complaints handling Raising concerns (whistle-blowing) Safeguarding children and young people Safeguarding vulnerable adults
B Management and Leadership	
Effective management of self and others, effective dental teamworking in the interests of patients, providing constructive leadership where appropriate	Professionalism Practice management Business management Teamworking Leadership skills
C Clinical	

Development outcome	Example of linked CPD content
Maintenance and development of knowledge and skills within own field(s) of practice	Clinical and technical areas of study Radiography Infection control and decontamination Medical emergencies, CPR, BLS Technology and treatment advancements Upskilling opportunities, including extended duties Quality assurance for MHRA Clinical audit
D Professionalism	
Maintenance of skills, behaviours and attitudes which maintain patient confidence in dental professional registrants and put patients' interests first	Ethical and legal issues and developments Professionalism Equality and diversity training Duty of care and duty of candour

HRA, Medicines and Healthcare products Regulatory Agency.

Reflection after enhanced CPD

Learning can occur on a regular basis within the workplace by the dental nurse reflecting on their work performance – by constantly analysing, constructively criticising and evaluating themselves. The aim is to recognise their own shortcomings and act upon them to improve their overall work performance. This is referred to as *reflective practice*, and by carrying out these actions regularly the dental nurse becomes a *reflective practitioner* (see later). The GDC has enshrined this concept in Principle 7 of their *Standards* document and requires that all registrants embrace it throughout their career, as it promotes the principle of lifelong learning. In addition, they have introduced a compulsory element of reflection into the enhanced CPD requirements, so that all registrants evaluate how their CPD activities have impacted on their professional life and development. The ultimate aim of reflecting on CPD activities is to determine if they benefited the registrant in their daily work and actions, so that they are continually enabled to provide safe and appropriate care to patients.

The GDC has not been prescriptive about how reflection is carried out; some may reflect on a CPD event immediately after it, others periodically throughout the year or at the end of the year, and either alone or with others. Whichever process is followed, there is a requirement to carry out reflection and make a record that it has taken place in the CPD activity log. This not only proves to the GDC that enhanced CPD is being undergone correctly and is of benefit to the registrant, it also provides recorded information to the registrant of their professional maintenance and development for future reference. When reviewed collectively at a later date, it may become apparent that unexpected outcomes occurred with one or more CPD events, and their PDP may require updating or adjusting accordingly.

One of the most useful methods of carrying out reflection after a CPD event is to include a column for reflective comment within the activity log – the GDC template does this, and a column can easily be added to whichever template or design of activity log is in use by the registrant. The GDC template is available to download at www.gdc-uk.org.

Examples of questions that should prompt reflection after an enhanced CPD activity could include any or all the following:

- Did the activity confirm the previous level of knowledge you had about the topic, or did you learn new information?
- Is the knowledge/information relevant to your daily work and your field(s) of practice?
- Did the activity link to the anticipated GDC development outcomes?
- Did you identify any changes required to your daily work actions, especially in relation to issues of patient safety?
- Has the activity highlighted gaps in your knowledge or techniques that will require further CPD to address?
- What was the overall benefit to you of undertaking the CPD activity?
- Does your PDP require updating to accommodate your reflections?

The 'reflective log' thus produced can be revisited throughout the year and be used to guide the future development of the PDP, and the registrant. It can be used in discussion with colleagues (at staff meetings, appraisals, or peer review sessions) to determine if further formal study and training may be required, if any of the activities would be of use to other work colleagues, or even if there are opportunities for an expansion of the registrant's field(s) of practice.

Reflective practice

The requirement to carry out enhanced verifiable CPD activities, including reflection and accurate recording of all CPD events in an activity log, is not necessary until the student dental nurse qualifies and becomes a GDC registrant. However, as a student they should always embrace the need to become a reflective practitioner, as this will lay the foundations to always strive to achieve lifelong learning and maintenance of their skills. Once they become a registrant, undertaking enhanced CPD and its requirements should then be second-nature. Indeed, as a student following the NEBDN Diploma training course, they will be required to maintain a PDP and undergo witnessed feedback and reflection as part of the requirements to complete the RoE document, before taking the final examinations. So,

self-reflection and undertaking reflective practice as a student dental nurse are of great importance in the process of developing a future dental professional.

However, when reflecting on your own performance it is human nature to be subjective and tend towards being either overly critical or overly lenient, as your ideas are based on the perception you have of yourself. More constructive analysis is that carried out by others, especially more experienced colleagues who have gone through the learning and reflection process themselves previously. This is the basis for an appraisal system within the workplace, where a senior colleague acts as a mentor for a more junior colleague, and gives verbal and written feedback on their performance (see previously). During the dental nurse training course, senior colleagues who are GDC registrants must be involved in the student's PDP completion and their individual witnessed feedback and reflection process.

The two main types of reflection that occur are:

- **reflection in action** – occurs as a situation happens
- **reflection on action** – occurs after the event, also referred to as 'hindsight'.

Reflection enables the dental nurse to think about how learning occurs, especially from experience, so that their work performance becomes more effective. It should produce a thinking professional who can react effectively and appropriately to changing circumstances to produce a successful outcome for the patient and the dental team.

It is the duty of the employer to ensure that changes in legislation are followed and referred to in updated policies, but it is the duty of the dental nurse to ensure that the updates are known of, understood and adhered to.

An example of reflection on action in the dental nursing context is given here. Compare the competence of a student dental nurse carrying out a certain procedure for the first time with their competence when performing the same procedure for the fourth or fifth time. Obviously, they will feel more comfortable as experience is gained, because subconsciously their own techniques are bettered after each event. In other words, 'practice makes perfect'.

So for instance, when aspirating for an oral surgery procedure, the first time the following may occur:

- Unsure of all the instrument identifications, as some may be being handled for the first time.
- Aspiration is not fully effective, as there is uncertainty about when to intervene without blocking the dentist's vision.
- Hesitant when handling some instruments, because they are unfamiliar.
- Concentrating so much on the procedure that the patient is forgotten.

Whereas when performing the procedure for the fourth or fifth time the following may occur:

- Instruments are now known because they are more familiar.
- Aspiration is more effective, perhaps by learning from the first patient choking and the dentist being unable to see clearly.
- Confident when handling instruments because they are more familiar.
- Able to monitor and reassure the patient at the same time as performing the other duties.

Reflection on action occurs by being able to think back over the procedure at a later date. This allows realisation and identification of any problems encountered, with the natural continuation of thought being to recognise how to improve next time.

Most of us carry out this second type of reflection on a regular basis, for example when driving home from work and going over the day's events in our minds, or by discussing our day with a family member, friend or colleague. However, we often forget the full impact of our thoughts unless we write them down at the time and review them at a later date.

Therefore, it would be prudent for the dental nurse to keep written notes of events for inclusion in their PDP. This helps to organise and clarify thoughts, so that the reason why problems occurred can be

discovered and action plans can be developed to prevent their recurrence.

A suggested layout of the notes could be as follows:

- **Describe** the event.
- **Record** your emotions and thoughts.
- **Evaluate** the event, giving both good and bad points.
- **Critically analyse** the event – why did it happen?
- Reach a **conclusion** – what could have been done differently?
- **Develop an action plan** – what will be done differently next time?

After going through this process, it is relatively easy to determine whether a gap in knowledge has been identified. This information can then be used to determine what supervision and support are required to fill that gap, and whether they need to be given on a formal basis during the training course, or on an informal basis in the workplace as additional experience opportunities.

Once the PDP (with input from written notes) has been running for a while, its effectiveness at improving the performance of the dental nurse must be evaluated to determine if it is successful or not, and if not then what else can be instigated to improve matters where necessary.

The evaluation process should not be carried out by the student dental nurse alone, as it will be more effective if others are involved too, such as a mentor, tutor, line manager, practice manager or employer. They will all be able to give an impersonal evaluation and opinion on the performance of the dental nurse, as well as probably being in a better position to action any changes required.

To evaluate the effectiveness of the development plan, the following points must be considered:

- Reflect on the performance of the dental nurse since implementation of the plan.
- Demonstrate an improvement in their performance.

- Regularly review the impact of the plan on their work.
- Implement identified development opportunities.

The reflection process is as described previously for reflection on action events, with consideration given to the performance of the dental nurse during certain work activities when looked back on at a later date. Was an improvement in performance seen, and can that be demonstrated as having occurred?

So for example can the dental nurse:

- assist during various procedures now without having to be supervised
- carry out new skills correctly and unaided
- perform new duties that have been taught in the workplace.

These examples identify ways in which the knowledge-based and skill-based requirements of the professional dental nurse have been addressed and improved upon where necessary, but their attitudes and behaviour also form key elements of these professional requirements.

To implement performance improvements in their ethical knowledge, the dental nurse must demonstrate that they follow the principles of 'best practice' at all times, irrespective of their own personal values and beliefs. They must therefore strive towards achieving the following:

- promote equality, diversity, and anti-discriminatory practice at all times
- respect the patient's rights at all times
- promote, develop, and maintain effective working relationships with other team members.

And once qualified:

- never stray outside the legal limits of their own qualifications
- take an active part in CPD

- ensure that all changes to effective dental nursing are known and acted upon, so that the concept of 'best practice' is always attained.

During the reflective process, the dental nurse will also consider whether the previously identified priority issues have been addressed. If not, then their actioning must become a matter of urgency, using a new set of SMART objectives to ensure that the issues are definitely addressed in this second round of reflective practice and performance review. The dental nurse will need to consider the reasons why the priority issues were not achieved the first time, and help or support may be required from the employer if they are to be successful in the future. In particular, previously identified development opportunities (as discussed previously) may now require implementation.

Recording enhanced CPD activities and annual statement

All registrants must produce and hold the following documents as their complete CPD record, within each 5-year cycle:

- Activity log showing:
  - name and registration number
  - date and number of hours of each CPD activity
  - title and description of CPD activity
  - linked GDC development outcomes
  - written reflection in some form.
- Evidence of each CPD activity, such as a certificate, and the details tallying with those recorded in the activity log.
- Personal development plan.

The GDC carries out random checks on registrants to ensure that they are completing the enhanced CPD scheme requirements correctly, and all these documents will need to be submitted, if requested, at any point in the CPD cycle.

Each year, every registrant must also submit an annual statement, again to let the GDC know that they are complying with the enhanced

CPD requirements – this is best submitted by logging on to the GDC's registrant website, eGDC at www.egdc-uk.org.

The annual CPD statement will request confirmation of all the following:

- Declaration of the number of CPD hours completed, even if the number is zero (see below).
- Declaration that an activity log has been kept.
- Declaration that a PDP is in place.
- Declaration that the completed CPD is relevant to current or intended field(s) of practice.
- Declaration that the statement is full and accurate.

To ensure that all registrants gain maximum benefit from their enhanced CPD activities, the GDC requires that they undergo a minimum of 10 hours CPD for every two consecutive years, irrespective of their registrant group. So although one year may be declared as '0' hours, the next or previous year must be declared as '10' hours. Any combination of 10 hours is also permitted in consecutive years, so '5' and '5', '1' and '9', '7' and '3', and so on. However, it is hoped that the majority of registrants would exceed the minimum 10-hour requirement in consecutive years anyway, but the declared hours must always tally with those stated on the CPD evidence document (certificate, etc.). Any failure by a registrant to comply with the new enhanced CPD requirements may put their registration with the GDC at risk.

While Principle 7 of the GDC *Standards* document may seem relatively short compared to the other principles, and is partially covered by the good teamworking requirements as discussed in Principle 6, the role of enhanced verifiable CPD, reflection and lifelong learning are huge with regard to the development and maintenance of a true dental professional.

Clinical governance and quality assurance

Clinical governance is the term used to refer to the NHS framework for quality assurance that must be aspired to and followed by all those

working in the delivery of NHS health and dental care. It defines the level of service quality that all NHS organisations (hospitals, clinics and practices) are expected to meet or be working towards, and those relevant specifically to dental services were set out in 2006. Although originally set out by the NHS and subject to compliance checks by PCOs, it was good practice for private dental workplaces to follow the framework too. Now, national quality standard bodies (CQC, HIW, HIS, and RQIA) expect private service providers to follow the framework.

The aim of the framework is not only to improve the quality of healthcare provided by standardising it, but also to make providers accountable for ensuring consistency of care, thereby making the service they provide reliable for patients. In essence, every dental workplace will achieve this by ensuring the following:

- The whole team understands the service the workplace is supposed to deliver.
- The whole team understands their individual role in delivering that service.
- There are monitoring systems in place to determine if that service is being delivered.
- There are processes in place for continuous improvement in the service delivery.

As clinical governance has been around in dentistry for over 10 years now, it would be difficult to imagine that all workplaces do not already comply with its required standards, although many may not refer to it under this title. The 12 themes that are covered by the framework and examples of the key actions and policies necessary for compliance are listed in Table 3.5 and all student dental nurses should find equivalent examples of compliance in their own dental workplace.

Table 3.5 Clinical governance themes and compliance.

Theme	Examples of key actions and policies
Infection control	Infection control policy Staff immunisation records Inoculation injury policy HTM 01-05 (or equivalent) policies
Child and vulnerable adult protection	Child and vulnerable adult protection policy Enhanced DBS (or equivalent) checks Staff employment records Staff training records
Dental radiography	Ionising radiation policy Compliance with IRR and IR(ME)R Radiation protection file Local rules Quality assurance audits of radiographs
Health and safety	Health and safety compliance requirements Risk assessments Fire safety COSHH *Legionella* and water management RIDDOR compliance First aid and medical emergency training
Evidence-based practice	NICE guidelines on recall intervals Referral protocols to local hospitals
Prevention and public health	Oral cancer awareness Smoking cessation Fluoride application Dietary advice

Theme	Examples of key actions and policies
Confidentiality	Patient confidentiality Data security and protection policies Access to health records
Staff training and involvement	CPD and lifelong learning Personal development plans Staff appraisals and meetings Staff training and development Raising concerns
Communications and consent	GDC requirements Patient consent and mental capacity Raising concerns Record keeping
Patient information and involvement	Complaints policy Handling complaints Patient information leaflets Patient surveys
Accessibility	Disability access and compliance Access to emergency care
Quality assurance and self-assessment	Audits Record keeping

COSSH, Control of Substances Hazardous to Health; IRR, Ionising Radiations Regulations; IR(ME)R, Ionising Radiations (Medical Exposure) Regulations; RIDDOR, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995.

The 12 themes in the left-hand column indicate the clinical areas where the NHS and the relevant national quality standards body expect every dental workplace to have evidence of how it ensures that the service provided is to a consistent standard for all patients. For example, with infection control there should be a written policy of how the workplace ensures that cross-infection does not occur, by stating the methods used for decontamination and sterilisation, that single-use disposables are used wherever possible, that staff and patients are provided with suitable PPE, and so on. All these points should then tie in with the relevant sections of *Health Technical*

Memorandum 01-05 (HTM 01-05 or equivalent; see Chapter 8) and be shown to do so, and then additional evidence such as staff immunisation records are also held by the workplace as further evidence of compliance. An inoculation injury policy will demonstrate that all staff members are aware and trained to deal with this eventuality in an approved manner, by having a written policy readily accessible to all. Some workplaces may also have other evidence of compliance besides those given as examples in the right-hand column.

Many of the examples of actions and policies listed above are discussed in more detail elsewhere in this chapter and in later chapters, and the role of the CQC as a national quality standard body is discussed at the end of this chapter. The role of the other national bodies (HIW, HIS, and RQIA) follow a similar line.

To ensure compliance then, all team members in the dental workplace should be involved in carrying out the following actions:

- Establish the current work processes: how various tasks and work practices are carried out now.
- Identify any potential problems with the current processes: safety issues, incomplete procedures, not in line with current regulations, etc.
- Define what changes need to be made: refer to relevant regulations or discuss at staff meetings.
- Determine who will be responsible for implementing the changes.
- Formalise and document the updated processes as policies and protocols, and introduce them as standard operating procedures in the workplace (see below).
- Ensure all staff are aware of these by holding regular staff meetings to discuss findings and developments.
- Act on any staff training needs that may be identified during the meetings or in staff appraisals.
- Have a system in place to regularly review and update the standard operating procedures, and ensure all staff are updated

too.

Consequently, the procedures followed by all staff when carrying out the normal work activities in the workplace are consistent to all and are not to be varied by individuals in any way – they become the standard operating procedures of that workplace. They begin as various policy documents which describe the courses of action adopted by that workplace, and may vary from practice, to clinic to hospital department. Once in writing as the required course of action to be followed, it should be signed by all employees to show their agreement with its terms (so they comply with it) and it becomes a protocol – a code of conduct within that particular workplace. All the protocols together form the standard operating procedures of that workplace.

Clinical audit and peer review

These are both methods used to assess the quality and effectiveness of certain areas of the service delivered to patients in the workplace, and are a valuable part of clinical governance requirements under the quality assurance and self-assessment theme. Clinical audits are carried out by individuals (including dental nurses) while peer reviews are carried out as a group process, usually of dentists from local practices in an area.

Clinical audit

This is a contractural requirement for NHS practices by their PCO, and private practices must also comply as part of their monitoring by the relevant national quality standards body (CQC, HIW, HIS, or RQIA). An audit allows the individual to achieve the following:

- Examine certain aspects of their clinical practice to determine if their techniques are effective. CQC suggest the following but this list is not exhaustive:
    - Patient waiting times
    - Radiographs
    - Record keeping.
- To make improvements where necessary.

- Then re-examine the same aspects at a later date to ensure that the quality of that particular technique is being maintained or further improved.

Each clinical audit project should be structured as listed below, and an example of a retrospective clinical audit project of bitewing radiographs is discussed in Chapter 12.

- Brief description of the aims and objectives of the audit.
- Decide whether the audit is to be retrospective (looking back at data from techniques already carried out) or prospective (collecting data at the time the technique is carried out).
- Define the feature to be audited.
- State the standard to be set (which standard is the audit being compared against).
- Summarise the methodology (state sample size, recording methods, method of data analysis).
- Present the audit findings (usually in a table or as a spreadsheet).
- Make any changes required if the set standard has not been met.
- Repeat the audit at a later date to determine if standards are being maintained or if further improvement has occurred.

Peer review

This can be organised as an alternative quality assurance project to clinical audit, and involves several dentists from local practices sharing their experiences of certain clinical areas that they are all involved in, with the aim of identifying areas where changes can be implemented to improve the quality of the service delivered to their patients.

As several people are involved in peer review it takes far more organising than clinical audit, and to be successful each group needs to decide on a leader or convenor of that group in order to provide the following:

- Organise the group and provide the encouragement to take part in the project.
- Organise the structure and the plan for each meeting.
    - When, where, and which topic for each meeting
    - Set a timetable
    - Set an agenda and meeting notes for each meeting.
- Keep a record of the topics/techniques that have been reviewed.
    - A new topic/technique can be discussed at each peer review meeting.
    - Delegate each topic to a different member so they lead that particular meeting.
    - Keep notes of all discussions and decisions made at each meeting.
- Use the notes to produce a report at the end of the project, with a copy for each member as proof of involvement and compliance with the quality assurance process.
- Act as a point of contact for other members throughout the project.

The project report produced should include the trial implementations of the various changes made to the clinical areas examined, and note any improved practice performance. This information can then be shown as the evidence base for various practice procedures – why a procedure has been changed and is now carried out in a certain way, for example.

Some PCOs may provide funding for clinical audits and peer reviews, but they may then stipulate the topics to be analysed rather than leaving it to the practice(s) to decide. However, they should then produce certificates of participation which can be used as evidence for verifiable CPD. Otherwise, all clinical audit and peer review activity should count as general CPD.

Whichever the case, although these activities are a regulatory and/or contractural requirement, they are useful in stimulating individual learning and hopefully a desire to critically self-examine and analyse

various aspects of clinical practice, with the aim of improving the quality of care delivered to patients. Further information and advice on clinical audit and peer review is available from the BDA at www.bda.org. Further information on standards in dentistry can be found in the FGDP publication by the Royal College of Surgeons of England *Standards in Dentistry* (Figure 3.8).

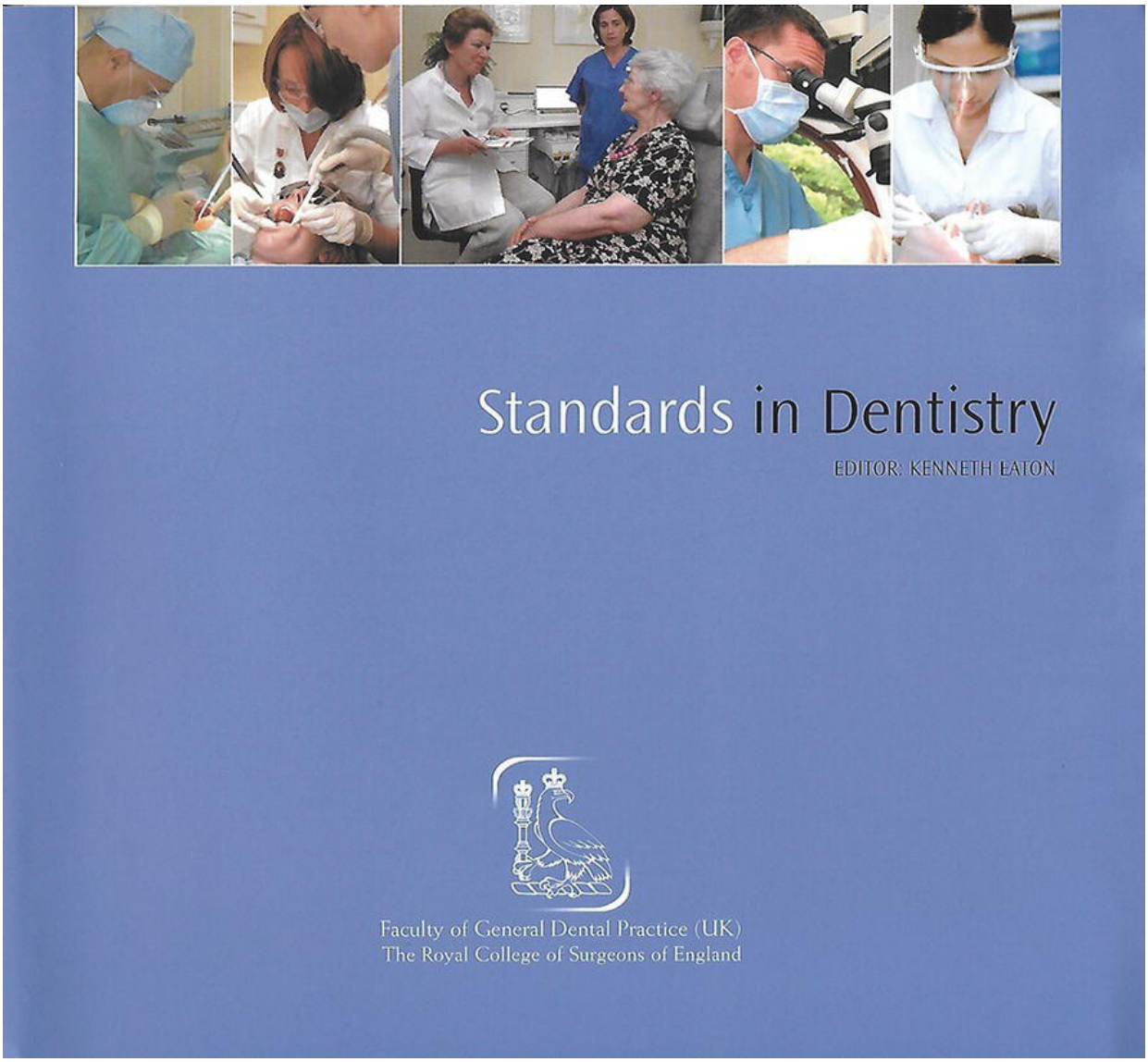

Figure 3.8 Faculty of General Dental Practice *Standards in Dentistry* publication.

Principle 8 and raising concerns and safeguarding

The GDC *Standards* document states that patients expect:

- the dental team to act promptly to protect their safety if there are concerns about:
  - the health, performance or behaviour of a dental professional – this is called 'raising concerns'
  - the dental workplace – this is called 'reporting untoward incidents'
- a dental professional will raise any concerns about the welfare of vulnerable patients – this is called 'safeguarding'.

Raising concerns

Throughout any team member's working life, a certain standard of behaviour and competence is expected at all times from all dental professionals, by both the public and the regulators of the profession. Sometimes, it may become apparent to a team member that the actions of another are putting patients or other team members at risk; for example, if correct infection control measures are not being carried out or if the team member has an alcohol addiction. In these situations, all GDC registrants have a duty to 'raise concerns' over the matter, in accordance with Principle 8 of the GDC *Standards* document.

A dental professional's duty to raise a concern overrides any personal and professional loyalty to the colleague causing the concern, even if it is an employer. The concern the team member has should be acted upon as soon as possible, whether or not there is an immediate risk to patients. Raising a concern is not the same as making a complaint about the individual. A complaint may require the complainant to prove their case whereas raising a concern does not require proof of malpractice; the concern is being raised so that others can deal with it, as necessary.

Raising concerns does not always result from issues of underperformance, but may instead involve the health or behaviour

of another team member or even yourself. Underperformance is usually defined as performance that puts patients at risk, fails to meet accepted and required standards, and/or is outside or conflicts with the professional's duty to put patients interests first and act to protect them. This therefore includes any issues where a dental professional works outside the limits of their qualification or competence.

Sources of help and advice

There may be instances when it is not clear whether or not to raise concerns, for fear of causing problems for a colleague unnecessarily or being considered a troublemaker by others. This may be especially so for junior team members such as trainee dental nurses. At these times, various possible sources of help should be sought.

- Another colleague, especially a senior one.
- Employer or manager.
- Professional association.
- Dental defence organisation.
- Health and Safety Executive (HSE), if the matter is specifically about the work environment (see later section on reporting of untoward incidents).
- Healthcare Commission, if it is not appropriate to raise the concern with the employer/manager, or they have not acted when the issue was raised:
    - CQC (England)
    - Healthcare Inspectorate Wales
    - Regulation and Quality Improvement Authority (Northern Ireland)
    - Healthcare Improvement Scotland.
- GDC: under certain circumstances (see later) where the person causing the concern is a registered dental professional.
- Public Concern at Work.

Public Concern at Work is an independent authority that deals with whistle-blowing issues that are in the public interest, promoting compliance with the law and good practice in organisations across all sectors, not just healthcare. The authority focuses on the responsibility of workers to raise concerns about malpractice and on the accountability of those in charge to investigate and remedy such issues. It offers free advice to people concerned about danger or malpractice in the workplace but who are unsure of whether or how to raise the concern. Further details are available at www.pcaw.co.uk.

Otherwise, there are two stages for raising concerns, locally and then centrally. If a dental professional is concerned by the behaviour, health or professional performance of a colleague that does not pose an immediate risk to public safety, then they should try to deal with the issue locally by talking to their colleague directly and trying to persuade them to seek appropriate help. If this advice is ignored, they should then raise the matter with the appropriate local authority:

- their mutual employer
- the designated person within the local PCO, if self-employed
- the employing authority, if in a salaried position.

If the case appears to be serious or a local referral has been made and no action has been taken, the GDC should be contacted. Dentists and dental employers have a responsibility to ensure that people they employ or manage are encouraged to raise concerns and are protected if they do so. They also have an obligation not to include a gagging clause in staff contracts, and dental staff should never sign a contract or agreement containing one – this would specifically prevent them from raising concerns, or would restrict their input into an investigation once a concern had been raised. This is a direct breach of Principle 8 of the GDC *Standards for the Dental Team,* and contrary to the more recent expectations of professionalism enshrined in the duty of candour.

Wherever possible, then, a concern should be raised in the workplace first, or with the appropriate health commissioning body. In some circumstances, it is appropriate to raise a concern about a registrant directly with the GDC, and their guidance suggests the following:

- When taking local action would not be practical, such as when the employer or manager is the source of the concern.
- When action at a local level has failed to resolve the issue, such as when the issue has been ignored or not investigated.
- When the problem is of a serious nature:
  - issues of indecency
  - issues of violent behaviour, including domestic violence
  - issues of dishonesty or fraud
  - issues of illegal practice
  - when a serious crime may, or has been, committed.
- When there is a genuine fear of victimisation or a cover-up may occur.
- When a registrant may not be fit to practise due to health, performance or conduct issues.

As discussed previously, student dental nurses are unregistered dental personnel and therefore not under the regulation of the GDC. However, their expected standards of conduct, performance and ethics are stated within the GDC publication *Student Professionalism and Fitness to Practice* (see Figure 3.2) and their training course provider is under GDC requirement to have a procedure in place for reporting patient safety incidents involving students. While some of the nine ethical principles of practice within the GDC *Standards* document will not be relevant to students during their training period, they are still expected to follow those that do while training and Principle 8 is one of them. The GDC website (www.gdc-uk.org) contains a support area called 'Focus on Standards' which helps registrants and students apply the standards to their daily work situation. There is also a dedicated 'Student Professionalism' resource area which contains more information on what is expected of students during their training period and how to maintain their professionalism and avoid raising concerns about their health, performance and conduct.

Understandably, some may worry about the issue of protection for people who raise concerns, as in the past whistle-blowers (the lay

expression used to refer to people who raise concerns) were often sacked from their employment after being identified as the source of leaks of disturbing information. To encourage people to continue to raise concerns without fear of retribution from their employers, the Public Interest Disclosure Act 1998 (PIDA) was passed which gives protection to employees who raise concerns about potentially dangerous or illegal practices in the workplace. The PIDA offers protection to all employed dental professionals (NHS or private) as well as to self-employed dental professionals working under NHS contracts. The Act applies more widely to employees in any workplace, not just to the healthcare sector.

To ensure that disgruntled employees do not use protection under the Act as a means of causing problems for their employers by making spurious or groundless accusations, protection under the PIDA only applies under the following circumstances:

- When the whistle-blower is acting in good faith (not being malicious).
- When they honestly and reasonably believe that the information and any allegation in it are substantially true.
- When they are not raising concerns for the purpose of personal gain (such as gaining promotion by ensuring someone else is sacked).
- When they have initially been unsuccessful in raising concerns with the employer first, unless they have reason to believe that:
    - they would be victimised
    - the employer would ensure there was a cover-up
    - the matter is very serious.

Thus the concerns raised with any regulatory body, such as the GDC in the case of dental professionals, will be protected under the PIDA if they are about:

- crime (e.g. fraud, theft, assault)
- the breaking of a legal obligation (e.g. duty of care to patients)

- miscarriage of justice (e.g. an innocent colleague being prosecuted)
- danger to health and safety or the environment (e.g. any breaches of legislations covered in Chapters 4, 8 and 12)
- a cover-up by the employer, involving any of the above issues.

When a member of the dental team does raise a concern with the GDC they do not have to prove their concerns before action is taken, but the concerns raised must be made in good faith.

As citizens, we are all encouraged to report potential fraud and crime to various bodies, such as the police, the Department for Work and Pensions, the DVLA, and Trading Standards, and to avoid retribution from fraudsters and criminals we are encouraged to do so anonymously. However, when raising a concern under the PIDA, anonymity is discouraged as it makes the issue more difficult to investigate, as well as making it very difficult to offer protection to an anonymous whistle-blower. The whistle-blower can always ask for their name not to be revealed without their permission.

Workplace responsibilities

Dental employers, managers and team leaders are expected to encourage and support a culture in the workplace where staff can raise concerns openly and without fear of reprisal, hence the GDC's insistence that gagging clauses must not be included in contracts and agreements. This open culture should run throughout the whole workplace and be embedded in relevant policies and procedures so that it is obvious to all that this is the behaviour expected of all personnel. It should be introduced at a new employee's induction and run through all staff training from there on, involving all current staff too.

The workplace must have written procedures in place to enable staff to raise concerns, whether about colleagues or issues within the workplace environment. These should be set out as an underperformance and whistle-blowing policy, under which the employer or manager must:

- be aware of and adhere to all current laws relevant to issues about raising concerns (including PIDA)
- support staff who raise concerns, rather than ignore or criticise them
- ensure that valid concerns are acted upon, so that shortfalls in standards and performance are dealt with
- have support systems in place for staff who may be having health or behaviour problems, or issues with their professional performance.

Once a concern has been raised it must be taken seriously and investigated promptly. Confidentiality must be maintained when appropriate, and the staff member who raised the concern should be kept informed of the progress of the investigation. An unbiased assessment of the concern should be made by the employer, manager or team leader (whoever is investigating the matter) so that suitable action can be taken to resolve the issue where necessary, or reasons why no action is taken should be recorded. Follow-up should then occur to monitor any actions taken and ensure that they were appropriate and the problem is solved.

Reporting untoward incidents

Untoward incidents are those which occur unexpectedly and with unfavourable outcomes, and in this context they usually involve a patient coming to harm as a result of the incident. Near misses, or untoward incidents that were narrowly avoided, are also included under the heading. Any incident which has had an impact on patient safety, or had the potential to do so, is an opportunity for the profession to learn from mistakes so that similar incidents can be avoided in future. To do this though, they have to be reported to a central body, collated and analysed to identify common risks and systems failures. This information can then be used to alert all other healthcare sectors of the issues raised so that further incidents can be avoided.

Dental practices can report incidents either to their PCO, or directly (and confidentially) to the National Reporting and Learning System

(NRLS) in England and Wales. Examples of untoward incidents and near misses that should be reported include the following:

- Exposure to hazardous substances in the dental workplace, such as nitrous oxide from a faulty gas cylinder.
- Medication errors, such as prescribing penicillin-derived antibiotics to a patient with an allergy to them.
- Missing instruments, such as the loss of an endodontic file into either the digestive or respiratory tract.
- Wrong site surgery, such as the extraction of the wrong tooth.
- Patient identification error, such as providing treatment to the wrong patient
- Disease transmission, such as by the use of contaminated instruments on a second patient, due to poor infection control methods.

The NRLS receives information about untoward incidents across the whole NHS, but is not concerned with investigating individual incident reports or with taking action against individual healthcare workers (including the dental team). It is concerned with analysing the incidents to understand how they occurred, so that underlying problems can be identified and practical guidance on their future avoidance rolled out to the healthcare sector, for the benefit of patients. It relies on healthcare staff to report incidents to them, and a culture of honesty and openness is more likely to encourage this than one of blame and persecution when an individual makes a mistake and then reports it.

When an incident occurs which results in a patient receiving serious injury, or requires medical treatment to avoid serious injury or death, the relevant national quality standards body must be notified immediately. These are as follows:

- England: CQC.
- Wales: Health Inspectorate Wales (HIW).
- Scotland: Healthcare Improvement Scotland (HIS).

- Northern Ireland: Regulation Quality Improvement Authority (RQIA).

In England, the CQC must be notified if any of the following occur:

- Injuries likely to last for more than 28 days or lead to permanent damage.
- Injuries or events causing pain likely to last for more than 28 days.
- Injuries or events leading to psychological harm.
- Any injury requiring medical treatment to prevent death or permanent injury.
- Suspicion, concern or allegation that a patient is, or has been, abused.
- Suspicion, concern or allegation that a patient is, or has been, abusing another person (see later section on safeguarding).
- Any incident that has been reported to, or investigated by, the police and that affects the provision of care for patients, such as assault, malicious damage, theft from a patient while in the dental workplace.

In addition, certain work-related injuries, diseases or events (including work-related death) must be reported to the HSE by the employer, within 15 days of the incident. This is a statutory requirement under the Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations (RIDDOR), which is discussed further in Chapter 4.

Patient safety policy

With the best will in the world, mistakes and safety incidents can happen. Chance and human error may play a part in an incident and can never be fully eliminated, but the majority of safety incidents occur because of systematic and recurrent failings which have not been identified and acted upon previously. The value of managing risks in the dental workplace by carrying out risk assessments cannot be over-emphasised, as they should result in the work environment

being as safe as possible if carried out correctly. All staff should be involved in risk assessing their particular area of the workplace, as they may have different views than those who work in another area and may identify potential risks that others fail to consider. Once all the risks have been identified, systems must be developed to manage them and reduce their potential to cause harm to both staff and patients. Risk assessment is discussed in detail in Chapter 4.

Patient safety should be a topic discussed regularly at staff meetings, and especially after an incident has occurred, so that everyone is constantly thinking of ways to improve the work environment and avoid future incidents. By having a patient safety policy in place, all staff will understand its relevance.

- Who is the appointed staff member with responsibility for investigating a patient safety incident.
- What constitutes a patient safety incident.
- What actions to take if one occurs.
- How incidents should be recorded, investigated and acted upon.
- What support may be needed for the patient, their family, and any staff member involved.
- What lessons can be learned from the incident.

The final point is the most important, as it should lead to improvements in the workplace which make it a safer environment for everyone. The incident needs to be analysed to determine the chain of events that led up to it – this is called a root cause analysis. It is less concerned with blaming individuals and more about how the events occurred and why something went wrong. Changes can then be made to procedures to prevent a similar event happening again. This information should then be provided as feedback to all staff, and if necessary to an update to the patient safety policy.

Safeguarding

This term is used to describe the actions required to protect children (including young people) and vulnerable adults from abuse or neglect by another person. It is concerned with protecting the welfare of the

child or vulnerable adult, as well as with ensuring their safety. It is also one of the seven 'core' topics of CPD for all dental professionals, although its mandatory coverage during a 5-year cycle may be delivered either as verifiable or general CPD.

Those who require safeguarding are deemed to do so because they may lack the mental capacity to make decisions for themselves, especially in their own best interest. They are protected from harm and others are able to make decisions and allow interventions on their behalf under the Mental Capacity Act 2005, which expects that adults have the ability to make informed choices, while children and vulnerable adults may not. To have mental capacity, a person must be able to:

- understand the implications of their situation, so that they know where they are, why they are there and what will happen to them while they are there
- take action themselves to prevent abuse, so they know who to ask for help and how to get it
- participate fully in decision-making about matters relevant to themselves, so they realise what is in their own best interests.

The age and lack of life experience of children and young people makes them vulnerable to abuse and neglect, while adults may be deemed vulnerable due to a variety of reasons:

- permanent mental health issues, such as congenital medical disorders or severe brain injury
- temporary mental health issues, such as being drunk or under the influence of mind-altering drugs
- acquired medical conditions, such as age-related memory loss, stroke (CVA), dementia, or degenerative brain diseases.

Vulnerable adults then are those less able, or unable, to protect themselves and may have difficulty in making their wishes or feelings known to others.

Very few dental professionals will not come into contact with child patients on an almost daily basis, and this puts them in an almost

unique position of being able to observe this group of patients and help prevent their abuse, or to suspect it and report their suspicions accordingly. On a lesser scale, many dental professionals will come into contact with vulnerable adults too, either in a hospital or special needs environment, and this group is at risk from the same types of abuse as children.

The CQC regulations require all dental workplaces in England to have systems in place for safeguarding children and vulnerable adults while on the premises, and to have knowledge of how to access local arrangements for child protection services. Further details of the requirements are available at www.cqc.org.uk.

No member of the dental team would be expected to make a diagnosis of abuse, but all would be expected to recognise potential causes for concern, document them, discuss their concerns with an appropriate senior colleague, and report them appropriately, when necessary. A very useful quick reference guide produced by NICE is also available to download from www.nice.org.uk, and this gives further details on possible child maltreatment indicators and actions to take (Figure 3.9).

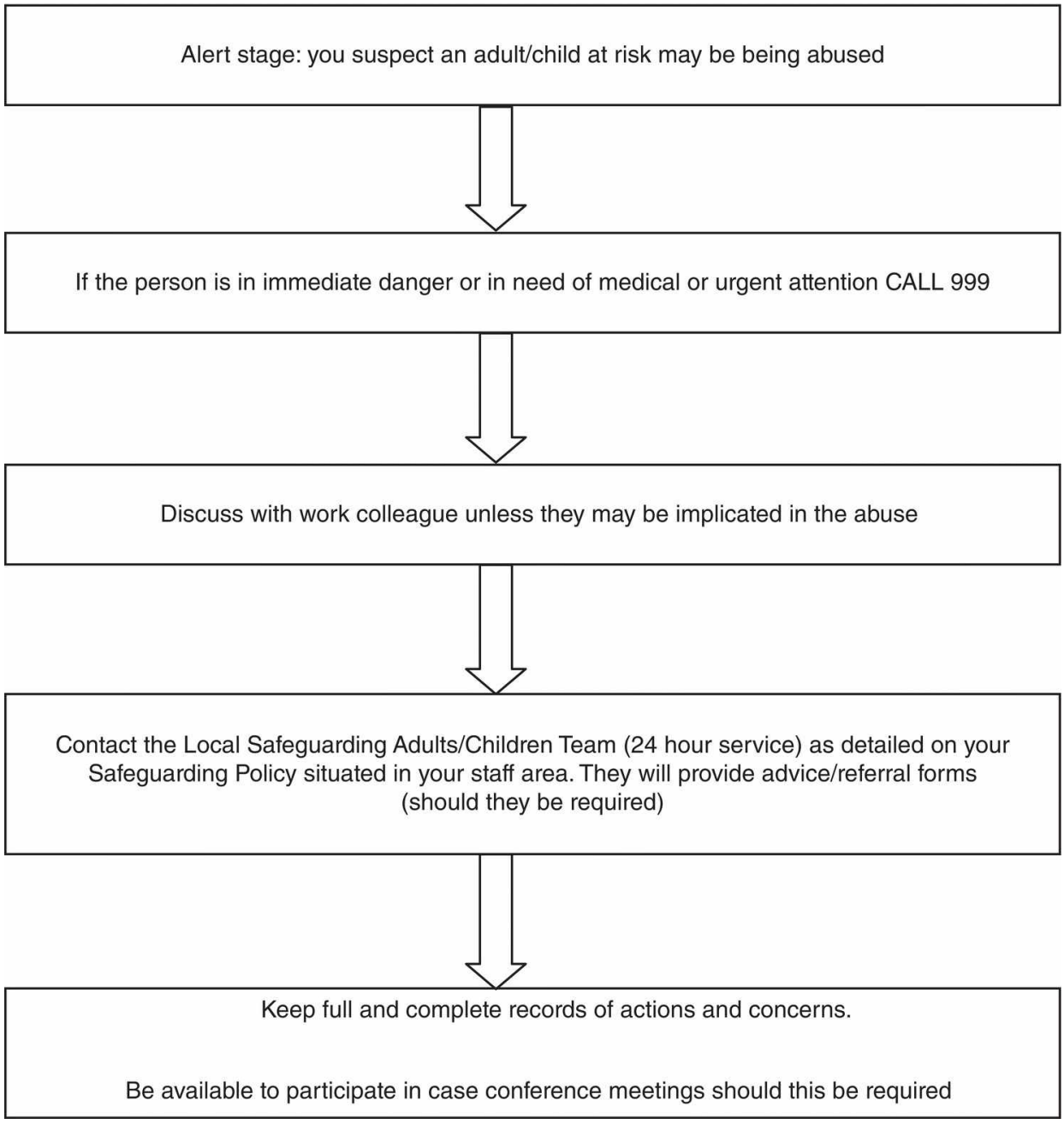

Figure 3.9 Safeguarding flowchart.

Types of abuse

Any type of abuse occurs when there is a violation of a person's human and civil rights by another person (or persons), and this may be as a single act or occur repeatedly. Where a child or vulnerable adult is dependent on another person for their care and well-being, that person has power and control over the child or vulnerable adult

and there is then the opportunity for abuse or neglect to occur unless adequate safeguards are in place.

There are four broad categories of abuse, and the possible indicators or areas of concern that should alert the dental team are discussed for each:

- Neglect.
- Physical abuse.
- Emotional abuse.
- Sexual abuse.

Financial abuse and the abuse of trust may also occur, but are less likely to be observed in the dental workplace. Financial abuse may involve theft, fraud, exploitation of inheritance or property concerns, while abuse of trust occurs when a person is in a position of power or influence over another, and uses it to the detriment of the health or well-being of the vulnerable person.

Neglect is the persistent failure to meet the child or vulnerable adult's basic physical and/or psychological needs: adequate food, clothing, shelter, supervision, medical and dental treatment, emotional support, and so on. Lack of any of these needs over a period of time is likely to result in the serious impairment of the victim's health, development or well-being.

Signs to look out for include the following:

- Failure to comply with dental professional advice that is in the best interest of the child or vulnerable adult, such as failing to carry out adequate oral hygiene actions or failing to arrange for tooth restoration.
- Malnourishment: lack of adequate, healthy nutrition.
- Inappropriate clothing, such as having insufficient warm layers of clothing in the winter.
- Persistently dirty, uncared-for appearance, such as having grubby skin, dirty hair, head lice, dirty or damaged clothing.

- Untreated illness, including severe dental caries involving several teeth.
- Difficult behaviour, such as attention seeking, distraction or withdrawn.

Physical abuse involves anything that causes physical harm to the victim – hitting, shaking, scalding, burning, biting – but also the fabrication of symptoms or deliberately causing illness in the victim, such as forcing dangerous levels of salt intake on the victim to produce coma.

Some children really are just accident prone but accidental injuries tend to occur on one side of the body and affect bony prominences such as the nose, chin, elbow or foot. Some vulnerable adults may also be prone to frequent injury by having a physical disability, or by having no concept of danger due to mental incapacity. Elderly people are generally more likely to suffer from falls, especially as they become frail with age or ill health. Accidental injury must always be considered first.

Signs to look out for include the following:

- Orofacial trauma, which occurs in at least half of children diagnosed with physical abuse, so injuries to the cheeks, intraoral soft tissues, the ears.
- Bilateral injuries, so having two black eyes, rather than just one.
- Bite marks, which may be more obvious to dental professionals than others.
- Soft tissue injuries to the neck: scratches, bruises, cuts and bite marks.
- Flinching away from sudden movements or noises, so exhibiting signs of being fearful.

Emotional abuse involves the persistent emotional maltreatment of the victim, causing severe and adverse effects on their emotional development, for example bullying, made to feel worthless, useless, unloved or unwanted. It may also involve humiliation in front of

others (such as the dental team), intimidation, harassment or verbal abuse.

Signs to look out for include the following:

- Inability to cope with normal life events (e.g. unable to make decisions or being antisocial).
- Becoming agitated and distressed when left alone (e.g. especially by a parent or other known adult).
- Self-harm (e.g. cutting themselves, bulimia).
- Drug or alcohol abuse.
- Educational problems.

Sexual abuse involves the victim being forced or enticed to take part in sexual activities of a physical nature. With children it may also include non-contact activities such as being forced or enticed to watch sexual acts or take part in producing pornographic material.

Signs to look out for include the following:

- Physical trauma to the lips and oral cavity that is not easily explained, such as soft or hard tissue trauma from having objects forced intraorally (especially palatal bruising, trauma or fractured teeth).
- Evidence of lesions that may indicate a sexually transmitted disease (e.g. ulceration and vesicle formation of gonorrhoea or syphilis).
- Inappropriate sexual knowledge or behaviour, beyond that expected for the age of the victim, such as the use of sexual words or innuendos, or flirtatious behaviour.
- Pregnancy in a child or vulnerable adult who is known to be institutionalised and therefore unlikely to be in a relationship.

Vulnerable adults also include those who need community care services because they have a mental or other disability, or are old and/or infirm or suffering from an illness that prevents them from adequately taking care of themselves. They include those who are

unable to protect themselves against significant harm or exploitation, including by financial methods, such as unwitting elderly victims being conned out of their life savings by fraudsters (an example of financial abuse).

Practical steps

In all cases the dental professional must be prepared to make a judgement decision on whether to pass on their concerns and involve others or not. However, if a tragedy occurs that could have been prevented by a team member's intervention, difficult questions will be asked by their dental defence organisation, by the GDC and possibly by the police. The patient is always the most important person in any potential case of abuse, and as with all other situations, the dental professional has a duty of care to that patient and must put their interests first at all times.

The process to be followed may vary on a local level, but should follow a cascade of seriousness as indicated below.

- Document the concerns as soon as they are noticed, including any injuries present.
- Enable another team member to witness any injuries too, but without alarming the patient or their parent or guardian.
- Discuss the matter with a senior professional colleague in the practice (there should be a nominated safeguarding lead, for example).
- The senior colleague may decide to contact any of the following local colleagues for advice, especially if considering reporting the matter:
    - dental defence organisation
    - hospital consultant
    - dental advisor
    - consultant in dental public health
    - child protection lead at the LAT
    - local social services department.

- Where abuse of a child is likely, the Local Safeguarding Children Board (LSCB) will be contacted, as well as the police.
- Where abuse of a vulnerable adult is likely, the Local Safeguarding Adult Board (LSAB) will be contacted instead, as well as the police.
- Where there is serious physical injury present, the victim should be referred to the local hospital accident and emergency department, and both social services and the police should be notified, especially if the parent or guardian refuses to consent to medical care.
- In England, if the police are notified then the CQC must also be contacted.

Criminal records checks

It is now a requirement for all dental team members who have any contact with children or vulnerable adults to undergo an enhanced criminal records check, if they wish to work in the dental care professions. This is a requirement of both the CQC and NHS LATs when recruits apply to work in a dental workplace, and has been carried out retrospectively on those who already work in the dental sector. Other independent 'umbrella' organisations may also be authorised by the DBS (previously the Criminal Records Bureau) to carry out the same checks on those working, or applying to work, in private dental workplaces in England and Wales. Therefore, it is not possible for any dental professional to work without being sufficiently checked and scrutinised first.

The checks are carried out by the DBS in England and Wales, and enhanced checks will disclose convictions, police cautions and information on previous police investigations where a conviction or caution was not issued. The checks carried out by the DBS are particularly thorough in that they consider every adult patient to be vulnerable whilst undergoing dental treatment, and therefore no one is exempt from their scrutiny – dental professionals who have no access to child or vulnerable adult patients are still subject to the same enhanced checks as their colleagues in other workplaces.

In Scotland, similar criminal records checks are carried out by Disclosure Scotland under the Protecting Vulnerable Groups Scheme,

and in Northern Ireland they are carried out by Access Northern Ireland.

The existence of a criminal conviction or caution does not itself prevent anyone from working in the dental professions, and each case must be judged on its merits. An example that would not be considered very relevant is having a conviction for having no car insurance – whilst not ideal for a professional to have this against them, it has no bearing on their suitability to work safely in the dental workplace. Further information is available at the following sources:

- England and Wales: www.dbs.homeoffice.gov.uk
- Scotland: www.disclosurescotland.co.uk
- Northern Ireland: www.accessni.gov.uk

Principle 9 and professionalism

The GDC *Standards* document states that patients expect:

- all members of the dental team to maintain appropriate personal and professional behaviour
- to have trust and confidence in all dental professionals, and the dental profession as a whole.

It is an honour for any member of the dental team to be considered as a 'professional' by the public, but it is not something that comes automatically and naturally once a dental qualification has been achieved. It is also an expectation by society that all dental professionals are duty-bound by the following:

- Dental qualification achieved (of all team members) is used to provide a service to society.
- Adhere to the concept of 'duty of care' towards patients and abide by the principles it enshrines, to the benefit of those patients.
- Governed by codes of ethics, as well as by appropriate legislation and regulations.
- Show commitment to competence, integrity, morality and altruism at all times, so to always 'do the right thing' in an unselfish and correct way for the benefit of others.

All these points together describe professionalism.

The GDC sets the following four standards in relation to Principle 9:

- Ensure your conduct, at work and privately, justifies patients' trust in you and the dental profession.
    - Treat everyone fairly, with dignity and lawfully.
    - Use proper channels to raise concerns about a colleague, and never make disparaging remarks about them in front of patients.
    - Do not use public media inappropriately in relation to colleagues or patients (social networking sites, blogs, other

social media).
    - Maintain appropriate boundaries in relationships with patients.
- Protect patients and colleagues from risks posed by your health, conduct or performance: seek occupational health or other appropriate advice as soon as an issue arises.
- Inform the GDC if you are subject to criminal proceedings or a regulatory finding is made against you, anywhere in the world.
    - This include fitness to practise procedures of another healthcare regulator in any country.
    - This includes being placed on a barred list by the DBS or Disclosure Scotland.
- Co-operate fully with any relevant formal or informal inquiry, and give full and truthful information during any inquiry by the following organisations:
    - GDC fitness to practise inquiries.
    - PCOs.
    - Other healthcare regulators or regulatory body.
    - Coroner or procurator fiscal (in Scotland) when investigating a death.
    - HSE.
    - Legal representative of a patient or colleague.

All these points are relevant to both qualified dental professionals and to student dental team members.

Care Quality Commission

The CQC is the independent regulator of health and adult social care services in England, and since the empowerment of the Health and Social Care Act 2008 it has been the organisation responsible for ensuring adequate standards in premises such as hospitals, nursing homes for the elderly, and care homes for those with a wide range of special needs.

From 1 April 2011, its powers of regulation were extended to include all providers of primary dental care services in England that carry on 'regulated activities' (in this case dentistry and oral healthcare), and all providers, whether NHS or private, have had to become registered with them since then.

Following the Francis Inquiry into the Mid-Staffordshire NHS Foundation Trust (see previously) the Health and Social Care Act was updated in 2014, and enacted in 2015. This included the establishment of the duty of candour. From this point on, CQC inspections have revolved around ensuring that patient care does not fall below the new fundamental standards which evolved from the Francis Inquiry, and focus mainly on the quality and safety of services provided. These fundamental standards apply to all dental workplaces in England only, although other national quality standards bodies are expected to develop similar standards and perform a similar role in future in Wales (HIW), Scotland (HIS) and Northern Ireland (RQIA).

During an inspection several staff members, including student dental nurses, may be interviewed to determine if the workplace as a whole is aware of how they comply with the fundamental standards. The interview is not a memory test of various regulations and legislation, but those questioned should know where to find the necessary written information about the workplace policies and procedures, thus showing knowledge of how they must perform to achieve their compliance.

While carrying out the inspection, the CQC will assess the quality of the dental services provided against the fundamental standards and decide whether the workplace positively answers the five key questions of service provision in these premises (see later).

- Is it safe?
- Is it effective?
- Is it caring?
- Is it responsive?
- Is it well-led?

The fundamental standards

These are intended as common-sense statements that describe the basic requirements that the dental workplace (and all other care providers) should always meet, and set out the outcomes that patients should always expect to receive. They link in, and can be cross-referenced with, the nine core ethical principles of practice published by the GDC in *Standards for the Dental Team* discussed in full previously, including patient expectations for each principle. CQC registration requires that there are various samples of written evidence available in each workplace to show compliance with each standard, and meeting the fundamental standards should also ensure compliance with the GDC's standards of conduct, performance and ethics as a dental professional.

The fundamental standards are as follows:

- Person-centred care.
  - Involve patients in decisions about their treatment and care.
  - Ensure patients understand what is proposed.
  - Consider implications of Mental Capacity Act 2005 where relevant.
  - Provide up-to-date treatment safely.
  - GDC principles: 1 (put patients' interests first), 2 (communication skills), 3 (consent), 7 (quality assurance).
- Dignity and respect.
  - Treat all patients with dignity and respect.
  - Ensure their privacy.
  - GDC principles: 1 (put patients' interests first), 4 (confidentiality).
- Need for consent.
  - Obtain informed consent before providing any treatment.
  - Do not provide unsafe treatment even if consent is given.

    - Consider implications of Mental Capacity Act 2005 where relevant.
    - GDC principles: 1 (put patients' interests first), 3 (consent), 7 (quality assurance).
- Safe care and treatment.
    - Reduce health and safety risks to patients while providing treatment.
    - Prevent any cross-infection issues.
    - Treatment provided by suitably qualified and competent clinician.
    - GDC principles: 1 (put patients' interests first), 6 (teamwork), 7 (clinical governance), 8 (raising concerns, untoward incidents).
- Safeguarding patients from abuse and improper treatment.
    - Systems in place to prevent abuse of patients.
    - System in place to investigate appropriately if abuse suspected.
    - GDC principles: 1 (put patients' interests first), 5 (complaints handling), 8 (safeguarding).
- Premises and equipment.
    - Premises and equipment must be clean, well maintained and fit for purpose.
    - Equipment must be stored and used correctly.
    - Registered provider is legally responsible for ensuring these standards.
    - GDC principles: 1 (put patients' interests first), 6 (management and leadership), 8 (untoward incidents).
- Receiving and acting on complaints.
    - Effective complaints handling system in place.
    - Complaints must be investigated.
    - Changes made if failures are discovered.

    - GDC principles: 1 (put patients' interests first), 2 (communication skills), 5 (complaints handling), 8 (raising concerns), 9 (professionalism).
- Good governance.
    - Quality assurance systems in place.
    - Seek and act on relevant feedback from patients about services provided.
    - Ensure all records (clinical, staff, managerial) are complete.
    - GDC principles: 1 (put patients' interests first), 3 (consent), 4 (information governance), 5 (complaints handling), 6 (management and leadership), 7 (clinical governance), 9 (professionalism).
- Staffing.
    - Have enough staff to function as a dental workplace effectively.
    - Staff must be suitably qualified and competent to carry out their individual role within the team.
    - Staff must receive support and appropriate training and development opportunities to carry out their duties within the team.
    - GDC principles: 1 (put patients' interests first), 6 (teamwork, management and leadership), 7 (CPD), 8 (raising concerns), 9 (professionalism).
- Fit and proper persons employed.
    - Robust and vigorous recruitment process.
    - Staff have good character, necessary qualifications and competency to carry out their duties within the team.
    - On-going monitoring of staff suitability for their role.
    - Appropriate arrangements in place for those who are no longer suitable.
    - GDC principles: 1 (put patients' interests first), 6 (teamwork, management and leadership), 7 (CPD, reflective practice,

appraisals), 8 (raising concerns), 9 (professionalism).

- Duty of candour.
  - Treat patients with honesty and integrity.
  - Be honest and open when untoward incidents occur.
  - Have an effective policy and process in place to investigate when concerns are raised or untoward incidents occur.
  - Follow the necessary legislation where necessary.
  - GDC principles: 1 (put patients' interests first), 2 (communication skills), 4 (record keeping), 5 (complaints handling), 6 (teamwork), 8 (raising concerns, reporting untoward incidents), 9 (professionalism).

It is interesting to note that the GDC's Principle 1 – put patients' interests first – is relevant to all the fundamental standards expected by the CQC of all health and social care providers, including dental workplaces. Compliance with these standards will, therefore, hopefully prevent a similar occurrence as that uncovered at Mid-Staffordshire NHS Foundation Trust.

The five key questions

Under the CQC's new inspection process, a small sample of dental workplaces are randomly inspected, as well as those where concerns about their service to patients have been raised previously. An assessment is carried out of the quality of the dental services provided to determine whether they show compliance with the five key questions of patient care.

Whether due for inspection or not, all dental workplaces must consider the five key questions, their implications to their own work environment, and how they comply with, and can show their compliance with, each one. Each of the five key questions and the relevant fundamental standards to consider by the dental workplace are summarised here, as many have been discussed previously in this chapter or discussed in detail in further chapters.

Is it safe?

- Safe care and treatment:
  - Manage risks effectively (see Chapter 4).
  - Control and prevent infection (see Chapter 8).
- Safeguarding patients from abuse and improper treatment:
  - Systems in place to raise and investigate concerns (see previously).
  - Knowledge of how to report concerns to relevant authorities (see previously).
- Premises and equipment:
  - Premises fit for purpose (see Chapter 4).
  - Equipment correctly maintained and serviced (see Chapter 4).
  - Single-use items disposed of after one use (see Chapter 8).
  - Systems in place to report and investigate untoward incidents (see previously and Chapter 4).
  - Medicines managed correctly (see Chapter 6).
- Staffing:
  - Adequate numbers of staff for workplace to function safely (see previously).
  - Suitably trained and relevantly qualified staff (see Chapters 1 and 2).
  - Enhanced DBS checks carried out (see previously).
  - CPD and further training opportunities available (see previously).
- Duty of candour:
  - Systems in place to raise and investigate concerns (see previously).
  - Systems in place to investigate untoward incidents and 'near misses' (see previously).
  - Keep patients informed at all times (see previously).

Is it effective?

- Person-centred care:
  - Gain informed consent (see previously).
  - Consider Mental Capacity Act 2005 where relevant (see previously).
  - Patients treated with dignity and respect (see previously).
- Staffing:
  - Suitably trained and relevantly qualified staff providing care (see Chapters 1 and 2).
- Duty of candour:
  - Open and honest culture throughout the workplace at all times (see previously).
  - Patients treated with honesty and integrity (see previously).

Is it caring?

- Dignity and respect:
  - Patient information held in confidence (see previously).
- Patients involved in their care and treatment decisions:
  - Gain informed consent (see previously).
  - Consider Mental Capacity Act 2005 where relevant (see previously).

Is it responsive?

- Person-centred care:
  - Gain informed consent (see previously).
  - Consider Mental Capacity Act 2005 where relevant (see previously).
  - Suitably trained and relevantly qualified staff providing care (see Chapters 1 and 2).

    - Have suitable referral systems in place where required (see previously).
- Receive and act on complaints:
    - Complaints handling system in place (see previously).
    - Learn from valid complaints (see previously).
- Duty of candour:
    - Systems in place to raise and investigate concerns (see previously).
    - Systems in place to investigate untoward incidents and 'near misses' (see previously and Chapter 4).

Is it well-led?

- Good governance:
    - Quality assurance systems in place (see previously and Chapters 4, 8 and 12).
    - Acquire and act on patient feedback (see previously).
    - Adequate record-keeping systems in place (see previously and Chapter 12).
- Receive and act on complaints:
    - Complaints handling system in place (see previously).
    - Learn from valid complaints (see previously).
- Staffing:
    - Suitably trained and relevantly qualified staff (see Chapters 1 and 2).
    - CPD and further training opportunities available (see previously).
- Duty of candour:
    - Systems in place to raise and investigate concerns (see previously).

- Systems in place to investigate untoward incidents and ‘near misses’ (see previously).
- Open and honest culture throughout the workplace at all times (see previously).

The content of this chapter, though expansive and complicated in parts, provides the underpinning information and knowledge required for all members of the dental team to be considered professionals by their patients and by society. Consequently, it may be seen as the most important chapter of this whole text.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

4
Health and Safety in the Dental Workplace

Key learning points

A **factual knowledge** of

- health and safety requirements relevant to both employers and employees

A **working knowledge** of

- the legislative and regulatory requirements of the dental workplace and its staff
- risk assessment in the dental workplace
- occupational hazards and their avoidance in the dental workplace

A **factual awareness** of

- the actions to take in various first-aid scenarios
- general safety and security issues in the dental workplace

Health and Safety at Work Act (1974)

All dental workplaces, their staff and patients are covered by the provisions of the Health and Safety at Work Act (1974), as is any other workplace. In addition, other legislation is relevant to the dental workplace due to the potentially harmful nature of the equipment and chemicals used, as well as the occupational hazards associated with delivering dental treatment or working in the dental environment.

The Health and Safety legislation seeks to protect staff and patients while on the premises by making the staff aware of any potential hazards at work, and encouraging them to find the best ways of making their premises safer for all concerned. In legal terms, the employer has a statutory duty to ensure that, as far as is reasonably practicable, the health, safety and welfare at work of all employees and all visitors (including patients) are considered at all times. To do this, all the potential hazards first need to be identified, and then the likelihood of them actually causing harm to anyone must be determined. The chance that a particular workplace hazard could cause harm to someone is known as its risk, and the correct procedure to be followed by the employer (and their staff) to identify those hazards that could cause harm is called a risk assessment.

Compliance with the Health and Safety at Work Act is overseen and regulated by the Health and Safety Executive. This is a government body that provides guidance to employers on the correct enforcement of the Act, and investigates when any serious incidents occur in any workplace where someone suffers serious harm or is killed. Every dental workplace is required to be registered with the HSE.

Compliance with the additional legislation specific to the dental workplace is also required by the GDC, under its *Standards for the Dental Team* documentation (see Chapter 3). In addition, the UK's healthcare regulators outline standards of quality and safety within the healthcare workplace which patients have a right to expect while receiving care, including dental treatment (see Chapter 3). The healthcare regulators throughout the UK are listed below.

- England: Care Quality Commission
- Wales: Health Inspectorate Wales

- Scotland: Healthcare Improvement Scotland
- Northern Ireland: Regulation Quality Improvement Authority.

To comply with the basic requirements of the Health and Safety at Work Act, every employer in the dental workplace has a duty of care to abide by the following requirements:

- Provide a working environment for employees that is safe, without risks to health, and adequate with regard to facilities and arrangements for their welfare at work.
- Maintain the place of work, including the means of access and exit, in a safe condition.
- Provide and maintain safe equipment, appliances and systems of work.
- Ensure all staff are trained in the safe handling and storage of any dangerous or potentially harmful items or substances.
- Provide such instruction, training and supervision as is necessary to ensure health and safety.
- Review the health and safety performance of all staff annually, and be aware of and investigate any failures or concerns highlighted, when they occur.
- Display the official Health and Safety Law poster for all staff to refer to (Figure 4.1). This is also available in leaflet format and a copy given to each employee.

Health and Safety Law
What you need to know

All workers have a right to work in places where risks to their health and safety are properly controlled. Health and safety is about stopping you getting hurt at work or ill through work. Your employer is responsible for health and safety, but you must help.

What employers must do for you

1. Decide what could harm you in your job and the precautions to stop it. This is part of risk assessment.
2. In a way you can understand, explain how risks will be controlled and tell you who is responsible for this.
3. Consult and work with you and your health and safety representatives in protecting everyone from harm in the workplace.
4. Free of charge, give you the health and safety training you need to do your job.
5. Free of charge, provide you with any equipment and protective clothing you need, and ensure it is properly looked after.
6. Provide toilets, washing facilities and drinking water.
7. Provide adequate first-aid facilities.
8. Report major injuries and fatalities at work to our Incident Contact Centre on **0845 300 9923**. Report other injuries, diseases and dangerous incidents online at **www.hse.gov.uk**.
9. Have insurance that covers you in case you get hurt at work or ill through work. Display a hard copy or electronic copy of the current insurance certificate where you can easily read it.
10. Work with any other employers or contractors sharing the workplace or providing employees (such as agency workers), so that everyone's health and safety is protected.

What you must do

1. Follow the training you have received when using any work items your employer has given you.
2. Take reasonable care of your own and other people's health and safety.
3. Co-operate with your employer on health and safety.
4. Tell someone (your employer, supervisor, or health and safety representative) if you think the work or inadequate precautions are putting anyone's health and safety at serious risk.

If there's a problem

1. If you are worried about health and safety in your workplace, talk to your employer, supervisor, or health and safety representative.
2. You can also look at our website for general information about health and safety at work.
3. If, after talking with your employer, you are still worried, you can find the address of your local enforcing authority for health and safety and the Employment Medical Advisory Service via HSE's website: **www.hse.gov.uk**.

Your health and safety representatives: LOUISE SHEWARD + KERRY GLYNN

Other health and safety contacts: HSE STOKE ON TRENT LYME VALE COURT, LYME DRIVE, PARKLANDS BUSINESS PARK, NEWCASTLE ROAD, TRENT VALE, STOKE, ST4 6NW

Fire safety
You can get advice on fire safety from the Fire and Rescue Services or your workplace fire officer.

Employment rights
Find out more about your employment rights at **www.gov.uk**.

HSE

Health and Safety Executive

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Figure 4.1 Health and Safety poster.

To comply with these statutory obligations, dentists must keep their staff informed of all the safety measures adopted. Practices with five or more employees must produce a comprehensive health and safety policy and provide all staff with a copy. The policy will classify the practice health and safety procedures and name the persons responsible. It should also list the telephone numbers of all dental, administration and equipment maintenance contractors, the local HSE contact, and emergency services.

Role of the dental nurse

All staff in the dental workplace, including dental nurses, have a legal obligation to co-operate with their employers in carrying out the practice requirements in respect of these safety measures. They are designed to protect not only the staff and patients, but anybody else using or visiting the premises, such as self-employed workers, delivery persons or maintenance contractors. In a large dental workplace, a dental nurse may be appointed as safety representative under the Act for the purpose of improving liaison within the practice about health and safety matters.

However, many dental nurses begin their careers as young trainees in the dental environment, probably with little prior knowledge of health and safety issues and therefore quite vulnerable to injury or harm, so the following two sets of regulations are specifically important in protecting their welfare:

- Health and Safety (Young Persons) Regulations 1997
- Management of Health and Safety at Work Regulations 1999.

These two sets of regulations require a risk assessment of the dental environment to be carried out, with particular regard to the protection of younger staff members, by taking into account the following points:

- The risks to young people before they start work.
- The psychological or physical immaturity and inexperience of young people.
- Their lack of awareness of existing or potential risks to their health and safety.
- The fitting and layout of the practice and surgery, with regard to the safety of young people.
- The nature, degree and duration of any exposure to biological, chemical or physical agents within the work environment.
- The form, range, use and handling of dental equipment.
- The way in which processes and activities are organised.

- Any health and safety training given, or intended to be given.

A summary of the risk assessment details, covering the various types of work activity that a student dental nurse is likely to undertake, to ensure their safety in the dental workplace is shown in Table 4.1. The risk assessment should take into account the likely activities that the student dental nurse will undertake while on the premises, and these are listed in the left-hand column. To train effectively, they must always be involved in chairside assisting activities, so the potential areas of risk to the student during chairside working should then be considered (these are listed in the centre column). The right-hand column then needs to identify the methods required to ensure that the student is not exposed to these risks in the first place, and for each area it can be seen that suitable induction training is always required. This involves explaining why a certain activity is a risk to them, the provision of suitable training in the activity so that the risk is minimised as far as possible, and initial supervision when the activity is carried out for the first few times. Before dental nurses became registrants with the GDC, and therefore before training and qualification were necessary, this supervision used to be referred to as ‘shadowing’. This involved the student following and observing an experienced colleague correctly carrying out the various tasks to be learned, before their roles were reversed and the student would be shadowed by the experienced colleague until they were deemed able to carry out the activity unsupervised. The risk assessment procedure described here merely formalises the technique of shadowing.

Table 4.1 Risk assessment for student dental nurse.

Work activity	Potential risk	Prevention with control
Chairside assisting	Eye injury from projectiles during treatment Inhalation of aerosols during treatment	Explanation of risks, training, in activities undertaken, initial supervision Provision and use of all PPE
Instrument decontamination	Inoculation injury (clean or dirty) Contamination splash during cleaning	Explanation of risks, training in cleaning methods, initial supervision Additional PPE: plastic apron and thick rubber gloves
Use of autoclave	Burns from hot machine or instruments Scalds from steam	Explanation of risks, training in handling methods, initial supervision
Exposure to hazardous chemicals	Inhalation of vapours, skin contact, eye contact	Explanation of risks, training in handling methods, initial supervision Provision and use of full PPE Adequate ventilation
Use of X-rays	Accidental exposure to X-rays	Explanation of risks, inform of designated control area, avoid unauthorised entry to area

Full compliance with Health and Safety legislation for all dental workplaces, whether a practice, a clinic or a hospital department, involves all the following:

- Control of Substances Hazardous to Health 2002 (COSHH)
- Hazardous Waste Regulations 2005
    - HTM 07-01: Safe Management of Healthcare Waste 2013
- Health and Safety (Display Screen Equipment) Regulations 1992

- Health and Safety (First Aid) Regulations 1981
- Health and Safety (Sharp Instruments in Healthcare) Regulations 2013 (see Chapter 8)
- HTM 01-05: Decontamination in primary care dental practices, updated 2013 (see Chapter 8)
- Ionising Radiations (Medical Exposure) Regulations 2017 [IR(ME)R17] (see Chapter 12)
- Ionising Radiations Regulations 2017 (IRR17) (see Chapter 12)
- Manual Handling Operations Regulations 1992
- Personal Protective Equipment at Work Regulations 1992 (see Chapter 8)
- Pressure Systems Safety Regulations 2000
- Regulatory Reform (Fire Safety) Order 2005
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR)
- Water Supply (Water Fittings) Regulations 1999
    - HTM 04-01: HSE approved code of conduct L8 for the prevention of *Legionella*.

Health and safety policy

To ensure compliance with all the legal and regulatory requirements listed above takes a huge amount of work and time, but is necessary for the safety of everyone on the premises. The HSE are legally entitled to routinely inspect dental workplaces, as are the relevant healthcare regulator in each area of the UK, and both bodies will expect to see written evidence of relevant safety checks, certifications, and working policies and protocols to ensure that the workplace operates safely at all times. Although technically a written health and safety policy is only required in workplaces with five or more employees, it is good practice for all dental workplaces to have one, as it is evidence of good working standards and of compliance.

A health and safety policy statement sets out the following three points:

- Statement of intent: declaration of the employer's commitment to providing a safe and healthy workplace and working environment for all.
- Details of responsibilities for health and safety throughout the workplace.
- Details of safe systems of work and safe working practices for all work activities.

To understand the various responsibilities for health and safety that are required, the workplace must be assessed to determine what possible risks are posed on the premises, and by the carrying out of the day-to-day procedures in the workplace – this is called **risk assessment**. Once risk assessments have been carried out, the workplace can develop a raft of policy documents which set out the courses of action that have been adopted by the workplace in relation to various activities (such as 'infection control policy', 'safeguarding policy', 'confidentiality policy'). Policies may vary from workplace to workplace; one suitable for a hospital department will not be suitable for a small practice, for example. When each policy has been decided and then put into writing as the required course of action to be followed, it is read and signed by all staff to show their agreement with its terms; it then becomes a protocol. A protocol is a written

draft of terms agreed to and signed by all parties as a code of conduct within the workplace – all the protocols together are the standard operating procedures (SOPs) for that workplace.

At all times, all staff must adhere to and abide by the SOPs for their particular workplace, and this is especially important in relation to health and safety issues.

Risk assessment

As stated above, the whole purpose of the Health and Safety legislation is to protect everyone within the dental workplace (staff, patients and visitors) from coming to any harm while on the premises. This is achieved by carrying out a risk assessment of every potential hazard that could occur. The aim is not necessarily to eliminate every risk completely (this is likely to be impossible in most workplaces, including dental surgeries) but instead to minimise those risks identified as far as possible, so that there is little chance of them causing harm to anyone.

For example, various chemicals must be used in the dental workplace to carry out dental treatment successfully. These include decontamination solutions, X-ray processing solutions, and mercury in amalgam fillings; all are potentially harmful but only if mishandled or misused. Thus knowledge of their correct storage and usage by staff, and protection from misuse by all others, are key factors in avoiding a hazardous event.

The steps involved in carrying out a risk assessment on a hazard, whatever its nature, should always follow the same pattern.

1. **Identify the hazard**: a chemical, a piece of equipment, a procedure that occurs in the workplace, etc.
2. **Identify who may be harmed**: certain staff, certain patients, visitors, everyone, etc.
3. **Evaluate the risk**: is there a hazard only if mishandled or misused, is there a hazard with every use, or is there a hazard if certain precautions are not followed?
4. **Control the risk**: train all staff in correct usage, improve precautions to prevent mishandling or misuse, keep hazards away from untrained persons, install health monitoring where appropriate, remove the risk where possible, etc.
5. **Record the risk assessment findings**: to prove compliance, to provide a reference for all users, to ensure all staff are fully informed of the potential hazards in the dental workplace.

6. **Review the assessment process**: on a regular basis to ensure that hazardous events or injuries do not occur.

Although specialist knowledge of some hazards in the dental workplace is necessary to fully realise their potential for causing harm, many of the actions that should be followed to ensure the health and safety of everyone on the premises are common sense.

Consider the scenarios and relevant common-sense actions in Table 4.2. This gives examples of various hazardous situations that may be encountered by patients and visitors to the dental workplace in the left-hand column, in a similar way to those that may be encountered by the student dental nurse shown in Table 4.1. The right-hand column then suggests common-sense actions to take that will minimise the potential risk in the first place. So, for example, there are several potentially harmful chemicals used in dentistry that cannot be avoided, such as bleach-based cleaning agents. When used for their specific purpose, there is no risk but if used contrary to that purpose (such as being swallowed by a child), their potential to cause harm is huge. The common-sense action is to prevent the child from having access to the chemical at all times, by locking it away in a cupboard or storing it in a locked room away from the public access areas of the workplace. The differing design and layout of each workplace will require that an individual risk assessment is carried out for each one.

Table 4.2 Avoidance of hazards.

Scenario of potential hazard	Common-sense action to avoid harm
Injury sustained by falling over on the premises	Keep all access routes clear of debris and blockages Maintain floor covering adequately Avoid cleaning during work time Clear all spillages immediately Use hazard signs to highlight potential sources of injury ('Caution: wet floor', etc.)
Child drinking harmful chemical	Keep harmful chemicals out of reach Keep chemicals in locked storage area Keep children out of storage area Keep children under control at all times
Person falling out of window on premises	Install window locks Install restricted opening device Keep staff-only areas locked
Injury sustained from slammed door	Keep doors locked when rooms not in use Install slow closure devices to prevent slamming Install safety glass

These scenarios are not exclusive to the dental workplace – they could occur anywhere at any time and to anyone. However, if they do occur in the dental workplace then they are not merely an unavoidable accident but have become an avoidable risk that should have been prevented from happening. In other words, someone is to blame. If the simple common-sense actions have not been carried out initially, then the employer is to blame. If, however, a risk assessment has resulted in the necessary preventive measures being put in place and someone has flouted them, such as by leaving a door or cupboard unlocked to avoid the inconvenience of having to keep unlocking it, then that person is to blame instead.

All members of staff have a legal obligation under the Health and Safety at Work Act to co-operate with their employer by following the policies and procedures put in place to protect all persons while on the premises. They must also take reasonable care for their own and

others' health and safety while on the premises. Failure to do so, as indicated above, will result in their possible investigation and prosecution by the HSE, and a fitness to practise hearing by the GDC, for those who are registrants.

The level of reasonable care expected to be taken for their own health and safety as an employee (and in line with fitness to practise requirements by the GDC) requires all DCPs to abide by the following when in the dental workplace:

- Undergo suitable training in the use of dental materials and equipment.
- Always follow that training when using those materials and equipment.
- Always follow all policies in relation to health, safety and welfare issues.
- Never misuse or mishandle any materials or equipment on the premises.
- In particular, never misuse or fail to use any materials or equipment that are specifically meant to reduce or eliminate hazardous risks.
- Always report any faults in procedures or equipment to a senior colleague immediately.
- Never enter certain designated 'hazardous' areas unless authorised to do so.
- Always report any suspected health problem that will affect their normal work to a senior colleague as soon as possible.

It is important, then, that a *full* risk assessment of the dental workplace is carried out and its findings reviewed on a regular basis, and that all staff follow the control measures that have been put to place, at all times. Advice and guidance are available on risk assessment generally, and in the dental workplace in particular, from both the HSE and from organisations such as the BDA. Their website addresses for further information are:

- HSE: www.hse.gov.uk

- BDA: www.bda.org.

Control of Substances Hazardous to Health 2002

Many of the chemicals and other hazardous substances used in the dental workplace can be harmful to a person's health if they are misused or if adequate precautions are not taken to prevent access by unauthorised persons. However, without these substances the business of dentistry could not be carried out, so the continued use of the chemicals under safe conditions is the desired and necessary outcome. Again, the level of risk from any of the chemicals or substances involved, those who may be harmed and the necessary precautions to take are all determined by carrying out a risk assessment.

The risk assessment process to be followed in this case is determined by the COSHH regulations, which require all dental workplaces to carry out a COSHH assessment of all the chemicals and potentially hazardous substances used in the premises in order to identify those that could harm or injure staff members. Harm may be caused if an accident occurs to expose personnel to an unusually large amount of a chemical, or if a chemical accidentally gains entry to the body (e.g. by being inhaled), or merely just by the dangerous nature of even small amounts of a chemical (e.g. mercury). The COSHH assessment process follows the usual steps of a risk assessment but the written report produced must include every potential chemical hazard found, and the following specific information:

- The hazardous ingredient(s) it contains.
- The nature of the risk, by indicating the risk category using internationally recognised symbols (Figure 4.2) and giving specific first-aid advice in European recognised symbols (Figure 4.3). These can be accessed at www.cleanright.eu.
- The possible health effects of the hazardous ingredient(s).
- The precautions required for the safe handling of the product.
- Any additional hazard control methods required for its safe use.
- All necessary first-aid or emergency measures required in the event of an accident involving the product.

New international symbols

Toxic or very toxic

Harmful or irritant

Corrosive

Longer term health hazards

Highly flammable

Oxidising

Explosive

Harmful to the environment

Compressed gas

Figure 4.2 Current symbols of COSHH risk categories.

Figure 4.3 'Cleanright' pictogram example.

Note that the design of the hazardous substance symbols has changed from the old-style orange and black to a diamond-shaped white and black pictogram with a red border, and an accompanying warning phrase beneath. The warning phrase will indicate how the substance is hazardous: toxic, harmful, corrosive or irritant as explained in Figure 4.2.

The reports are then kept in a COSHH file for quick reference and updated regularly. They should be available to the whole dental team for reference, and each staff member should sign to say they have read and understood the information. Where necessary, instruction and training for staff must also be provided if a new product is used. An example of a COSHH assessment form is shown in Figure 4.4.

THE FIRST PRINCIPLE

www.thefirstprinciple.co.uk

COSHH Assessment Form

This assessment *only addresses the risk of harm to health* from the substances listed. Additional risk assessments may be required to control the risk from other hazards associated with this work/the procedures used.

Document Control			
Assessor (Print name)		Practice Name	
Assessment Date		Dates Reviewed	

Hazards Identified							
Substance/Manufacturer							
Hazardous Properties							
Hazard Classification http://www.hse.gov.uk/chemical-classification/labelling-packaging/hazard-symbols-hazard-pictograms.htm							
Other Hazards							
Quantity to be used							
Emergency Procedures	• Eye contact: • Inhalation: • Skin contact • Ingestion: • Spill procedure:						
What will the chemical be used for?							
Who may be exposed?							
Level of Risk under normal working conditions?	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH		
Other comments:							

Figure 4.4 Example of COSHH assessment form.

The COSHH assessment follows the usual steps of a risk assessment, with pertinent points to be determined as detailed below for each substance used in the dental practice, ranging from specific dental materials through to general cleaning agents. Useful HSE information and specific guidance on COSHH assessment is available in the publication *A step by step guide to COSHH assessment* (accessible at www.hse.gov.uk).

- **Identify those substances which are hazardous**: by reading the manufacturers' leaflets and instruction sheets enclosed with the product, or shown on the label.
- **Identify who may be harmed**: this is likely to be anyone who uses the substance, although public access must be taken into consideration too.
- **Identify how they may be harmed**: is the product hazardous on skin contact, or by inhaling fumes, or an eye irritant?
- **Evaluate the risk**: is the substance only harmful if misused, or is it harmful with every use? Any substance with stated workplace exposure limits (WELs) is hazardous to health if the exposure limit is exceeded, even when not misused.
- **Determine whether health monitoring is required**: for example, during exposure to mercury, or nitrous oxide gas used in inhalation sedation as a conscious sedation technique (see Chapter 14).
- **Control the risk**: by ensuring the substance is not misused, by providing suitable PPE, or reducing the risk as far as possible if it is harmful with every use. This may involve changing the product if the potential risk is considered too great.
- **Inform all staff of the risks**: by staff meetings, introduction of the COSHH sheets to be read and signed by all team members, and training in safe use and handling techniques where necessary.
- **Record the risk assessment**: keep documented evidence that the assessment has been carried out, with review and update dates recorded as necessary.

While the student dental nurse is an integral part of the risk assessment procedure as a member of staff, it is likely that more senior dental nurses may take over the role of carrying out COSHH assessments, maintaining the COSHH files and updating them as necessary, once suitable and documented training has been given. However, all student dental nurses must receive health and safety information covering these issues as part of their induction training with their employer.

Some general safety points with regard to hazardous substances likely to be found in the dental workplace, and specific information on the following occupational chemical hazards, are given below.

- Mercury exposure (see also Chapter 15).
- Acid etchant (see also Chapter 15).
- Sodium hypochlorite and other disinfectants (see also Chapter 8).
- Nitrous oxide exposure (see also Chapter 14).

Storage

All chemicals should be stored in cupboards away from public access, with separate fire-resistant locked storage facilities available for inflammable substances and poisons. The manufacturer's instructions will indicate the ideal storage temperature required, and this is usually room temperature (20 °C) or cooler, which is provided by refrigeration. Mercury must be stored in a cool cupboard in properly sealed containers.

Oxygen and nitrous oxide cylinders, used for treating patients under conscious sedation, should ideally be stored outdoors but if this is not possible a well-ventilated fire-resistant store should be used. Larger cylinders should be secured in an upright position so that they cannot fall over and puncture, or harm someone. An appropriate trolley should be available for moving heavy cylinders.

The exception to these storage requirements is emergency oxygen cylinders, which must always remain in easy-access locations throughout the dental workplace, at all times.

Ventilation and temperature control

Suitable ventilation in the dental workplace can be achieved simply by having windows open or by the use of extractor fans positioned so that they do not exhaust directly onto any passers-by. Air-conditioning units may also be installed, but the correct location of their vents and adequate system maintenance are crucial to prevent the risk of passers-by contracting Legionnaires' disease. Units that use recycled air are not recommended for the dental workplace, as they will allow any airborne contamination to cross-infect other persons.

Where nitrous oxide gas is used during inhalation sedation, the waste gas must be removed by a suitable scavenging system to prevent the build-up of harmful levels of the gas in the surgery. Conscious sedation is covered in Chapter 14.

In summary, then, adequate ventilation is essential to prevent the accumulation of hazardous vapours and gases, and therefore to minimise any risk of harm from them. This is particularly relevant to dangerous or irritant vapours from mercury, some disinfectants, nitrous oxide and some laboratory chemicals.

The temperature within the dental workplace is usually maintained by the central heating system in cooler months and by adequate ventilation throughout the summer. While the minimum working temperature should be no less than 16 °C, there is no maximum temperature above which work should stop. However, higher temperatures usually allow for a greater volume of vapours, gases and fumes to develop, so in warmer periods the ideal is to maintain a temperature of around 20 °C – this is called 'room temperature'.

Hazardous occupational chemicals

Mercury

Mercury is a liquid metal that is mixed with various metal powders to form dental amalgam, a material used to fill teeth. It is classed as a hazardous substance because it is toxic, and it can enter the body in the following ways:

- **Inhalation**: toxic vapours are released from uncovered sources at room temperature and above, and are particularly hazardous because they are colourless and odourless and therefore difficult to detect.
- **Absorption**: particles can be absorbed through the skin, nail beds and eye membranes, and eventually become lodged in the kidneys.
- **Ingestion**: particles can contaminate foodstuffs and drinks, and be taken into the digestive system and eventually lodge in the kidneys.

Dental amalgam has been the material most commonly used to fill posterior teeth in the UK for many years, so mercury is present in significant amounts in the majority of dental workplaces. However, the World Health Organization (WHO) agreed at the Minimata Treaty in 2017 to reduce the amount of mercury in the environment over the coming years and this will have an impact on the use of amalgam as a dental restorative material in the UK. Indeed, in July 2018 the use of amalgam as a dental restorative was banned in deciduous teeth, in permanent teeth of children under 15 years of age, and in pregnant and nursing mothers in the UK, unless deemed necessary due to the specific medical needs of the patient.

Other changes that are due in relation to the use of amalgam in dentistry over the next few years in line with the Minimata Treaty include the following:

- January 2019: all amalgam to be used in pre-dosed encapsulated form only.
- January 2019: use of amalgam separators becomes mandatory.
- January 2019: separators installed in the previous 12 months must retain a minimum of 95% amalgam particles.
- January 2021: all separators must retain a minimum of 95% amalgam particles.
- Evidence that all amalgam waste is handled and collected by an authorised waste management establishment.

- July 2019: UK must put forward its national plan to implement the phase-down in the use of dental amalgam.

Currently, exposure to the hazards mercury poses cannot easily be avoided in the dental workplace while the use of dental amalgam continues, but the risks can be minimised by following simple rules designed to limit the chances of staff contact.

Inhalation

- Ensure that the workplace is adequately ventilated and kept at a reasonable working temperature, so that fumes do not build up.
- Avoid placing mercury and waste amalgam near heat sources (including sunny windowsills), as more fumes are given off at higher temperatures.
- Use capsulated amalgam so that bottles of mercury do not have to be stored on the premises.
- Store all waste amalgam in special sealed tubs containing a mercury absorption chemical (Figure 4.5).
- Similarly, used amalgam capsules must be stored in special sealed tubs, as it is likely that tiny amounts of mercury will remain in them after use (Figure 4.6).
- Ensure every trace of amalgam is removed from instruments before they are sterilised in the autoclave, otherwise fumes will be released as the autoclave heats up.
- If a mercury spillage occurs, wear appropriate PPE (see Chapter 8) including a facemask, to avoid inhalation.

Figure 4.5 Waste amalgam storage tub.


Cap Guard
Chairside
Capacity 300 Capsules
Disposable Dappens Dishes and
ONLY TO BE COLLECTED
BY INITIAL MEDICAL SERVICES
AMT
MERCURY VAPOUR SUPPRESSANT
United Nations X-Class Certified Container

Figure 4.6 Waste amalgam capsule storage tub.

Absorption

- Always wear the correct PPE when handling amalgam capsules and waste amalgam, to avoid skin, nail and eye contact.
- Open-toed shoes must not be worn in the surgery area, to avoid absorption through the feet if any amalgam or mercury is spilled.
- Always wear safety goggles or a face visor when old amalgam fillings are being removed, so that stray specks do not enter the eyes.
- If a mercury spillage occurs, wear gloves and safety goggles to avoid skin or eye contact.

Ingestion

- Food and drink must never be consumed in the surgery environment.
- Stocks of mercury and amalgam capsules must not be stored within the staff rest room.
- Waste amalgam containers must not be stored within the staff rest room.

Handling of mercury spillages

The use of capsulated amalgam products will limit the likelihood of a large mercury spillage, but the capsules themselves can potentially leak or rupture during use, releasing liquid mercury into the environment although on a much smaller scale.

All spillages of mercury, no matter how small, must be reported to the senior dentist and recorded in the workplace accident book (Figure 4.7). This will provide a written record of any accident or incident that has occurred on the premises, and that could have potentially harmed someone. It must include details of the following:

- the date and location of where the accident/incident occurred
- who was affected

- the names of any witnesses
- details of the accident/incident
- actions taken to assist those affected.

Once completed tear along perforation and store securely.

Report Number

Accident Report Book

1 Person affected/injured

Name

Home Address

Postcode

Occupation

Works No.

2 Person reporting the incident - if other than injured person

Name

Home Address

Occupation

Postcode

Department

Date / /

3 Accident/incident

Date / /

Time

Place/Room

Equipment/machinery involved

4 Description of incident - including cause and nature of injury

Action taken/recommendations

Signed

Date / /

Employer please initial box if accident reportable under RIDDOR

(Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995)

Figure 4.7 Page from Accident Report Book.

In the unfortunate event of any long-term health effects, this report will provide valuable evidence about whether correct procedures were followed, and whether the accident/incident was unavoidable or not.

If mercury is spilled, it tends to form into liquid globules or small balls. In this shape, the liquid can easily roll around and be difficult to pick up; indeed, larger globules often break into smaller ones when attempts are made to handle them. The correct actions to take after a mercury spillage are therefore very important in order to prevent further contamination and spread into the workplace environment.

If a small spillage occurs:

- wear suitable PPE
- suck up small globules into a dedicated bulb aspirator or a disposable plastic syringe (Figures 4.8 and 4.9)
- put the particles into the waste amalgam special waste container.

Figure 4.8 Loose droplets of spilled mercury.

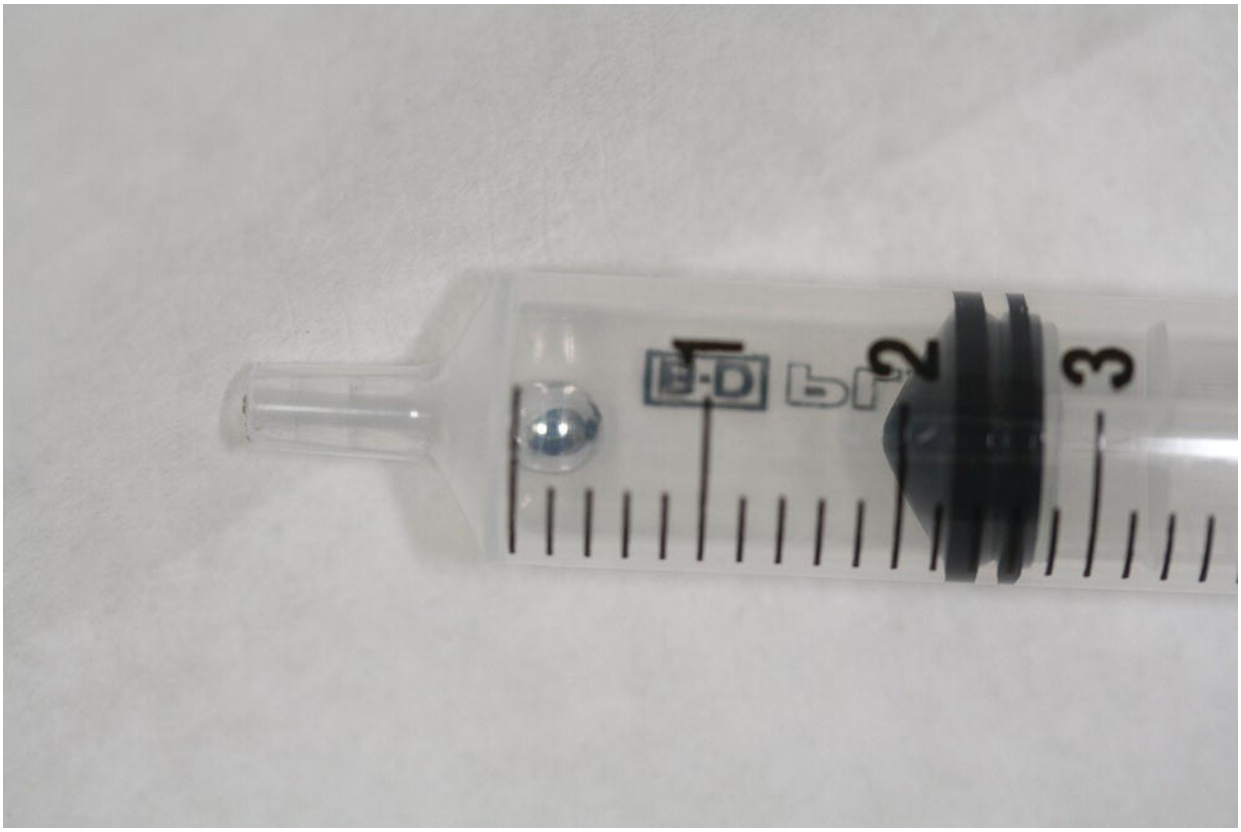

Figure 4.9 Droplet collection in syringe.

Never use the dental suction unit or the cleaning hoover to suck up spilt mercury – their use will release toxic mercury vapours into the workplace. Alternatively, the lead foils present in intraoral X-ray film packets can be used to gather the globules together and scoop them up.

To avoid the release of small mercury globules into the workplace during the mixing of amalgam, the amalgamator machine should have a closable lid and be stood on a foil tray to collect any mixing spillages without them contaminating the workplace (Figure 4.10). Any globules collected by these methods can be simply tipped into the waste amalgam store.


LINEA TAC
Memoria 0 = sec. 6 → IQC Palladium / Contour
Memoria 1 = sec. 6 → IQC Valiant / Dispersalloy
Memoria 2 = sec. 10 → Axia Glass / Amalcap
Memoria 3 = sec. 10 → Axia Base
Memoria 4 = sec. 10 → Axia Silver
Memoria 5 = sec. 5 → Tylin
Memoria 6 = sec. 7 → Duralloy/Ana 2000/Permite C
Memoria 7 = sec. 8 → Astralloy PD / 45
Memoria 8 = sec. 15 →
Memoria 9 = sec. 20 →
Tempi indicativi in sec. per 2 dosi ±1
HENRY SCHEIN®
CAP II
+
-
S
START
07
M

Figure 4.10 An amalgamator with raised lid and standing on foil-lined tray.

If a larger spillage occurs:

- wear suitable PPE
- open windows to ventilate the area
- inform senior staff
- use the contents of the mercury spillage kit to control the spread of the spillage (Figure 4.11)
- mix the powders of flowers of sulphur and calcium hydroxide with water to make a paste, and paint this around the spillage to contain it
- the remaining paste can be painted over the spillage
- once dry, the contaminated paste and spillage are wiped up thoroughly with damp paper towels, and disposed of in the waste amalgam store.

Figure 4.11 Mercury spillage kit contents.

If the size of the spillage is significant, such as a full bottle of mercury or if globules have rolled into inaccessible areas, the work area must be sealed off and closed down. The HSE must be informed of the spillage and the local environmental health team will attend to clear away the contamination professionally and safely.

Acid etchant

This material is used during the placement of composite (tooth-coloured) fillings, to chemically roughen the enamel tooth surface and ensure adequate bonding of the filling material to the tooth. As the name suggests, it is acidic and can therefore chemically burn soft tissues, such as within the patient's mouth or the skin of those handling the substance. The material itself is 33% phosphoric acid, in either a liquid or gel form (Figure 4.12).

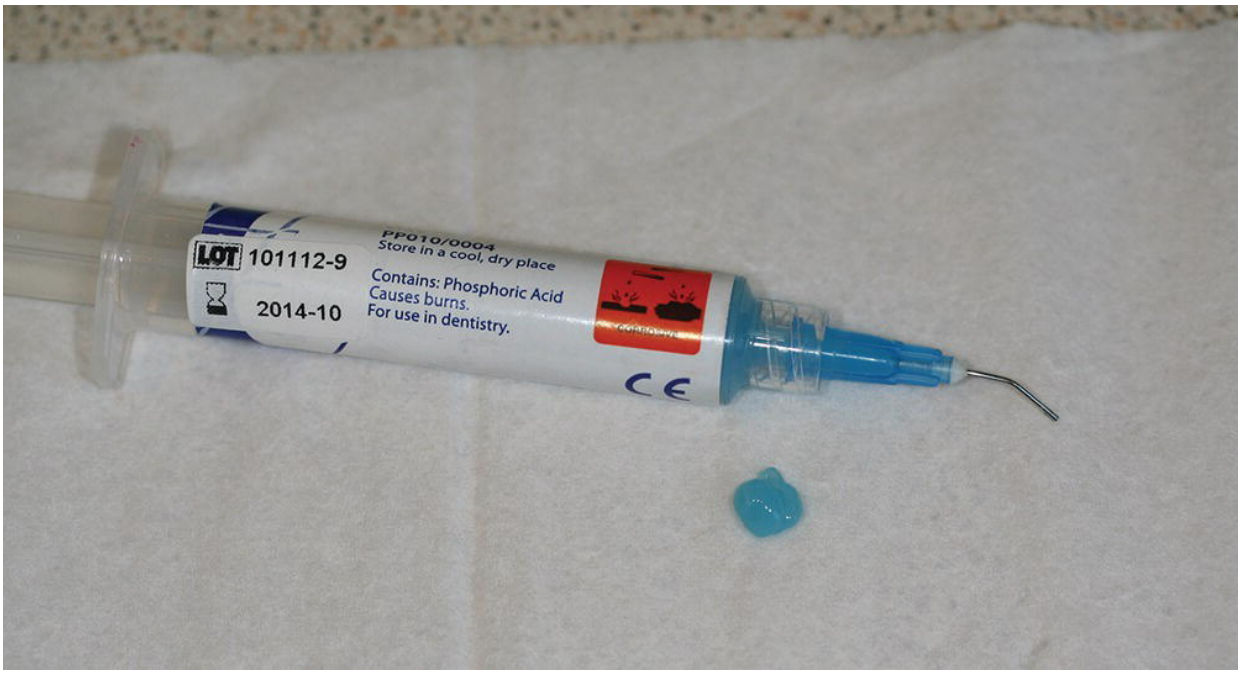

Figure 4.12 Acid etchant gel in dispensing syringe.

All staff handling the etchant must be wearing the correct PPE, and when placed within the patient's mouth the material must be confined to the tooth undergoing restoration, ideally by the use of rubber dam (see Chapter 15). Very careful aspiration must be used while the material is washed off the tooth, so that it does not fall elsewhere and burn the patient's oral mucosa. To aid this, the acid etchant is usually brightly coloured so that it is easily visible, for instance some manufacturers produce a bright pink liquid, others a bright blue gel. The manufacturer's instructions for use will show the necessary symbol indicating a hazardous substance, and will provide details of the first-aid actions to take if an accident occurs, in accordance with COSHH regulations.

Sodium hypochlorite (bleach) and other disinfectants

All disinfectants have a major role to play in the decontamination of work areas and fixed equipment in the dental practice (see Chapter 8). Bleach, which is sodium hypochlorite, is used in many situations.

- Fresh solution of 10,000 parts per million (ppm) (approximately 1%) to disinfect all non-metallic, non-fabric surfaces within the surgery.

- Fresh solution (as above) to disinfect impressions and removable prostheses before transferring between the patient and the laboratory.
- Fresh solution from the body fluid spillage kit (Figure 4.13) to clean away blood spillages (or other body fluids) within the surgery.


biohazard kit
Body Fluid
Clean-up
reliance
medical
biohazard body fluid
single application
clean up kit

Figure 4.13 Body fluid spillage kit contents.

Bleach has an unpleasant taste and smell, and is chemically irritant to soft tissues. It can cause tissue damage to the mouth and digestive tract, the eyes and lungs if strong vapours are inhaled. Appropriate PPE must be worn whenever it is handled, and fresh solutions made daily for the uses indicated above should be held in lidded containers, so that the noxious chlorine vapours do not become overpowering.

Disinfectant bottles of any solutions used will show the necessary hazardous substance symbol, and give the necessary first-aid actions in the event of an accident, in line with current COSHH regulations (Figure 4.14).

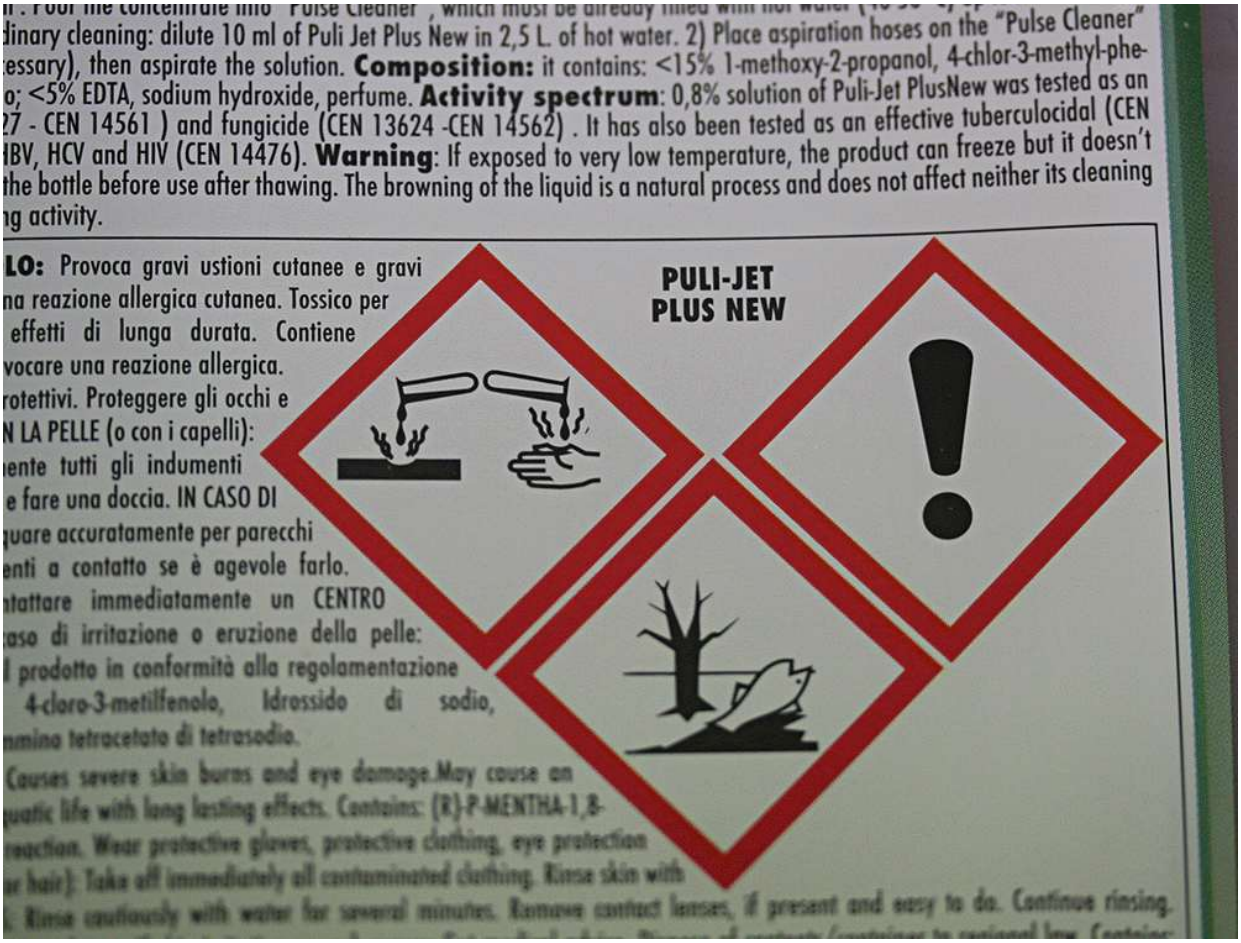

Figure 4.14 Hazardous substance label.

Other disinfectants

With the major emphasis on robust infection control in all healthcare environments nowadays, exposure to many types of disinfectant is the norm throughout the working day for all staff. Some disinfectants can irritate skin, airway and eyes when used carelessly, while others can cause irritation or initiate hypersensitivity or even allergic reactions in staff no matter how low their exposure to the disinfectant. PPE consisting of gloves, mask and glasses should be worn when handling them and working areas must be well ventilated to avoid irritation of the airway. Manufacturers' instructions must always be followed, in particular the first-aid advice recorded in the COSHH file in the event of an accident.

Hazardous Waste Regulations 2005

As producers of healthcare waste, all dental workplaces have a statutory duty of care to ensure that they avoid cross-infection of people and cross-contamination of the environment by managing and disposing of all healthcare waste properly. The current regulations that apply are based on the dental sector guide of the Department of Health's *HTM 07-01: Safe management of healthcare waste* (2013), in conjunction with the Environment Agency. This document sets out the required segregation of healthcare waste using a colour-coding system which applies to all waste producers, whether hospitals, dental or medical clinics, pharmacies or individual dental practices.

Healthcare waste must be segregated appropriately for the following reasons:

- Health and safety of all persons handling the waste:
  - certain items may cause injury while being handled, such as sharps
  - certain items may be infectious and cause cross-infection
  - certain chemicals may damage the environment
  - certain medicines may be toxic or carcinogenic (cause cancer).
- Ensure the waste is correctly packaged so that it can be transported safely to a recovery and/or disposal site.
- Ensure the waste is taken to a disposal site with the correct facilities for handling, recovering or disposing of it safely.
- Ensure the safe recovery or disposal of the waste by the correct method at the facility.

The use of a universal colour-coding system enables all personnel to be aware of the contents of the various containers used to collect and store the waste, without having to open bags or tubs to determine their contents and risk exposing themselves to harm. Therefore, it is important for each dental workplace, or their authorised waste

management company, to have carried out a pre-contract hazardous waste audit to determine the following:

- The categorisation of all waste produced by the dental workplace into:
  - hazardous infectious waste (list all items)
  - hazardous chemical waste (list all items)
  - non-hazardous waste (list all items).
- Details of the segregation of each type of waste (include information on the specific bags/containers to be used for each type of waste and how they will be marked to identify the waste producer).
- Details of the storage process for each waste category (include information on where items are stored on the premises and their respective collection agents).

Using the above information, a healthcare waste policy for the dental workplace can be developed and instigated so that all staff become familiar with it and are able to refer to it as necessary. It should contain the following information:

- name of the person responsible for healthcare waste on the premises (usually the senior dentist or business owner)
- how healthcare waste is classified and segregated (this must be in line with HTM 07-01 requirements)
- how healthcare waste is stored on the premises (this must be securely and with access for staff only)
- arrangements for collection and record keeping (this should provide a paper trail of all healthcare waste produced on the premises, and for the requisite time periods).

Waste classification

Dental workplaces produce a wide range of both hazardous and non-hazardous wastes, and in order to segregate the waste correctly it must first be identified and then classified in line with the current

regulatory guidance. The legislation that sets out which wastes must be classed as hazardous is contained in the Hazardous Waste Regulations 2005.

The current classification and colour coding of waste produced in the dental workplace is shown in Figure 4.15, with three broad types and various subtypes requiring segregation and storage on the premises.

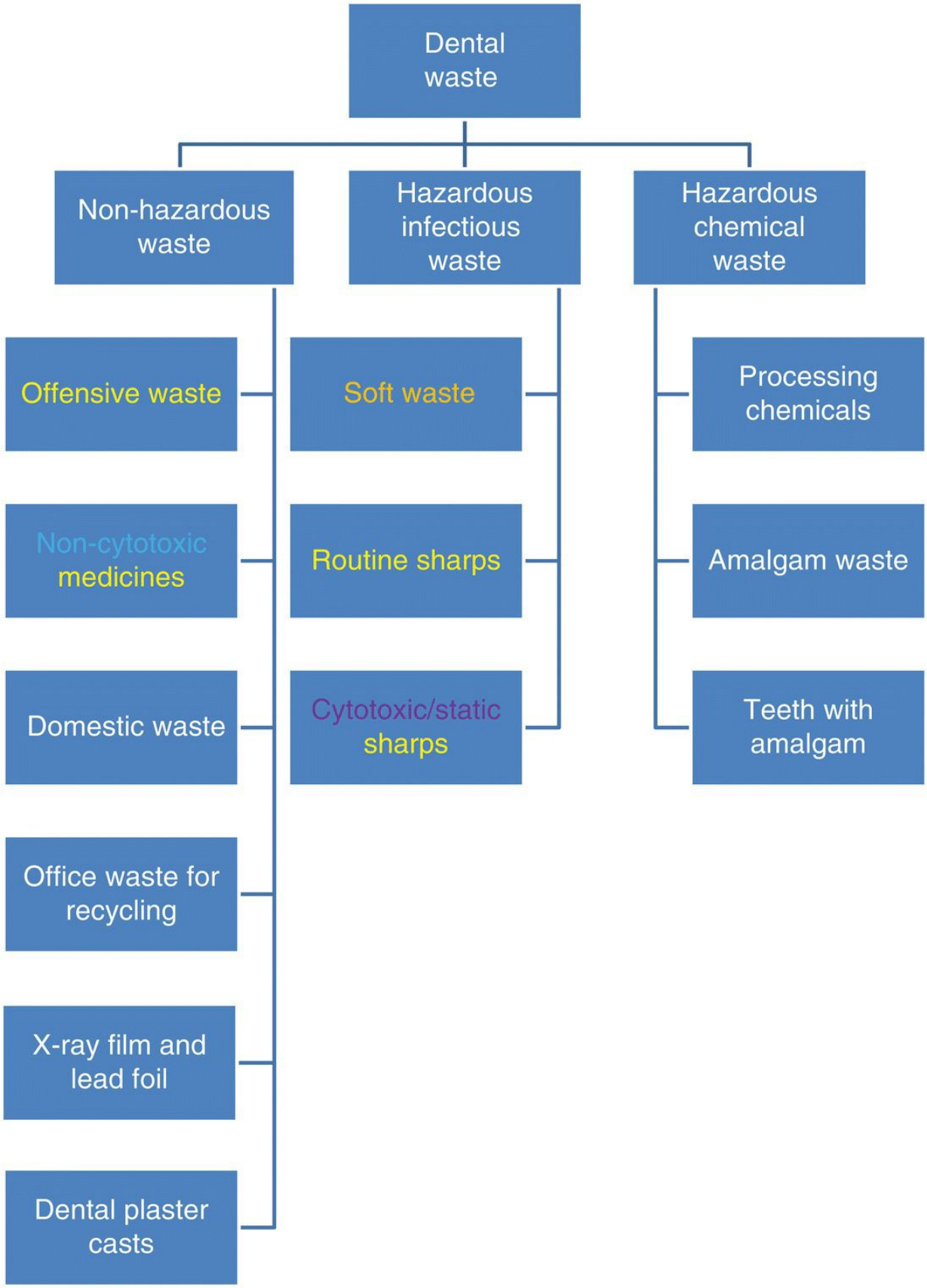
Dental waste
Non-hazardous waste
Hazardous infectious waste
Hazardous chemical waste
Offensive waste
Non-cytotoxic medicines
Domestic waste
Office waste for recycling
X-ray film and lead foil
Dental plaster casts
Soft waste
Routine sharps
Cytotoxic/static sharps
Processing chemicals
Amalgam waste
Teeth with amalgam

Figure 4.15 Waste classification categories with colour coding.

Non-hazardous waste

- Offensive waste: non-contaminated PPE, wipes and sanitary hygiene products (yellow bag with black stripe through).
- Non-cytotoxic/cytostatic medicines: out-of-date dental stock including antibiotics and analgesics (yellow or blue tub with blue lid – Figure 4.16).
- Domestic waste: staffroom and kitchen (black bag).
- Office waste: shredded paper, cardboard, plastics; should be sent for recycling.
- X-ray film and lead foil: separate white-lidded containers; both are sent for metal recovery (silver and lead, respectively).
- Dental plaster casts: study models and working models; these give off hydrogen sulphide gas if disposed of as normal landfill, so either recovery of gypsum or special landfill disposal (white-lidded container; Figure 4.17).

Figure 4.16 Non-cytotoxic/cytostatic medicines waste container.

Figure 4.17 Dental plaster casts waste container.

Hazardous waste (infectious)

- Bagged clinical (soft) waste: used or body fluid contaminated PPE, wipes, surface covers (orange sack, Figure 4.18).
- Sharps waste: routine surgery needles, blades, cannulas, endodontic instruments, burs, metal matrix bands, used local anaesthetic cartridges, teeth without amalgam present (yellow-lidded rigid container; Figure 4.19).
- Sharps waste uncontaminated with medicines (England and Wales only); Scotland and Northern Ireland may also use for fully discharged medicinal sharps (yellow rigid container with orange lid).
- Sharps waste contaminated with cytotoxic or cytostatic medicines: Botox administration equipment (yellow rigid container with purple lid).


CLINICAL WASTE
UNSPECIFIED N.O.S.
UN 3291
6
bpl.healthcare
5H4/Y10/S/12/GB/5883
NHS
PROPERTY
CLINICAL WASTE FOR
ALTERNATIVE TREATMENT
OR INCINERATION
HEAVY DUTY
NHS
PERFORMANCE
APPROVED
UN APPROVED WEIGHT 10 KGS
USE APPROVED CLOSURE METHOD
WARD/DEPT
DATE
IF FOUND TELEPHONE
ADDITIONAL INFORMATION
CLINICAL WASTE
UNSPECIFIED N.O.S.
UN 3291
6
This bag has NOT PASSED the tests for bulk transport
defined in 7.3.2.6.2 (c) (RID/ADR) and 4.3.2.4.2.3 (IMDG Code).
Not to be used for the transport of Radioactive Material.
bpl.healthcare
5H4/Y10/S/12/GB/5888

Figure 4.18 Orange soft hazardous waste sack.


WARNING DO NOT FILL ABOVE THE LINE
DANGER
DESTROY BY INCINERATION
OR OTHER SUITABLY AUTHORISED PROCESS
UN 3291 Clinical waste
Unspecified, N.O.S.
CONTAMINATED
SHARPS ONLY
SHARPSGUARD® yellow 5
EWC 18-01-01, 18-01-03, 18-01-09
EWC 18-02-01, 18-02-02, 18-02-08
Assembled by..... Date.....
Closed/Disposed by..... Date.....
Hospital..... Area/Dept/Ward.....
6

Figure 4.19 Non-cytotoxic/cytostatic sharps container.

Hazardous waste (chemicals)

- X-ray processing chemicals: developer and fixer solutions (rigid sealed containers, no colour specification; Figure 4.20).
- Amalgam waste: amalgam and mercury, spent and out-of-date capsules, amalgam separator slurry (white rigid container with lid and mercury suppressant; see Figures 4.5 and 4.6).
- Teeth with amalgam fillings: may be placed with amalgam waste or have separate white-lidded container provided with mercury suppressant.
- Certain electrical items and batteries: refrigerators and freezers release Freon gas that is harmful to the ozone layer and must be disposed of by a suitably registered waste contractor, while fluorescent light tubes, cathode tubes and some batteries also contain environmentally harmful chemicals if not disposed of correctly.

Figure 4.20 X-ray processing chemicals storage drums.

Waste management

In accordance with the Environmental Protection Act 1990, the duty of care is with the dental workplace to ensure that its healthcare waste is managed and disposed of safely and correctly. To comply fully, every dental workplace must ensure that it:

- has a written healthcare waste policy in place (see previously)
- gives staff access to the policy, and gives recorded training in correct waste management methods
- segregates waste in accordance with Figure 4.15 and stores it safely while on the premises, away from public access
- uses the correct storage containers for each waste category so that the contents are correctly recovered or disposed of (see above)

- correctly labels each hazardous waste and medicinal waste container to identify both the nature of the waste and the details of the dental workplace
- securely fastens orange waste bags at the neck with a robust identification tag so that they cannot burst open during travel
- only uses licensed waste collectors for removal and disposal of the waste at an authorised recovery and/or disposal site
- arranges waste collections at no longer than 12-month intervals
- accurately describes the container contents of all non-hazardous waste on transfer notes, which must be kept for a minimum of 2 years from the date of collection
- accurately describes the container contents of all hazardous waste on consignment notes, which must be kept for a minimum of 3 years from the date of collection
- receives and keeps the quarterly 'consignee returns' documentation which records the final destination of the hazardous waste consignment, and its disposal details
- registers with the Environment Agency as a hazardous waste producer if more than 500 kg of hazardous waste is produced annually.

Waste disposal

For quick and easy identification of each category of waste produced in the dental workplace, various colour-coded containers are used to help segregate the various items, as detailed previously. In addition, on all documentation the European Waste Catalogue (EWC) codes should be used; details of these codes are not relevant to the student dental nurse.

However, the containers and the EWC codes are used to determine the safe method of disposal of the healthcare waste and, in the case of some of the chemicals used, their safe method of recovering various constituents for reuse or sale. A summary is given below.

- Clinical waste incineration only: yellow-, blue- and purple-lidded yellow containers.

- Alternative treatment (such as specialist autoclaving) or clinical waste incineration: orange sacks and orange-lidded yellow containers.
- Municipal incineration, landfill or energy production from waste: black sacks, yellow and black striped sacks (although office waste should be considered for recycling).
- Chemical recovery for reuse or sale: white containers (amalgam, processing chemicals, lead foil, X-ray film).
- Chemical (gypsum) recovery or specialist landfill: white dental plaster cast containers.

Waste handling training and audit

All dental personnel who are likely to be involved in handling any healthcare waste must be correctly trained to do so. The training should cover all the following points:

- Risks associated with each category of waste (e.g. sharps injury, exposure to toxic vapours, cross-infection).
- Correct classification, segregation and storage procedures, in line with the healthcare waste policy of the workplace.
- COSHH information on all hazardous waste chemicals used on the premises.
- Safe handling, including the use of appropriate PPE and moving techniques.
- Correct procedures in the event of spillages or accidents.
- Correct completion of relevant documentation (transfer notes and consignment notes).

To ensure that the dental workplace is providing the correct training for its employees, monitoring its waste practices against the required standards, and discharging its duty of care with regard to healthcare waste, regular waste audits should be carried out. The audit cycle is described in Chapter 3.

In particular, the audit should focus on the types of healthcare waste produced (any unexpected waste production that was unforeseen), the use of waste containers (correct or not), the labelling of the containers (correct or not), content descriptions (correct or not), and whether the transfer or consignment notes accurately describe the healthcare waste they refer to each time they are completed. By carrying out the waste audit, the workplace can demonstrate that it has discharged its duty of care by correctly describing and packaging its healthcare waste, or it will have uncovered errors in the waste handling systems which can then be acted upon and corrected. This demonstrates good management and governance within the workplace.

Health and Safety (Display Screen Equipment) Regulations 1992

The use of computers in the dental workplace is now commonplace and the majority of staff will access patient details and workplace information via a computer on a daily basis. Problems may arise when the staff member has to sit viewing a screen for prolonged periods of time, so employers are required to make certain provisions under the Health and Safety (Display Screen Equipment) Regulations, to avoid muscle strain, fatigue, eyestrain and headaches. The regulations apply to all employees who are classed as display screen equipment (DSE) users, where most or all of the following criteria apply:

- The employee's work cannot be carried out effectively or at all without the use of DSE.
- The employee has no choice over whether to use DSE during their work.
- The work they carry out requires significant training or particular skills, so it cannot be delegated and carried out by others.
- The DSE is in use on a daily basis and for an hour or more continuously.
- The work requires the accurate transfer of information between the employee and the DSE.
- Visual attention and mental concentration demands are high while carrying out the work using the DSE, as there may be significant consequences if an error occurs (such as incorrect charting resulting in the extraction of the wrong tooth, for example).

A workstation risk assessment should be carried out for all users of DSE in the workplace to determine who is likely to suffer from the problems listed above, and how they can be prevented. Simple points to be considered are shown below.

- Adequate workstation training for staff, including correct posture and the use of any devices to prevent problems occurring,

especially the use of comfortable chairs which are height adjustable and ideally on wheels for easy manoeuvrability.

- Workstation issues: adequate surface space to work without being cluttered, adequate legroom, mouse pads with wrist support where necessary, and footrests either on the chair or as a separate plinth to prevent leg and foot strain where necessary.
- Display screen issues: suitable size screen (not too large or small) with adjustable contrast and brightness controls, use of anti-glare screens over the DSE where necessary, clean screen and functioning correctly with no flickering, use of suitable font and letter size that is easy to read.
- Regular breaks from the workstation, so that muscles and eyes have relaxation periods: short frequent breaks are better than long but infrequent ones.
- Eyesight tests for staff who experience headaches and eyestrain after DSE use, and the provision of spectacles (by the employer) which are specifically for display screen work if necessary.

The results of the eyesight test cannot be disclosed to the employer without the consent of the employee.

Health and Safety (First-Aid) Regulations 1981

In addition to the identification of the signs and symptoms of the medical emergencies that may occur in dental practice and their correct management (see Chapter 6), the workplace must have adequate provision to administer first aid when necessary too. The extent of the provisions required will depend on the number of staff in the premises at any time, although there is no legal requirement to provide first aid treatment and facilities for non-employees, including patients.

The risk assessment process carried out to comply with general health and safety requirements should identify the hazards and risks associated with the workplace itself, and the occupational hazards associated with the business of dentistry. The hazards and risks identified will determine the extent of the first-aid provision that is required for the premises and the employees.

In line with clinical governance guidelines (see Chapter 3), every practice must comply with the following requirements:

- All staff must be trained and certificated in BLS (see Chapter 6).
- All workplaces with more than five employees should have at least one person trained in emergency first aid.
- All practices must have a first-aid kit available, besides the full range of emergency drugs and emergency oxygen cylinders required under clinical governance guidelines.
- All practices must have an accident book (see Figure 4.7), which is used to record all except major accidental events that occur on the premises to staff, patients or visitors.
- In the event of a medical emergency, the dental team must be able to reassure and help the casualty until the professionals arrive, and this may include BLS to maintain life if necessary.

The first-aid kit that must be present in the dental workplace should be placed in an easy-access and signposted location. Regulations stipulate that it should be a green box with a white cross or state conformity to the current British Standard, and should contain

minimum requirements with regard to sterile dressings, eye pads, bandages, sterile water or saline pouches, etc. (Figure 4.21).

Figure 4.21 First-aid box with contents.

Specific training for emergency first aid is available for any staff and is provided by various organisations, including the British Red Cross and St John Ambulance. Other providers are also now available as HSE approval and certification is no longer required by the training course providers. Dentists are not qualified as first aiders unless they have undertaken appropriate training with a suitable course provider.

The first-aid emergencies that should be covered are listed below and summarised in the following sections. See also Chapter 6 for further information on collapse and BLS, and information on managing a choking casualty.

- Severe bleeding
- Burns and scalds
- Poisoning

- Electrocution
- Bone fractures

Severe bleeding

- The first-aid principle is to *restrict the blood flow to the wound and encourage clotting to reduce blood loss*.
- Arterial bleeding will spurt rhythmically and be cherry red in colour.
- Venous bleeding will gush quickly and be dark red or purple in colour.
- Capillary bleeding will ooze slowly and be dark red in colour.
- The required treatment is to raise the injured part above the level of the heart if possible, and apply direct pressure to the wound for up to 15 minutes using a clean dressing.
- Any foreign objects present should not be removed from the wound.
- As a last resort, severed arteries can be compressed against the underlying bone for up to 15 minutes, using a tourniquet.
- The casualty should be removed to hospital once the bleeding is under control, or the emergency services should be called if it cannot be controlled.

Possible causes of severe bleeding in the dental workplace include unexpected surgical trauma, traumatic falls, severe sharps injury, etc.

Burns and scalds

- A **burn** is an injury caused by dry heat (such as a flame), corrosive chemicals (such as strong acids) or irradiation (such as X-rays).
- A **scald** is a wet burn caused by steam or hot liquids.
- The first-aid principles are to *prevent infection* of the underlying tissues and to *prevent clinical shock developing* due to the loss of

blood serum.

- The required treatment is to remove the casualty from the source of danger if possible, and to reassure them if they are still conscious.
- The injured part should be placed under cold water for a minimum of 10 minutes to reduce blistering.
- Any restrictive jewellery should be removed before any swelling occurs if possible, but clothing should be left in place as its removal may cause tearing of the tissues.
- Seek medical help for all but minor burns or scalds, and be prepared to carry out BLS if the casualty collapses due to clinical shock, which may develop in severe cases.

Possible causes of burns in the dental workplace include touching hot equipment or instruments, touching naked flames, direct contact with various chemicals (etching gel, bleach products, other cleaning agents) and uncontrolled or excessive exposure to X-rays.

Poisoning

- The first-aid principle is to *limit the exposure of the casualty to the poison*, and maintain life if necessary.
- Consult any available COSHH documentation immediately for the required first-aid advice.
- The required treatment is to remove the casualty from the source of the poison, without endangering other lives.
- Where vapours are the cause, provide good ventilation of the area immediately.
- Vomiting should not be induced in the casualty, as caustic poisons will burn the digestive tract each time they pass through.
- Maintain the airway, possibly with the use of an oropharyngeal airway device, and carry out BLS if necessary.
- Seek urgent medical help.

Possible causes in the dental workplace include the ingestion or inhalation of various agents, such as corrosive chemicals (bleach products and acids), toxic chemicals (cleaning agents, processing chemicals, mercury), and toxic vapours (processing chemicals, mercury, gases such as butane from heaters and nitrous oxide used for conscious sedation).

Electrocution

- This is caused by an electrical current passing through the body, causing burns and possibly affecting the electrical conduction of the heart itself.
- The first-aid principle is to *remove the casualty from the electrical source and maintain life until help arrives*.
- The required treatment is to isolate the electrical supply if it is safe to do so, treat any surface burns and minimise the effects of clinical shock.
- The casualty should not be touched by the rescuer until the electrical source has been isolated, otherwise the rescuer could be electrocuted too.
- Treat any surface burns, as described above.
- Carry out BLS if necessary.
- Seek urgent medical help.

Possible causes in the dental workplace are any faulty electrical equipment, including portable appliances.

Fractures

- A fracture is a break of a bone, either contained within the surrounding soft tissues or puncturing through them to cause a compound fracture, where the bone ends are visible and soft tissue damage is severe.
- The first-aid principle is to *prevent further tissue damage by restricting the movement of the casualty*.

- The required treatment is to not move any injured part of the body, to cover any open skin wounds with clean dressings, and control bleeding as necessary.
- Seek urgent medical help.

Possible causes in the dental workplace are external trauma or a fall, although violent assault of a person may also be a cause.

Basic life support techniques and medical emergencies are covered in detail in Chapter 6.

Manual Handling Operations Regulations 1992

Manual handling is the term used to describe any actions which involve the hands-on moving or lifting of items (including patients) without the support of lifting equipment or other mechanical devices. It should be avoided wherever possible in the workplace, as regular manual handling often results in the onset of musculoskeletal strain and injuries which cause prolonged absence from work; indeed, manual handling injuries result in more work absences than any other cause. Consequently, all staff should undergo regular training and update in this area as part of their CPD, and suitable courses are available at www.isopharm.co.uk.

The regulations set out the duties of both employers and employees to avoid manual handling incidents and injuries, and those of employers are as follows:

- Avoid the need for hazardous manual handling in the workplace, as far as is reasonably possible.
- Where manual handling cannot be avoided, a risk assessment must be carried out to determine the likelihood of injury occurring.
- The identified risks of injury from manual handling must be reduced as far as possible.

In the majority of dental workplaces, the usual manual handling that occurs is the transport of boxes containing stock items or the movement of waste containers in and out of storage. Hospital departments and dental clinics may also require staff to be involved with the movement of disabled, sedated or unconscious patients, and separate and specific training must be given in these areas by the employer.

While performing the risk assessment of any manual handling and lifting that has to be carried out in the dental workplace, the following points must be considered when deciding whether the task is hazardous or not.

- The weight and dimensions of the object being moved or lifted.

- The likelihood of staff having to reach, bend, twist or stoop while moving or handling the object.
- The frequency of the manual handling task.
- The likelihood of excessive movements being required to move an object, such as pushing or pulling.
- The distance that the object has to be moved.
- The need for the object to be carried up or down stairs.
- The physical ability of the staff involved in moving and handling.
- The existence of any medical conditions that contraindicate staff from moving or handling objects (this includes pregnancy).
- The need for any training to be given in the correct techniques of moving and handling (the HSE has a guide to manual handling which can be accessed at www.hse.gov.uk).

If each point is taken separately, it can be seen that much can be done to avoid injury to staff during moving and handling activities.

Weight and dimensions

The heavier the load and the greater its dimensions, the more difficult will be its handling and the more likely for injury to occur, so consider the following points:

- Split the load to make it lighter.
- Ask other staff to help while lifting and moving it.
- Use a trolley or other handling aids, if available.

Awkward movements and frequency

Examples include twisting and bending while lifting or moving a load. The more times the move is carried out, the more likely it is to cause injury, so consider the following points:

- Clear the path of travel before lifting, to avoid having to twist.
- Move the feet to change direction, rather than twisting the body.

- When precise positioning is required, put the load down and then adjust its position.
- When loads have to be moved frequently, use a trolley or other handling aid to avoid straining the back.

Excessive movements

Pushing and pulling lighter loads is not usually a problem, but when heavier loads are involved they must either be split into smaller units first or a trolley or other handling aid must be used.

In most instances, large boxes of stock can be opened and put into their place of storage individually, to avoid having to push or pull them into position.

Distance and stairs

It makes sense to move objects the minimum distance whenever possible, and to avoid having to carry them up and down stairs manually. The place of storage for stock should be carefully considered in order to avoid repetitive strain injuries to staff, and a lift must always be used if available. Otherwise, a trolley or other handling aid needs to be provided. Figure 4.22 shows the sensible use of a remote-controlled stair-lift to transport boxes of stock items upstairs.


Amazing
Nitrile Powder Free Examination Gloves
• Finger Textured • Latex Free
• Non-Sterile • Ambidextrous
SMALL (92886)
For Single Use
3000 Gloves
(10 Boxes x 300 Gloves)
AURELIA
A AR 040
For Service Call
handicare
08700 118 282

Figure 4.22 Use of stair-lift to avoid manual handling up and down stairs.

Physical ability and medical conditions

Elderly or unfit staff are more likely to injure themselves while moving and handling, by overestimating their own capabilities, and the following must be considered:

- Elderly staff tend not to be as strong as younger staff, and may have less stamina to hold a load for any length of time.
- Overweight staff will find it difficult to hold loads as close to their centre of gravity as they need to for stability, and this will put unnecessary strain on their arms and back.
- Short staff will lift and carry loads less easily than taller staff.
- Male staff tend to be stronger than female staff, although this cannot be assumed.
- Various medical conditions will prevent some staff from being capable of moving and handling objects without risking injury to themselves, such as back problems, heart and respiratory conditions, hernias, some physical disabilities.
- Pregnant staff should not be involved in moving and handling heavy objects.

Training

A correct handling technique should be taught to all staff involved in moving and lifting objects in the dental workplace, and this may involve:

- sending the staff (and the employer) on a well-run training course to learn the best posture to adopt while lifting and moving loads
- acquiring trolleys and other handling aids for the premises
- changing the location of storage rooms, to make them closer to the delivery point and ideally at ground level

- acquiring more storage cupboards or shelves at waist height for heavier items
- acquiring stepladders for the placement of light loads in storage spaces above shoulder level.

City & Guilds provide a qualification in moving and handling, with approved training providers situated throughout the country.

Pressure Systems Safety Regulations 2000

In the dental workplace there are two types of equipment in use to which these regulations are relevant: autoclaves and air receivers (compressors). Autoclaves are used to sterilise hand instruments and items used on patients so that they are made safe for reuse (see Chapter 8), while air receivers are used to compress atmospheric air which is then used to drive dental handpieces and suction units. Only large air receivers such as those found in large multiple surgery premises are required to comply with the regulations, but all sizes and types of autoclave must comply.

When a pressure vessel is working, a considerable amount of stored energy is produced, and if the vessel undergoes failure while in use that pressure is suddenly released into the surroundings. This may cause serious or even catastrophic injury to any persons in the vicinity, and damage to the surrounding environment too.

The hazards associated with a working autoclave involve the following:

- High temperatures produce steam which issues from both the reservoir lid and the door on opening, and this may cause scald injuries.
- High pressures generated during the sterilising process may blow open an unsecured or faulty door with the power of an explosion, causing serious injury to anyone in the vicinity of the machine at the time (and damage to the surroundings).
- Faulty machines which do not release the excess pressure before the cycle end will violently blow open the autoclave door when it is unlocked, possibly causing injury to the staff member involved.
- Liquid-containing glass containers which are run through a sterilisation cycle can explode within the chamber or upon opening the autoclave door, causing injury to anyone in the vicinity.

For these reasons, all autoclaves and large air receivers must comply with the regulations as follows:

- Before initial use, a ‘competent person’ (specialist certified engineer) must draw up a written scheme of examination which details the periodic examination of the pressure vessel.
- Written records of the periodic examinations must be kept, and the inspections must be carried out every 14 months for autoclaves and every 2–4 years for large air receivers.
- Periodic examination and inspection of the pressure vessel must involve servicing, performance testing, necessary maintenance and safety examination at each time.
- Regular maintenance of autoclaves must also be carried out by the workplace between times, as detailed in HTM 01-05 (see Chapter 8).
- Small air receivers must be routinely maintained by a service engineer.

Regulatory Reform (Fire Safety) Order 2005

This updated the previous legislation (Fire Precaution Regulations 1999) in 2006 and stipulates that the employer/owner of the premises (including dental workplaces) is the 'responsible person' who must take reasonable steps to reduce the risk from fire, and to make sure that people on the premises can escape safely if there is a fire, especially disabled persons or those who need special help. Fire certificates are no longer issued to workplaces and now have no legal status, so the responsible person must risk assess the fire precautions that are needed for their own work premises, or arrange for another competent person to do so (various dental companies offer this service). The fire precautions required will vary from one workplace to another; a ground-floor practice will be considered less dangerous to staff and patients in the event of a fire than one that is in a multistorey building, for instance.

A typical fire risk assessment should consider the following points, and in this order:

1. **Identify the fire hazards on the premises**: these will include flammable materials (liquids, vapours, textiles, paper products), heating appliances with naked flames, electrical equipment, static sparks from electrical equipment, flammable sedation gases and emergency oxygen cylinders, flammable rubbish.
2. **Identify who may be harmed**: anyone on the premises, paying special attention to children and vulnerable adults who may be attending, and where they may be on the premises.
3. **Evaluate the risk of a fire occurring**: the amount of various flammable materials on the premises, and where they are used or stored, the number of heating appliances and items of electrical equipment, any sedation gases, the amount of flammable rubbish at any time.
4. **Control the risk by taking precautions**: reduce the amount of flammable materials used where possible, and ensure they are stored away from heat sources, replace naked flame heat sources (such as portable butane gas room heaters) with safer

alternatives (only likely exception will be hand-held butane burners used for denture work), ensure electrical appliances are properly serviced and maintained, use and store sedation gas cylinders away from heat sources, avoid storing flammable waste near heat sources, and consider if current fire detection methods, firefighting equipment and evacuation procedures are adequate or not.

5. **Record the risk assessment findings**: in particular, record all findings and details of the actions taken to improve precautions, and ensure all staff are notified of the findings and any new actions to be followed.
6. **Review the risk assessment periodically**: annually is adequate, recording the date of the review and whether any revisions were made or not.

All dental workplaces then undergo a fire safety inspection, so that the premises can be formally recorded as having carried out the necessary risk assessment. Although several companies provide the means for this to be carried out by post, a visit by a suitably qualified inspector from the Fire and Rescue Service will hold more weight if a fire does occur and the practice is held to account for its level of compliance.

The inspection will give advice with regard to the following:

- The number and positioning of smoke detectors.
- The number and positioning of fire extinguishers.
- Written records of staff training in the use of fire extinguishers.
- The types of fire extinguishers to be provided, with at least two types present in all workplaces (see later).

Fire detection and raising the alarm

The Regulatory Reform (Fire Safety) Order 2005 states that an electrical fire alarm system and/or an automatic detection system are only required on premises where these devices would be necessary to give warning in case of fire. To determine which method of detection

and alarm the workplace requires, the three major types of fire warning system should be considered.

- Manual system: suitable for small open-plan workplaces where a fire breaking out is unlikely to occur without being detected at an early stage. Basic smoke alarms (Figure 4.23) should still be situated around the premises, but a whistle or klaxon horn (Figure 4.24) will suffice as the means of raising the alarm. Smoke alarms should be fitted at key points around the premises, and written records kept of their regular testing to ensure they are functioning correctly; all modern designs also have an automatic low battery alert system installed.
- Electrical system: suitable for larger workplaces over several storeys, where a whistle or horn is unlikely to be heard in some areas. These systems are activated by manually breaking the glass at one of several call points situated around the premises (Figure 4.25) so that an electric siren warning is emitted.
- Automatic system: suitable for larger premises (especially clinics and hospitals) where a fire could remain undetected until escape from the building may be compromised. They require expert design and installation.

Figure 4.23 Smoke alarm.


Fire
exit
AVVISATORE A GAS
HANDY HORN
AVERTISSEUR A GAS
GASDRUCK FANFARE
LUCHT HOORN
BOCINA A MANO
BUZINA DE MÃO
fire evacuation floor plan
fire exit

Figure 4.24 Klaxon horn used for raising alarm.

Figure 4.25 Fire call point.

Emergency plan

All workplaces need to plan what action the staff should take in the event of a fire on the premises, and this information should be written down (for workplaces employing more than five people) and accessible to all staff at all times. The plan will vary between workplaces, depending on their size, layout, and the numbers and types of patients they are likely to treat. For example, a specialist orthodontic practice is likely to have more child patients on the premises than a regular dental workplace and will require different actions to be taken in the event of a fire.

Every emergency plan should provide clear written instructions on the following:

- Actions to be taken by staff in the event of a fire: in small premises this may only need to be simple instructions on the fire

action notice (Figure 4.26).

- Warning system in use: whistle, klaxon, electronic siren, etc.
- Contacting the Fire Service: dial 999 and ask for 'Fire', stating the location is a dental practice, clinic, etc. This will alert the service to the presence of potential flammables/gases on the premises, and that there are likely to be multiple persons on the premises.
- Evacuation procedures, including arrangements for disabled, child, and elderly persons.
- Stated assembly point and attendance check procedures, so that everyone stays together and there is no uncertainty about persons still on the premises following a register check.
- Key escape routes (see later).
- Location and use of the firefighting equipment available (see later).
- Specific responsibilities of nominated staff:
  - contacting the emergency services
  - retrieving the patient register/visitor book
  - ensuring patients and visitors are aware of the assembly point location
  - ensuring each area is clear of people
  - ensuring elderly/disabled persons are assisted from the premises.
- Power shutdown methods.
- Records kept of regular staff training events in fire safety and evacuation procedures.

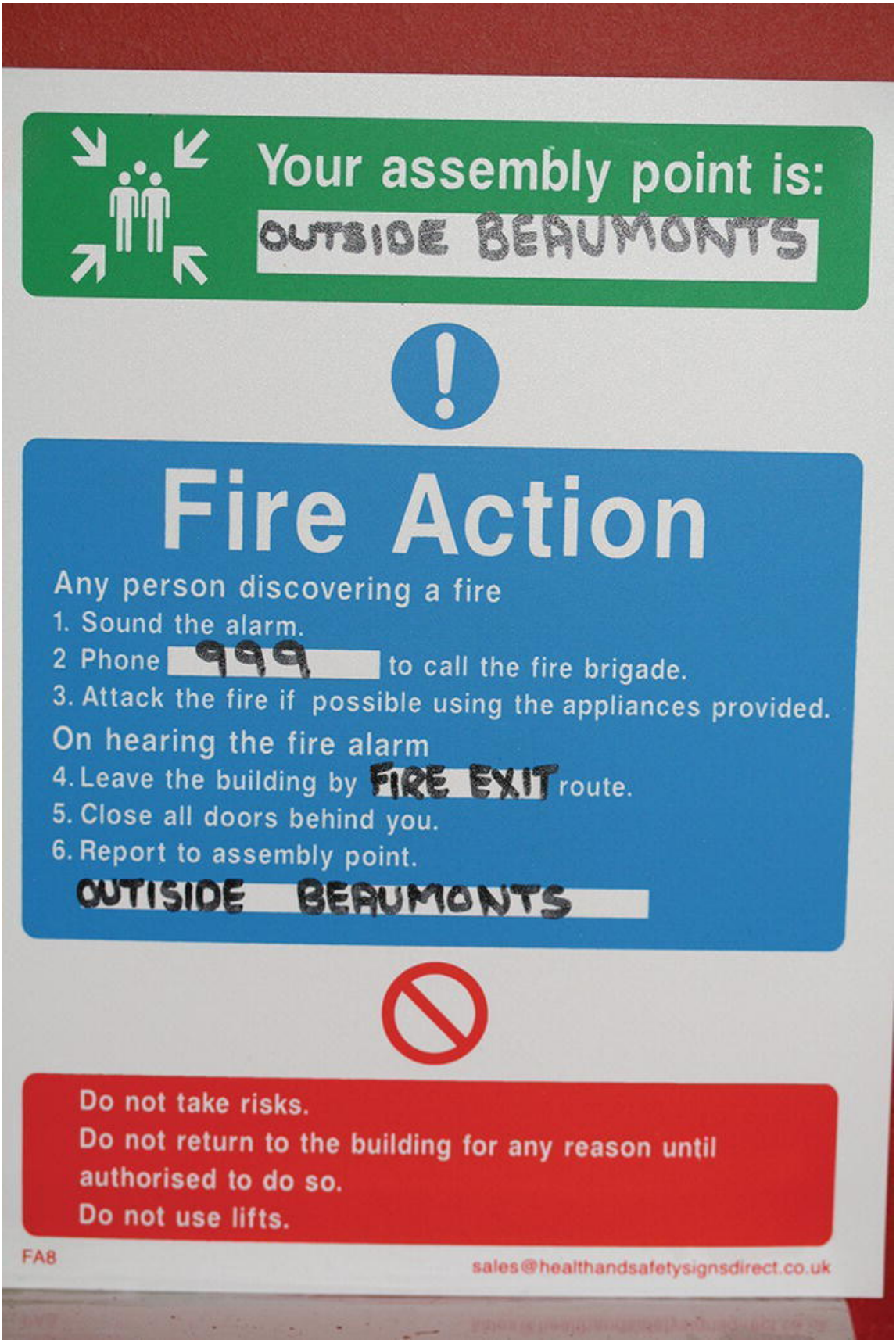
Your assembly point is:
OUTSIDE BEAUMONTS
Fire Action
Any person discovering a fire
1. Sound the alarm.
2 Phone 999 to call the fire brigade.
3. Attack the fire if possible using the appliances provided.
On hearing the fire alarm
4. Leave the building by FIRE EXIT route.
5. Close all doors behind you.
6. Report to assembly point.
OUTISIDE BEAUMONTS
Do not take risks.
Do not return to the building for any reason until authorised to do so.
Do not use lifts.
FA8
sales@healthandsafetysignsdirect.co.uk

Figure 4.26 Fire action notice.

Firefighting

When a fire breaks out, trained staff may be able to safely extinguish it using suitable firefighting equipment on the premises, so that the risk of injury to all other persons is removed. The main equipment available for use in firefighting is the fire extinguisher (Figure 4.27), although some premises will have additional equipment such as fire blankets and hoses. To determine which firefighting equipment should be available in the workplace, the classification of fires is considered as follows:

- **Class A fire**: caused by the ignition of carbon-containing items such as paper, wood and textiles.
- **Class B fire**: caused by flammable liquids such as oils, solvents and petrol.
- **Class C fire**: caused by flammable gases such as domestic gas, butane, liquefied petroleum gas (LPG).
- **Class D fire**: caused by reactive metals that oxidise in air such as sodium and magnesium.
- **Class F fire**: caused by liquid fats such as used in kitchens and restaurants.


nu-swift
CO2
FIRE EXTINGUISHER
Agent 2kg Carbon Dioxide
Fire rating 34B
Use upright pull out pin
Aim horn at base of fire
Squeeze lever
For use on these fires
B
E
NU-SWIFT PREMIER MODEL 1320SE
CE 0029

Figure 4.27 Fire extinguisher: black label and wording indicates carbon dioxide extinguisher.

Class E fire classification (caused by electrical components and equipment) is no longer in use as these fires can be tackled using extinguishers also required for other classifications, namely carbon dioxide and dry powder.

In the dental workplace, the likeliest causes of fire shown above suggest that extinguishers to fight classes A, B and C should be available. The content of each fire extinguisher varies depending on its recommended use, and is identifiable by a coloured label or specific wording on the label of the extinguisher. All extinguishers are coloured red so that they are easily visible, while the label and its wording describe the fire classification that it is suitable for, as follows:

- Red (water) extinguisher: for use on all except electrical fires.
- Black (carbon dioxide) extinguisher: for use on all fires (see Figure 4.27).
- Blue (dry powder) extinguisher: for use on all fires.

The extinguishers must all be inspected and certificated by a competent person on an annual basis, and replaced as necessary. They should be located:

- within easy reach, ideally along escape routes, especially in corridors or stairways rather than within a room off the corridor or stairway
- in conspicuous positions (so not hidden by surrounding cupboards, for example), grouped together at fire points where possible
- on wall mountings and signposted to make their position obvious
- in a similar position on each level of the premises.

Evacuation and escape routes

During the risk assessment process, consideration should be given to whether, in the event of a fire, all persons on the premises could leave safely and reach a place of safety. There should be no possibility of anyone being cut off from escaping from the premises by either smoke or flames.

In particular, the following areas of fire safety must be complied with:

- Escape routes must be kept free from all obstructions to allow immediate evacuation from the premises if necessary. In particular, key-operated doors must be kept unlocked during normal working hours.
- Fire exits must lead directly to a place of safety, usually outside the building itself.
- They must be clearly marked by green 'Fire Exit' signs, with an accompanying pictogram of a running man. In larger workplaces the sign will have a green emergency light incorporated into the design; this allows the exit to be visible through the smoke of a fire (Figure 4.28).
- Emergency lighting should be provided if necessary. This applies to larger workplaces rather than small practices, and the necessity will have been identified during the fire risk assessment.
- The emergency lighting will be activated automatically when the fire alarm starts, and provides green lighting visible through any smoke to direct persons along escape routes.
- Emergency doors should open manually in the direction of escape, and should not be operated electrically. In larger workplaces these should be special push-bar operated fire doors (Figure 4.29).
- Sliding or revolving doors should not be used as fire exits.
- All staff must be aware of the fire safety and evacuation process, and the procedure for evacuation should be practised at least annually.
- In addition, some staff should be charged with certain actions during the evacuation procedure, such as checking certain areas

are clear or closing certain doors to contain the fire.

- Special consideration also needs to be given to the needs of disabled persons. In small workplaces they should only be treated in ground-floor surgeries so that they can be easily evacuated from the premises.

Figure 4.28 Fire exit pictogram with emergency green light.

Figure 4.29 Push-bar operated emergency fire door.

Smoking in the workplace

Smoking in all enclosed workplaces is prohibited throughout the UK. All enclosed workplaces, which include all types of dental workplace, must display a 'No Smoking' sign at each entrance (Figure 4.30) and the sign must contain the following wording: 'No smoking. It is against the law to smoke in these premises'. Before the ban, careless disposal of cigarettes was a significant cause of fires in the workplace, so future analysis of fires and their causes will hopefully show a reduction in their incidence.


NO SMOKING.
It is against the law to
smoke in these premises

Figure 4.30 ‘No Smoking’ sign.

Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013

These regulations require employers to notify the HSE of major accidents and dangerous occurrences that have happened on the premises, and accidents causing more than 7 days absence from work.

Accidents that occur in the workplace fall into one of two categories:

- **Minor accidents**: these result in no serious injury to persons or the premises, and are dealt with in-house. A written record of the minor accident must be made and kept in the accident book, under the Notification of Accidents and Dangerous Occurrences Regulations (see Figure 4.7). Examples of minor accidents include a trip or fall resulting in no serious injury, a clean (non-infectious) needlestick injury or a minor mercury spillage that can be safely dealt with using the spillage kit.
- **Major accidents**: these result in a serious injury or death to a person or severe damage to the premises. They are classed as 'significant events' and are therefore *notifiable incidents* that must be reported to the HSE.

Notifiable incidents do not include those occurring to a patient while undergoing dental treatment but do cover all persons on the premises otherwise. Once notified, the HSE will carry out an investigation into how the incident occurred, to determine whether it was purely an accident or whether the practice or a staff member was at fault. Advice will then be given on how to avoid similar incidents in future, but in serious cases prosecution may follow. The HSE can be notified of an accident or dangerous occurrence online so that investigations can begin promptly.

Dental nurses should remember that once qualified and registered with the GDC, they are personally responsible for their own errors and acts of omission under Health and Safety law so it may be that they are the ones who are prosecuted. While in the dental workplace as a student, the trainee dental nurse is under the supervision of a more senior colleague and that senior person will be the one held accountable for any event under RIDDOR. The only exception to this would be if written records proved that the trainee had received the

correct training in health and safety issues but had knowingly and blatantly disregarded them, resulting in the occurrence of the notifiable incident.

The significant events covered by the regulations fall into one of three categories: injuries, diseases and dangerous occurrences. Further information is available at www.hse.gov.uk/riddor.

As with any other workplace, the occurrence of an accidental injury is a rare event in the dental world but nevertheless they can and do happen. Minor injuries, as discussed above, are handled in-house as they result in no serious harm to any persons. However, major injuries do result in serious harm or even death to the casualty.

The **injuries** that must be reported are as follows:

- Death of any person.
- Fracture of the skull, spine or pelvis.
- Fracture of the long bone of an arm or leg.
- Amputation of a hand or foot.
- Loss of sight or permanent reduction in sight in one eye.
- Serious burns (including scalding) of more than 10% of the body.
- Hypoxia (oxygen deprivation to the brain) severe enough to produce unconsciousness, due to a head injury or asphyxia.
- Any other injury requiring 24-hour hospital admission for treatment.

In addition, certain occupational diseases must also be reported when it is likely these have been caused, or made worse, by the person's usual work.

- Carpal tunnel syndrome: pressure on the nerve passing through the wrist which results in pain and tingling of the hand and fingers.
- Severe cramp of the hand or forearm: painful involuntary muscle contractions.

- Occupational dermatitis: skin inflammation due to work-related exposure to chemicals (such as various soaps and hand gels).
- Hand–arm vibration syndrome: usually due to prolonged and regular use of vibratory equipment, such as dental handpieces.
- Occupational asthma: respiratory condition brought on by exposure to inhaled chemicals.
- Inflammation of the tendons or their sheath affecting the hands or forearms.
- Any occupational cancer.
- Any disease caused by an occupational exposure to a biological agent (see below).

The dental team may be exposed to common diseases in the workplace on a daily basis from patients (such as simple colds or chest infections) or they may be exposed away from the workplace; in this case they are at risk of transmitting the infection to others in the workplace themselves. Dental personnel are also at risk of exposure to more serious pathogens by direct contact with infected blood and saliva from patients, and particularly by receiving an inoculation injury. The risk of infection by airborne diseases is increased significantly when the workplace is inadequately ventilated or poorly temperature controlled, and by cross-infection when the workplace is inadequately cleaned.

The **diseases** that must be reported under RIDDOR are any that cause acute ill health by infection with dangerous pathogens or infectious materials, such as:

- *Legionella*, causing Legionnaire's disease
- hepatitis B or C infection, both linked to the development of liver cancer
- HIV, causing acquired immunodeficiency syndrome (AIDS).

In the hospital environment or when treating those with poor personal hygiene, dental personnel may also be exposed to, or even transmit, other dangerous pathogens such as meticillin-resistant *Staphylococcus aureus* (MRSA, referred to as one of the 'super-bugs'

by the public) or *Clostridium difficile* (an intestinal micro-organism associated with diarrhoea and tetanus).

A dangerous occurrence is a significant event that could result in serious injury or death to anyone on the premises. It would result in the attendance of the emergency services (ambulance, fire and/or police) as well as specialists in service provision, depending on the cause (gas, electric, service engineer, environmental health officer, etc.).

The **dangerous occurrences** that must be reported are as follows:

- Explosion, collapse or burst of a pressure vessel (an autoclave or compressor).
- Electrical short circuit or overload that causes more than a 24-hour stoppage of business.
- Explosion or fire due to gases or inflammable products that causes more than a 24-hour stoppage of business.
- Uncontrolled release or escape of mercury vapour due to a major mercury spillage (see previously and Chapter 15).
- Any accident involving the inhalation, ingestion or absorption of a hazardous substance which results in hypoxia that is severe enough to require medical treatment.

Most of the dangerous occurrences listed involve a catastrophic failing of an item of electrically operated equipment, resulting in a fire or an explosion. Fire is a daily hazard that can occur in any workplace and, as discussed previously, a risk assessment of the dental workplace will identify several specific fire hazards.

In addition to the fire potential from chemicals and gases, all dental equipment is electrically operated and may short circuit, malfunction or spark and cause a fire at any time, especially if not serviced and maintained correctly.

Larger items of electrical dental equipment, such as the dental chair and inspection light or autoclaves, have to be serviced and maintained by trained personnel on a regular basis. However, smaller portable items such as curing lights can be inspected for electrical safety by a general electrician or other approved person, in a process known as

portable appliance testing (PAT). This should be carried out every 1 to 3 years, with each appliance having the plug, fuse size and wiring inspected for wear and tear. If all is well, a sticky label is applied to indicate that the appliance is PAT compliant and the due date of the next PAT inspection (Figure 4.31). A written record of the testing should be kept in the workplace if the 'other approved person' is a competent dental team member.

Figure 4.31 PAT inspection label.

It is apparent, then, that RIDDOR should only be relevant when a serious, genuine and unforeseen accident occurs in the dental workplace, as all other incidents should be avoided by the correct instigation of policies and protocols covering the following:

- Waste disposal (see previously).
- Ionising radiation (see Chapter 12).
- Recognition and management of occupational hazards (see previously and below).

- Infection control (see Chapter 8).
- Safe use of conscious sedation techniques (see Chapter 14).

Water Supply (Water Fittings) Regulations 1999

The mains water supply provided to the dental workplace by a utility company must be protected from contamination by back-siphonage (backflow), where contaminated water is drawn back through the waterlines into the mains water supply system. Prevention of backflow is achieved by the presence of an air gap between the point where the mains water exits a tap or connector, and the point where it enters a dental unit water line (DUWL). This physical break in the mains water supply to equipment used in the dental surgery prevents contamination of the mains supply by pathogenic organisms such as *Legionella*. The alternative method is to use a self-contained water supply, such as that provided by the use of a bottled water system on the dental delivery system (Figure 4.32).

Figure 4.32 Bottled water supply system to bracket table.

The dental equipment affected by these regulations includes the following:

- Dental spittoon: where the patient rinses and spits out.
- Delivery system: bracket table with dental handpieces, ultrasonic scaler, 3:1 syringe attached.
- Wet-line suction equipment: high-speed aspirator and saliva ejector unit.
- Washer-disinfector machines.
- Automatic radiograph processors which rely on water tanks to maintain the temperature of the processing chemicals.

However, having an air gap or a self-contained water supply does not eliminate the risk of *Legionella* contaminating the water supply in the dental workplace, and all premises must abide by the HSE approved code of conduct L8 for the prevention of *Legionella* infection (HTM 04-01 – ACOP-L8), including the following:

- Assess the risks of *Legionella* contamination in the workplace.
- Prepare a written course of action for preventing or controlling the risk: this will be written up as the Legionella Management Policy of the dental workplace.
- Use competent services (provided by various dental companies) to help in applying the health and safety requirements, including regular checking of the water supply for *Legionella* contamination.

Once the water is supplied to the dental workplace it is held within the plumbing system, consisting of the cold-water storage tank, the hot water tank (calorifier) and all the pipework between these two tanks and around the premises. It is within this system that *Legionella* bacteria may proliferate if the water temperature regularly lies within the range of above 20 °C to below 45 °C. Regular control and monitoring of these temperatures around the premises is an important part of the infection control actions to be carried out in the

dental workplace, and are discussed further in Chapter 8. The central heating system of the premises is a separate water system and is not relevant to *Legionella* management systems and procedures.

Within the clinical areas of the dental surgery, the DUWLs will still be a source for microbial contamination due to the presence of biofilm, even when distilled or reverse osmosis (RO) water is used rather than tap water in the self-contained water supply (see Chapter 8). For this reason, specific water line disinfectants for use within the self-contained water supply are available to reduce the risk of contamination to patients during dental treatment (Figure 4.33). Manufacturers' instructions must be followed with regard to the frequency of fresh solutions being used (some are daily, others are weekly), and when not in use the reservoir bottles should be rinsed with fresh distilled or RO water and left to drain upside down so that they become dry. On a regular basis (again, following manufacturers' instructions) the DUWL system is washed through with a higher concentration disinfectant solution which acts as a 'shock action' treatment and is in line with HTM 01-05 guidance.


Alpron
for the decontamination of water lines in dental treatment units
Alpron is a concentrate for the continuous decontamination of water lines (including instruments and tumbler filler) in all medical and dental treatment units. Water hardness = 2.5 °d.
Spectrum of activity:
• bactericidal/ fungicidal
• removes and prevents lime and algae formation
Alpron effectively protects against algae formation and lime deposits and prevents limescale forming when warming water or after it has been left standing.
Application with internal dosage device:
Fill container with undiluted Alpron and ask your service engineer to adjust the disinfection device according to the manufacturer's dilution instruction.
Application with external dosage device:
Mix Alpron with external water (e. g. the Clean-water-System) to 1 % (Proportion: 10 ml Alpron for 990 ml water) and connect it to the dental treatment unit. In case of dosage devices standing aside ask your service engineer to carry out the adjustment.
Application is only to be effected by dental specialists.
Clinical data:
Institute Fresenius, Stockach, 1995-10/1996-08
Prof. Dr. H.-P. Werner, Schwerin, cytotoxicity DIN EN ISO 10993-5, 2012-11
Active ingredients:
Tosylchloramide sodium, PHMB
Notes:
Contains Polyhexamethylene biguanidehydrochloride. The concentrate may produce an allergic reaction. Safety data sheet available on request.
Contains a source of phenylalanine.
The ready-to-use solution is physiologically and ecologically harmless. In units with copper heaters - especially after a longer period of stagnation and a low water hardness - the water might become slightly blue. In this case the tumbler filler should be operated shortly (fill 1 tumbler and empty it into the spittoon bowl) before the treatment.
REF 3177-N Alpron StarterSet
REF 3184 4 x 1 l bottle
REF 3200 5 l cubtainer
see additional label
LOT
0123
Contents:
e 1 l
ALPRO MEDICAL GMBH
ALPRO MEDICAL GMBH • Mooswiesenstr. 9
78112 St. Georgen • Germany
T +49 7725 9392-0 • www.alpro-medical.com
Citrisil
Formulation
White 1L
White 2L
Blue 1L
Blue 2L
Shock
Part #
C20-W
C20-2W
C20-B
C20-2B
ECS-10
Citrisil
by Sterisil
All-In-One
Dental Waterline Microbial Contaminant Control Tablet
• Maintains Dental Waterline Effluent ≤10 CFU/ml
• Maintains Silver Ion Antimicrobial Tubing & Bottle
NET CONTENTS: 1 Shock Tablet & 20 Maintenance Tablets
Except Part # ECS10 = 10 Shock Tablets
CAUTION:
Keep out of reach of children

Figure 4.33 Examples of DUWL disinfectants.

An alternative to these types of disinfectant DUWL products is a system using hypochlorous acid, which is a sanitising solution as well as a highly effective cleanser and bactericide. The solution is made up fresh each week in an electrolyser machine before being diluted with RO water for use in the DUWLs and as a surface disinfectant. To ensure each freshly made batch is suitable for use it is easily tested for water quality compliance (in line with HSE ACOP-L8) using test strips – a simple colour comparison chart indicates whether the solution falls within the compliance range, and if not it can be diluted or strengthened as necessary to do so. Once dry, the test strips are dated and stored as evidence of water quality compliance, as an insert in the decontamination room records folder. The solution itself can also be tested during the week to ensure it is still active using a degradation test strip; again, this uses a simple colour comparison chart which indicates the strength of the solution in ppm. Any solution in the colour range of 80 ppm or above is effective for use as a sanitiser in the DUWLs or as a surface disinfectant; solutions reading below this level are simply discarded and a fresh solution is prepared. Further information on the Tryclean system using hypochlorous acid is available at www.trycare.co.uk.

On a daily basis, the DUWLs should be flushed through for 2 minutes before the first patient is treated, and for 20–30 seconds between each patient thereafter to help reduce the build-up of biofilm in the lines. Where surgical procedures are carried out (such as the placing of implants), an independent system of irrigation using sterile water should be used to reduce the risk of contamination completely (Figure 4.34).


20:1
REDC
1200
RPM
MAX
N-cm
80%
FLOW
IMTEC

Figure 4.34 Sterile water supply for implant placement unit.

Occupational hazards

By definition, occupational hazards are those that a staff member may encounter during their normal working day, due to the nature of the work that they carry out while in the workplace. Those that are specific to the modern dental workplace may include all the following:

- Exposure to ionising radiation (see Chapter 12).
- Cross-infection and inoculation injuries (see Chapter 8).
- Exposure to hazardous chemicals, in particular:
  - mercury (see previously and Chapter 15)
  - acid etchant (see previously and Chapter 15)
  - sodium hypochlorite and other disinfectants (see previously and Chapter 8)
  - nitrous oxide (see Chapter 14).
- Exposure to hazardous waste (see previously).
- Exposure to lasers, curing lamps and tooth whitening lamps (see below).
- Use of display screen equipment such as computers (see previously).

Lasers, curing lamps and tooth whitening lamps

These devices have various uses in the dental workplace but all can cause harm, especially to the eyes, if they are not used in a safe manner.

Lasers

These devices generate an intense narrow beam of light or other electromagnetic radiation that can be used as a cutting tool on hard and soft tissues, such as teeth and oral soft tissues. They are classified according to their power output: the higher the classification, the more powerful and therefore the more dangerous. Those used in dentistry are class 3B or 4 (powerful) and can only be used under medical or dental supervision. The danger they pose is that they can

damage the eyes if viewed directly, and can burn other tissues if the beam used is too intense.

There is no specific legislation relevant to the use of lasers but general safety legislation will apply (including Health and Safety at Work Regulations), and as always the employer will be expected to have carried out a risk assessment before the devices are used.

In a similar fashion to the use of ionising radiation in the dental workplace, the use of lasers in class 3 and 4 should include the following:

- Access to a Laser Protection Advisor (LPA) with a similar role to the Radiation Protection Advisor (RPA) where X-rays are used.
- An appointed Laser Protection Supervisor (LPS) with a similar role to the Radiation Protection Supervisor (RPS), as above.
- A set of local rules, including a controlled area with limited access during use, methods of safe working, register of authorised users, etc.
- Provision of an isolation switch in case of emergency.
- Use of a warning symbol outside each controlled area (Figure 4.35).

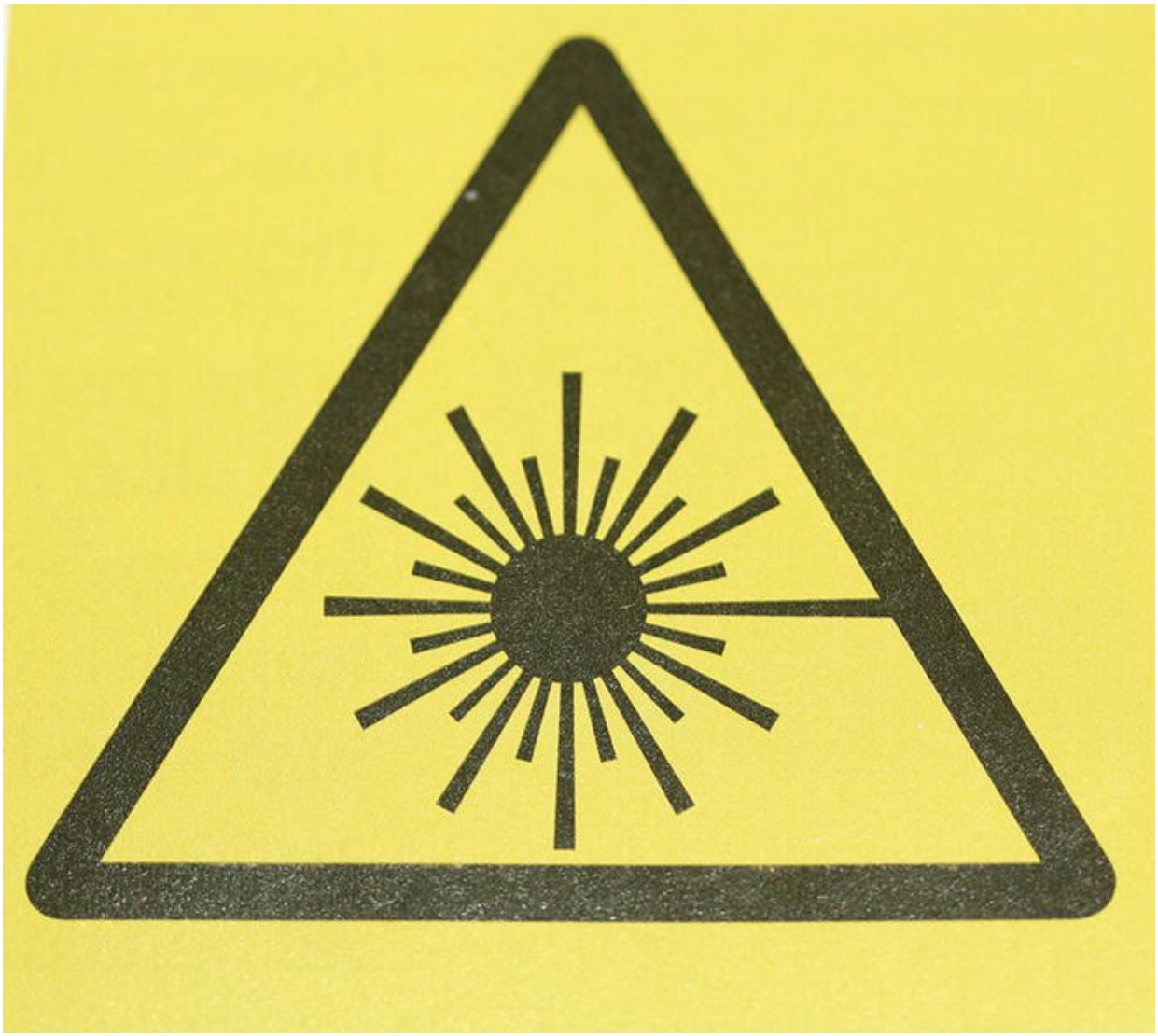

Figure 4.35 Laser warning sign.

The use of lasers is still relatively limited in the dental workplace.

Curing lamps and tooth whitening lamps

These devices (Figures 4.36 and 4.37) use blue halogen bulbs as their electromagnetic radiation light source. While they are less damaging to the eyes than a laser beam, they can still cause retinal damage if viewed without the required orange-tinted safety glasses or the orange-tinted safety shield. Both the patient and the dental team must use the appropriate eye protection when either of these devices is being used.

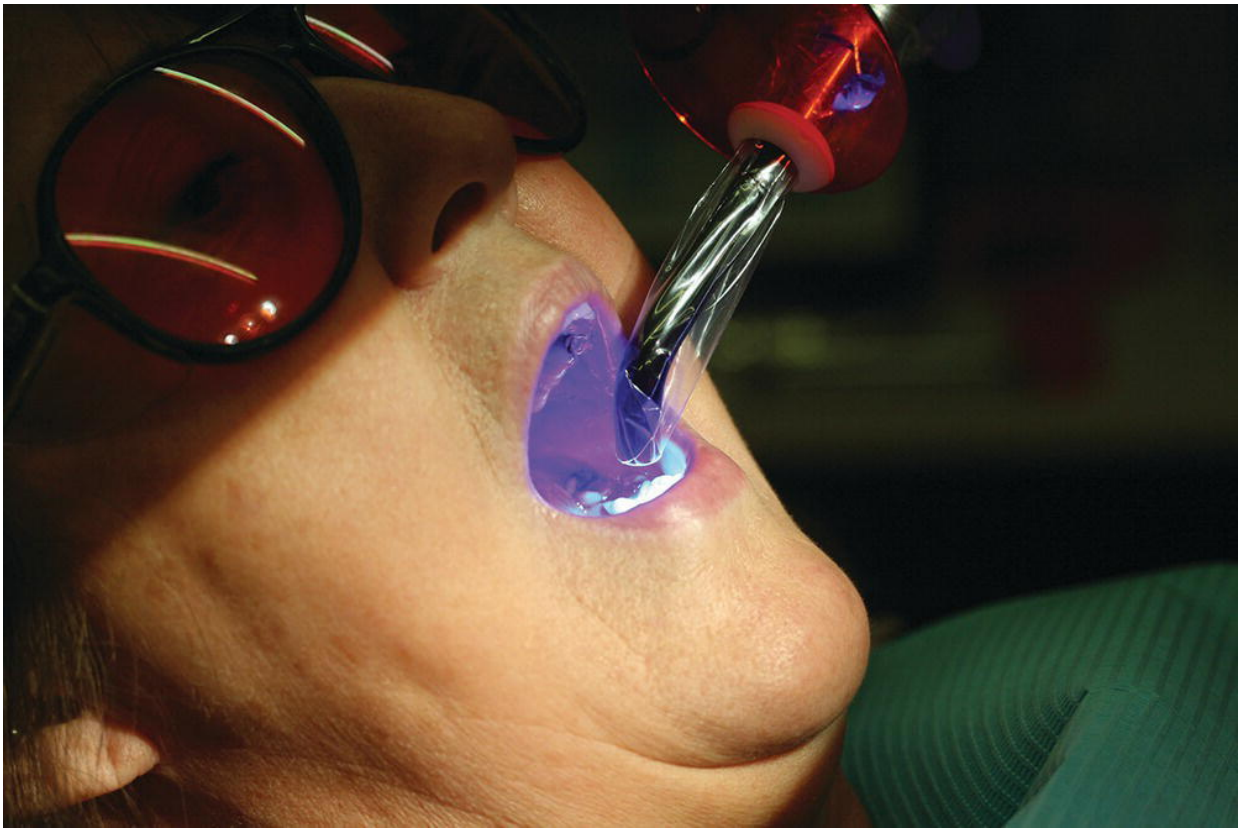

Figure 4.36 Curing lamp in use.

Figure 4.37 Tooth whitening lamp in use.

General safety measures

These relate to any work premises where staff are employed to provide a service to the public, and therefore apply to all dental workplaces, whether they are practices, clinics or hospital departments. The measures listed are all common-sense precautions aimed at preventing injury to anyone using or visiting the premises.

- A safe means of entry which is adequately lit and unobstructed, including for disabled people.
- Non-slip floor coverings which are secure, to prevent tripping.
- No dust traps in the decor of surgical areas, such as those present with embossed wallpaper coverings.
- No sharp edges on furniture and fittings.
- Guards around fires and heaters to avoid burns.
- No trailing electrical cables that could cause tripping.
- All portable electrical appliances must be inspected every 1 to 3 years for wear and tear problems: this is called PAT testing and may be carried out by any approved person as long as written records are kept.
- All electrical appliances should be disconnected overnight as a matter of routine, although this may not be possible with some items such as a fridge or the main computer server.
- A fully stocked first-aid kit should be available for minor injuries.

General security measures

Although it is unlikely that dental practices will have just one or two members on the premises during normal working hours, this situation can occur during holiday times or when several staff are attending courses so no patient appointments are set. In the interests of staff safety, it would be advisable for the premises to be locked during these times so that staff are not left vulnerable and open to attack.

All employers have a responsibility to maintain the security of the workplace premises and the safety and security of their staff. In addition, all staff have a responsibility to uphold the security procedures that have been put in place by their employer, to ensure that the safety of the workforce and the security of the premises are never compromised.

Maintaining security during the day

Security of the premises and safety of the staff during the day are achieved by ensuring that the premises are only accessed by those who have a right of entry. This is more difficult to achieve in large hospital departments and dental clinics than it is in general practice, where the majority of people attending are regular patients who are known by the staff. However, procedures must be in place to ensure that all visitors to the premises have to pass through a reception point, so that they can be seen and identified by staff. Several methods can be used to achieve this.

- Locked entry point with a speaker phone.
- Fire exits that can only be opened from inside the premises.
- Entry way that has to pass directly through reception, so that all visitors have to report there.
- CCTV system.
- Trained staff manning reception at all times, with an appointments system in place to identify any unexpected visitors to the premises.

- Security screening in place so that the reception area cannot be breached.
- Panic button in case any threatening behaviour occurs.

When expected visitors attend, such as booked patients, maintenance or repair workers, or stock sales representatives, they will be checked off against the appointment book and then usually held in the reception waiting area. All persons other than patients should be asked to sign the visitor book.

Patients will have appointment details to be confirmed, while other visitors will have usually phoned to book their attendance with a staff member. In any instance, the following should be the norm to eliminate the risk of any violence towards staff:

- Ensure all staff are trained to be caring and sympathetic towards patients.
- All visitors to the workplace should be treated with respect, and spoken to courteously.
- This is especially important when a patient attends unexpectedly or without an appointment, and highlights the need for a robust dental emergency policy to be in place.
- Ensure all staff are aware of the practice protocols in relation to assault and violence towards themselves.
- Ensure all patients are aware of these too: this should be nothing less than a statement of ‘zero tolerance’ in cases of violence towards staff.

While working at reception, it is important that all cashboxes or tills are out of the reach of other persons and are locked unless in actual use. This reduces the risk of opportunistic thieves attempting to steal from the premises.

Similarly, all patient records, whether written or computerised, must be held securely and out of view of anyone attending the premises, since the confidentiality of patient details is a legal requirement in the dental workplace. Filing cabinets or the record storage room should be locked at the end of each day, and computer records should be

password protected. In larger dental workplaces, passwords are often only given to senior staff members.

Staffrooms should not be accessible to anyone except staff, and can be made so by the use of locks or security code entry systems. Ideally, lockers should be provided for all staff too, so that valuables and personal belongings are never at risk of being stolen.

Maintaining security out of hours

It is of great importance that the dental workplace is always securely locked when not in use. Not only are expensive portable items of equipment on the premises, but also drugs, syringes and needles, which may attract break-ins by drug users, for instance. In addition, the security of patient records and the data protection of their contents must be maintained at all times.

Several methods of maintaining the security of the premises are available.

- Adequate alarm system in place, ideally manned by a security company, so that unusual entry times or alarm activation can be acted upon immediately.
- Only senior staff should be given the alarm code, to reduce the number of persons who may open the premises.
- Similarly, key holder numbers must be kept to a minimum.
- The loss of a key by any member of staff must be reported to the employer immediately.
- All keys must be handed in when staff leave their employment.
- Ensure that alarms are set correctly at the end of each day, so that break-ins are detected immediately.
- Change the alarm code on a regular basis, and ensure that only senior staff are notified of the new code.
- Ensure that all monies are banked daily, to remove the incentive for opportunist burglary.
- Ensure that all doors are locked and bolted at the end of each day, especially the fire exits.

- All windows should have locks on them, and be closed and locked at the end of each day.
- Ground-floor windows are often required to have metal screens placed over them by insurance companies.
- Most dental employers will have a policy to limit staff access to the premises to their normal working hours only, and this must be upheld by all.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

5
General Anatomy and Physiology

Key learning points

A **factual knowledge** of

- the normal structure and function of the human body
- the circulatory system and associated medical conditions relevant to the dental team
- the respiratory system and associated medical conditions relevant to the dental team
- the digestive system and associated medical conditions relevant to the dental team
- the nervous system and associated medical conditions relevant to the dental team

Dental nurses must have a good underpinning knowledge of the normal structure and function of the human body, and especially of the oral cavity and its surroundings, to be able to understand the subjects of human health, the processes involved in the onset of human disease, and the methods available to prevent disease or to treat it when already present.

The anatomy and physiology of the head and neck structures and the oral cavity are discussed in detail in Chapters 9 and 10 respectively. This chapter deals with the anatomy and relevant physiology (that is, the functioning) of the main organ systems, to provide the necessary holistic knowledge and understanding of the human body in relation to dentistry and dental nursing.

Definitions

The scientific discipline that deals with the life processes of living organisms is called *biology*. The study of the structures of the human body and their relationships to one another is called *human anatomy*, and the study of how the body normally functions is called *human physiology*.

The subject of anatomy covers not just the gross structure of the human body – muscles, bones, organs, etc. – but the equally important microscopic structures of the cells and tissues themselves that make up these gross structures. The microscopic anatomy of the tissues is not relevant to this text, but is covered in detail for those interested in *Basic Guide to Anatomy and Physiology for Dental Care Professionals* (C. Hollins, 2012, Wiley-Blackwell).

Cell biology

The basic unit of living organisms is the cell, and all cells (except red blood cells) contain a nucleus that holds the individual genetic material (DNA) that makes each of us unique. The DNA is held as chromosomes which separate and duplicate during cell division and growth.

Most cells are specialised in their roles and actions, and perform certain functions within the body. When similar specialised cells are grouped together to carry out these particular functions, they are called tissues (such as skin or bones). Groups of tissues that perform different functions are called organs, such as the heart or the liver, while those that have related functions are called systems, such as the digestive system or the respiratory system.

There are four basic types of cell in the human body:

- **Muscle cells**: these are stimulated by electrical impulses to generate forces and produce motion. They may be attached to bones to allow limb movement or enclose hollow cavities so that their forces cause expulsion of the cavity contents (such as the movement of food through the digestive tract).
- **Nerve cells**: these can initiate and carry electrical impulses to distant areas of the body along their length to produce many actions, such as to cause muscle cells to contract or glands to release chemicals or fluids in the body (such as the salivary glands).
- **Epithelial cells**: these cover the whole body surface as skin or surround organs or line hollow structures within the body, such as the inner surface of the airway or the stomach. They act to separate areas of the body from each other and from the external environment, to prevent the uncontrolled movement of harmful micro-organisms.
- **Connective tissue cells**: these are present throughout the body in many different forms, ranging from cartilage found in ligaments, bone forming the skeleton, various cells forming the blood and lymph systems, to dentine found in teeth.

All these cells require a source of fuel to produce the energy they need to work and carry out their individual functions, and this fuel is provided by the food that we eat. The energy it contains is released for use by the cells by the action of food digestion in the digestive system, and is used for all the following actions:

- Maintain body temperature above or below that of the surroundings; this is called *homeostasis*.
- Produce movement to allow food gathering, and therefore the production of more energy.
- Allow reproduction to occur, for the survival of the species.

In addition, the body cells require oxygen to be able to burn the food eaten to produce the energy they require to function. Oxygen is brought into the body through the respiratory system, and transported around the body to every cell that needs it by the circulatory system.

The human body has 10 organ systems, each with various components and specific functions to allow the continuation of life, as shown in Table 5.1. The 10 body systems are identified in the left-hand column, with those of particular relevance to the dental nurse listed as the first four. The centre column identifies the structures that make up that system, while the right-hand column states the function(s) of the whole system. These functions help to illustrate how the systems work together to enable the body to work effectively and maintain life. So, for example, the circulatory system is responsible for the transport of oxygen around the body but the cells that actually carry it are made by structures within the immune system.

Table 5.1 The body systems.

System	Composed of	Functions
Cardiovascular	Heart, blood vessels, blood	Transport of blood to lungs for oxygenation Transport of oxygenated blood to body Transport of deoxygenated blood back to lungs
Respiratory	Nose, throat, larynx, trachea, lungs	Exchange of oxygen and carbon dioxide between the body and the atmosphere
Digestive	Mouth, salivary glands, pharynx, oesophagus, stomach, intestines, pancreas, liver, gallbladder	Digest, process and absorb nutrients from food Excrete waste products
Nervous	Brain, spinal cord, nerves, sensory organs	Give consciousness Regulate and co-ordinate body activities
Musculoskeletal	Bone, cartilage, tendons, ligaments, joints, skeletal muscle	Support and protect internal organs Allow movement
Immune	White blood cells, lymph, spleen, bone marrow, thymus	Defend against infection Produce red and white blood cells
Endocrine	All glands that secrete hormones	Regulate and co-ordinate body functions
Urinary	Kidneys, ureter, bladder, urethra	Regulate blood plasma Excrete waste products
Reproductive	Male or female sex organs	Reproduction

System	Composed of	Functions
Integumentary	Skin	Protects against injury and dehydration Maintains body temperature

The four main body systems of relevance to the dental nurse are the circulatory system, the respiratory system, the digestive system and the nervous system.

Circulation

The main component of the circulatory system is the heart, a muscular pumping organ situated in the thorax (chest cavity), just to the left of the midline and over the left lung. It is connected by blood vessels to every tissue in the body, and carries out the following actions:

- Pumps oxygenated blood from the lungs to the body tissues so that they can work.
- Collects deoxygenated blood from the body and transports it to the lungs where the waste products it contains are excreted, by being breathed out.

Oxygenated blood is that with a high concentration of oxygen within it, and is a bright cherry-red colour. Deoxygenated blood is that with a low concentration of oxygen within it, and is a dark reddish-purple colour.

The heart has four chambers within its structure; the upper two are called the atria and the lower two are the ventricles. The atria and ventricles are separated by one-way valves that allow blood flow in the direction of atria to ventricles only, and the left and right sides of the heart have no communication between them. The right side of the heart transports only deoxygenated blood, from the body to the lungs, while the left side of the heart transports only oxygenated blood, from the lungs to the rest of the body (Figure 5.1).

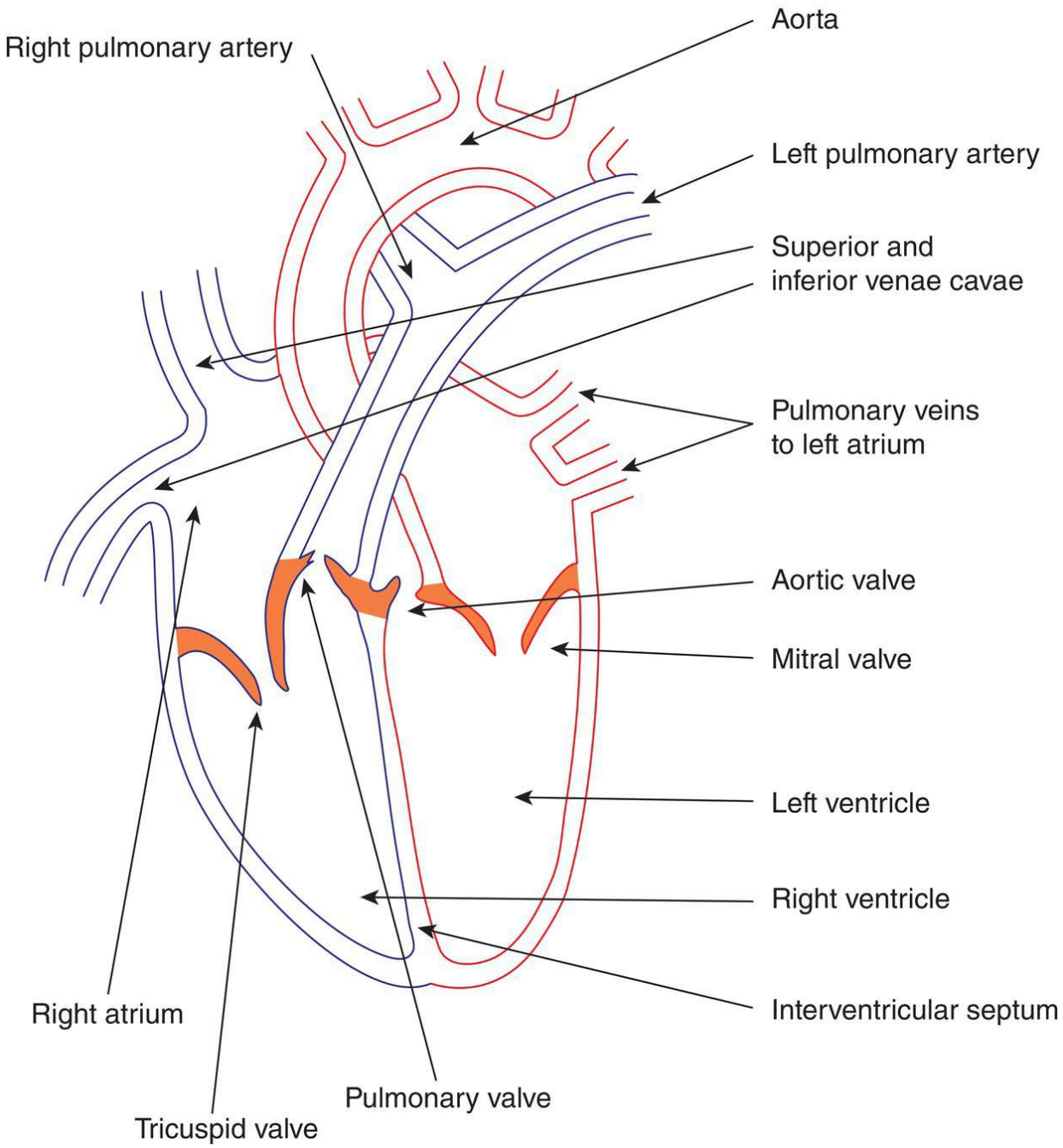

Figure 5.1 Gross anatomy of the heart. Left side (red) carrying oxygenated blood, right side (blue) carrying deoxygenated blood.

Action of the heart

Deoxygenated blood is collected from the whole body through the veins and transported to the right atrium via the inferior and superior venae cavae. As the heart beats, it pumps this blood through the one-

way valve between the two right heart chambers (tricuspid valve) and into the right ventricle. The next beat pumps it out of the right ventricle and into the pulmonary artery where it passes to the lungs for reoxygenation.

Once oxygenated, the blood returns to the left atrium through the pulmonary veins, then is pumped through the one-way valve (mitral valve) into the left ventricle. The next heartbeat pushes this blood out of the heart into the aorta, and then back around the whole body to reoxygenate all the cells and tissues and allow them to continue their normal functions.

The heartbeat itself begins on the top surface of the right atrium in a group of specialised muscle cells called the sinoatrial node or *pacemaker*. These cells receive electrical stimulation from two sets of nerves from the brain; one set speeds up the rate of the heartbeat and the other set slows it down. In this way the heart rate is regulated to allow both exercise and rest as necessary. After each heartbeat, the blood is prevented from flowing backwards again by the one-way valves within the heart itself, which snap shut as the blood pressure increases within the successive heart chambers.

Circulatory system

The circulatory system is an enclosed loop of blood vessels, with the heart at its centre. The blood vessels taking oxygenated blood around the body are the arteries, the largest of which is the aorta, and these gradually decrease in size away from the heart to become arterioles and then capillaries. The capillaries are just one cell thick, and this allows the oxygen that they carry to be released into the surrounding tissues so that it can be used to burn food nutrients and create energy.

As oxygen passes out of the capillaries, the waste product of energy production – carbon dioxide – passes from the surrounding tissues into the capillaries. This gas exchange process is called internal respiration (Figure 5.2). The deoxygenated blood then travels from the capillaries into small veins called venules, then into larger veins until it reaches the heart in one or other of the largest veins, the venae cavae. Deoxygenated blood from the upper body is transported to the superior vena cava, and that from the lower body to the inferior vena cava. This is the systemic circulation.

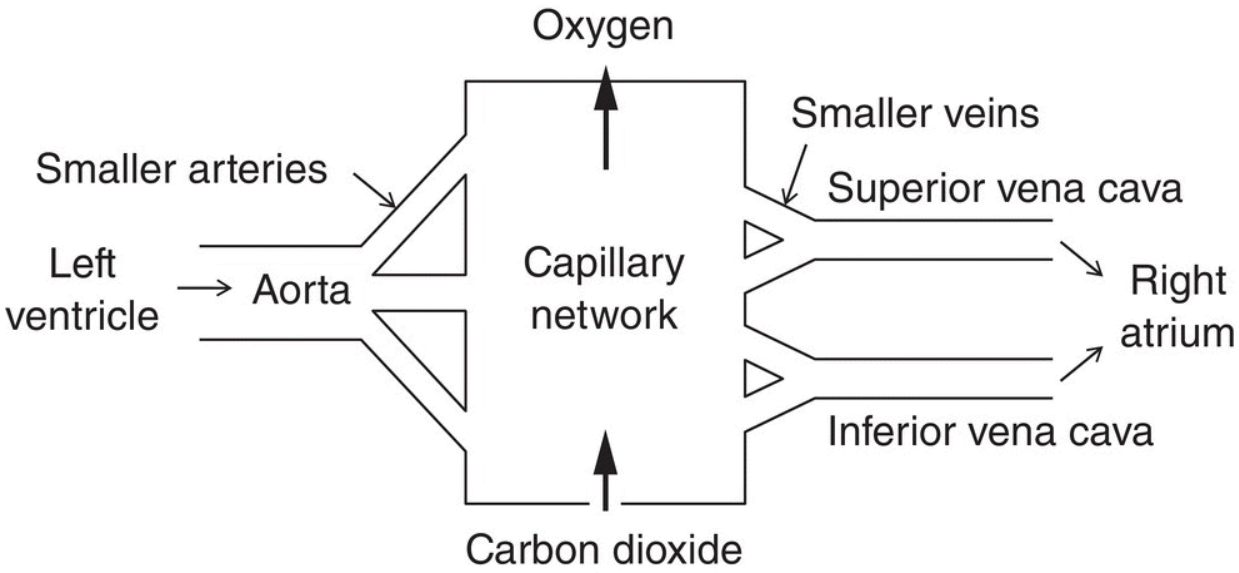

Figure 5.2 Internal respiration: oxygenated blood releases oxygen into the body tissues and becomes deoxygenated, and waste carbon dioxide is collected from the body tissues and transported to the heart.

At the same time, and with each heartbeat, the deoxygenated blood in the right side of the heart is pumped to the lungs through the pulmonary artery (the only artery to carry deoxygenated blood). Here, the carbon dioxide is released into the lungs to be breathed out while oxygen that has been breathed in travels from the lungs into the blood capillaries, so that the blood is reoxygenated again. This gas exchange is called external respiration (Figure 5.3). The oxygenated blood is then transported to the left side of the heart in the pulmonary veins (the only veins to carry oxygenated blood) so that it can then be pumped back around the body. This is the pulmonary circulation (Figure 5.4).

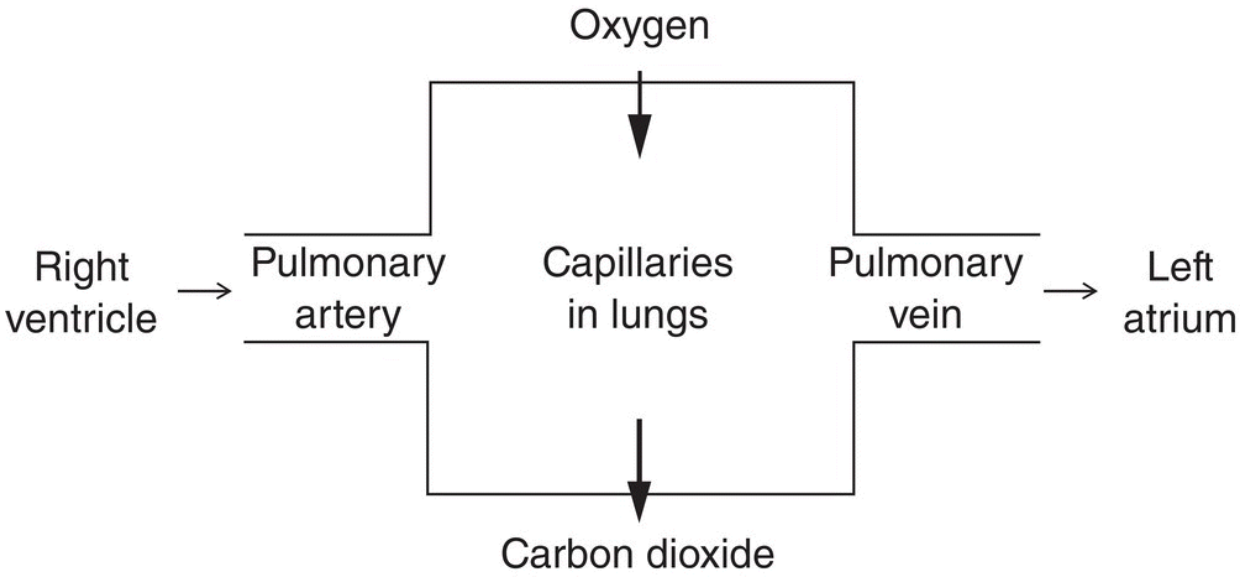

Figure 5.3 External respiration: deoxygenated blood in the lungs releases carbon dioxide to be exhaled, and collects oxygen to become reoxygenated.

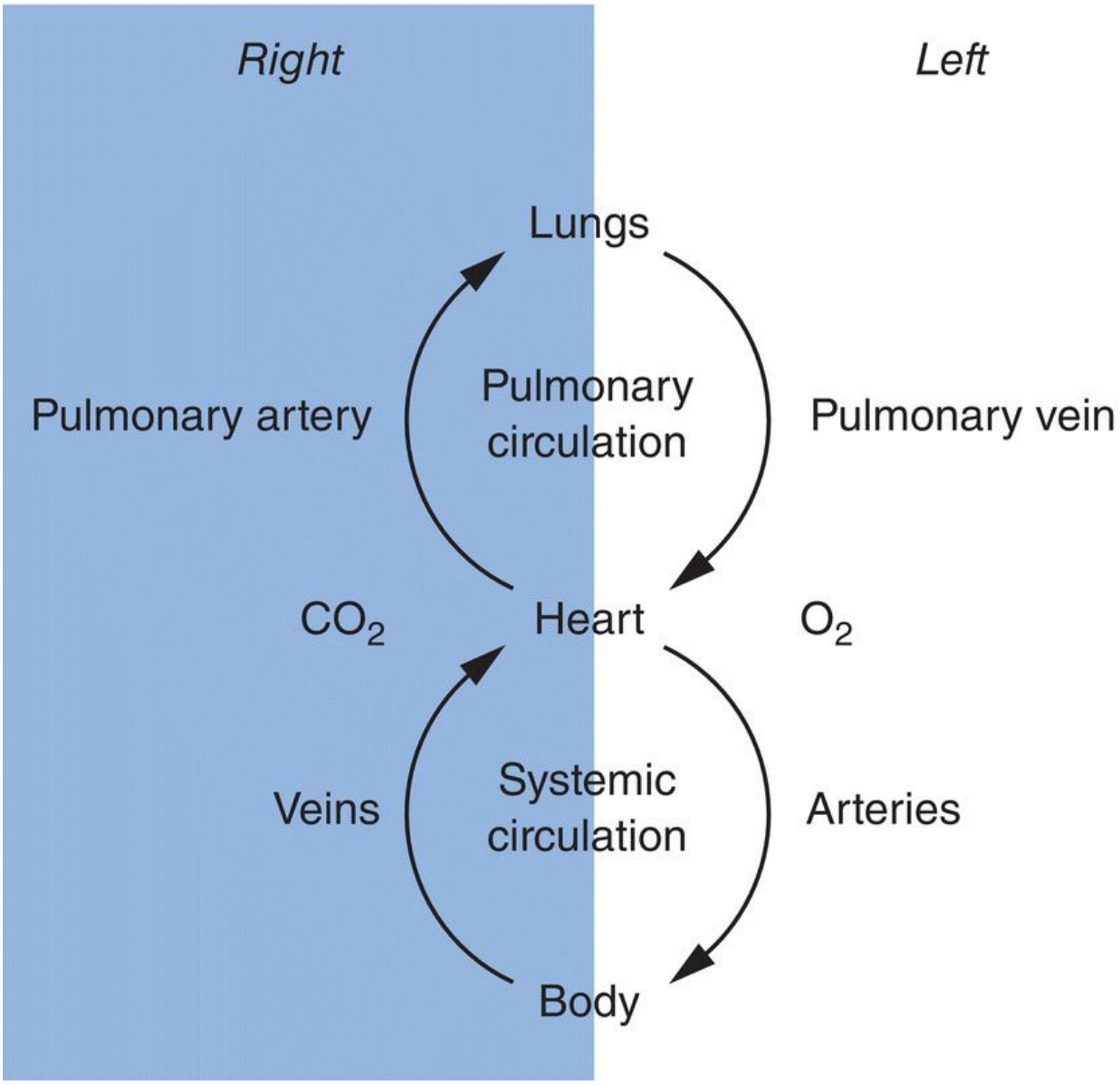

Figure 5.4 Circulation (deoxygenated blood shaded blue).

Blood vessels

When the blood leaves the heart in the arteries, it is under greatest pressure due to the heartbeat, so the walls of the arteries are elastic to allow them to expand as the powerful surge of blood passes along them. Once the initial wave of the pumped blood has passed, the artery walls relax back to their normal size again until the next heartbeat. This difference in pressure within the arteries can be measured and recorded as a person's blood pressure. The maximum

pressure of the blood in the arteries occurs during the peak of ventricular contraction, or *systole*, while the minimum pressure occurs at the end of ventricular contraction, or *diastole*.

So, blood pressure is recorded as systolic pressure over diastolic pressure, and in a healthy adult at rest is usually around 120/80 millimetres of mercury (mmHg), and is measured using a sphygmomanometer and a stethoscope, or an automated device (Figure 5.5). Also, when the artery passes over bone, the blood surge can be felt as the pulse at various sites around the body.

- **Carotid pulse**: at either side of the neck where the carotid arteries lie across the neck vertebrae, and above the surrounding muscles.
- **Brachial pulse**: at the inner surface of the elbow where the brachial arteries lie over the elbow joints.
- **Radial pulse**: at the inner surface of the wrists as the radial arteries lie over the radius bone of the lower arms (Figure 5.6).
- **Femoral pulse**: at the top of the inner thighs as the femoral arteries lie over the femoral bone of the upper legs.

Figure 5.5 Measuring blood pressure using an automated sphygmomanometer.

Figure 5.6 Taking the radial pulse.

In comparison to the arteries, the veins contain little elastic tissue. It is not required because the pressure of the blood surge is greatly reduced by the time it reaches the venous side of the circulatory system, as it is so far away from the source of the heartbeat. Indeed, the larger veins contain one-way valves along their length to prevent the blood from flowing backwards between heartbeats, in a similar action to that of the valves within the heart itself. When these valves begin to lose their function as we age, the veins become varicosed (abnormally swollen) and the accumulated blood within the veins can often be seen in the lower legs as unsightly 'varicose veins'.

Blood

The circulatory system is filled with about 5 litres of blood in an adult, and it is regulated and kept at a temperature of around 37°C by the process of homeostasis. Blood consists of several cell types floating in a straw-coloured fluid called plasma.

- **Erythrocytes**: red blood cells.
- **Leucocytes**: white blood cells.
- **Platelets**: thrombocytes, which are fragments of larger blood cells called megakaryocytes.

Erythrocytes are biconcave disc-shaped cells (like a doughnut) with no nucleus, so they cannot divide and replace themselves but are constantly produced in the body by the red marrow of certain bones, such as the pelvis and the spinal vertebrae.

Their lack of nucleus and their shape provide the maximum space available for them to carry out their main task, to transport oxygen around the body. They achieve this by attaching oxygen to the red pigment they contain – haemoglobin. As discussed previously, oxygen is vital to all cells to be able to produce energy and carry out their various functions. It is picked up by the erythrocytes in the capillaries of the lungs during external respiration, transported around the body by the circulatory system to wherever it is needed, and then released into the tissues during internal respiration. The presence of the red iron-based protein haemoglobin within the erythrocytes gives blood its characteristic red colour. When the haemoglobin is bound to oxygen molecules, as in arterial blood, it has a bright cherry-red colour, and when there is little oxygen present, as in venous blood, it has a dark reddish-purple colour.

Leucocyte is the collective name for a group of several cells that are mainly concerned with defending the body against attack by micro-organisms and disease. They are made in several areas of the immune system, such as the lymph nodes and bone marrow, and circulate throughout the body constantly. However, when the body comes under attack from micro-organisms, massive numbers of leucocytes pass around the circulatory system to the area of disease, and then squeeze through the capillary walls to the body tissues that are under attack. Here, they surround and destroy the micro-organisms so that the disease is stopped from spreading. In very severe infections, the leucocytes are helped to destroy the invaders by the presence of antibodies released from the body's immune system.

Platelets (or thrombocytes) also contain no nucleus, as they are just separate fragments of a larger blood cell found in the red bone

marrow. Platelets are concerned with the coagulation of blood at the site of injury to prevent excessive blood loss. They achieve this by physically helping to plug damaged blood vessels by acting as a meshwork for the successful formation of a blood clot, as well as by releasing powerful chemicals that assist further in clot formation.

Plasma is the fluid part of the blood that carries the blood cells within it. It consists of about 90% water, with powerful chemicals called plasma proteins floating within, as well as the three types of blood cells. Plasma acts as the transport system of the body, by carrying numerous cells and chemicals from one area to another as they are needed. A summary of its functions is as follows:

- Transport of erythrocytes to allow oxygenation of the body tissues.
- Transport of waste carbon dioxide, dissolved in the plasma, from the body tissues to the lungs for exhalation and removal from the body via the respiratory system.
- Transport of digested food nutrients from the digestive system to the body tissues, for use as fuel to create energy.
- Transport of waste products from these cells to the kidneys, where they are filtered out as urine which is then excreted from the body through the urinary system.
- Transport of leucocytes to the site of any micro-organism attack, to allow the body to defend itself from disease.
- Formation of antibodies and antitoxins from special plasma proteins called globulins, which help the body resist attack in more severe infections.
- Transport of powerful chemicals called hormones, from the glands where they are made to the area of the body where they are required.
- Transport of the plasma protein fibrinogen to the site of any injury, to assist in blood clotting.

Relevant disorders of the circulatory system

Several disorders affecting the circulatory system are relevant to the dental nurse, as they may have an impact on the particular dental treatment offered. They may affect the suitability of local anaesthetics or conscious sedation techniques used, and patients suffering from some disorders may even present as a medical emergency during treatment. The recognition and management of medical emergencies are discussed in Chapter 6.

In particular with disorders of the circulatory system, the disclosure of any of the following points by the patient during medical history taking should be taken into full consideration by the dental team, with regard to the patient's well-being during dental treatment.

- **Heart conditions**: any medical condition that affects the efficiency of the heart may prevent it from coping adequately during stressful situations, such as when experiencing pain, anxiety and fearful events like undergoing dental treatment.
- **Blood disorders**: in particular, those blood disorders that prevent adequate clotting of the blood, as the patient may then experience an uncontrolled haemorrhage; also, any disorders affecting the oxygen-carrying capacity of the blood, which contraindicates the provision of dental treatment under some types of sedation techniques.
- **Medications**: certain medications may react with some types of local anaesthetics used in dentistry, especially those containing *adrenaline* as a vasoconstrictor, and possible interactions may occur with:
    - thyroxine, for an underactive thyroid gland
    - some antidepressants.
- **Other medications**
    - Hormone replacement therapy (HRT) for menopausal women is often linked to a raised blood pressure, so adrenaline-containing local anaesthetics should be avoided.
    - Elderly patients may be on a complicated cocktail of various medications, and the more drugs taken, the more likely an adverse reaction is to occur.

- Some antihypertensive drugs have an unwelcome side-effect of causing gingival tissue overgrowth, or gingival hyperplasia, which can make good oral hygiene levels difficult to achieve.
- Diuretics given to patients with hypertension act by encouraging fluid removal from the body; unfortunately, this can result in reduced salivary flow and the patient will experience a dry mouth, or xerostomia.
- Anticoagulants given to patients at risk of suffering a stroke or myocardial infarction, or who have survived either of these events: these act by reducing the clotting ability of the blood, so preventing the formation of a thrombus but thereby making excessive bleeding more likely during surgical procedures.

Any medication (prescribed or 'over the counter') can be investigated for any potential side-effects or contraindications to dental treatment by looking them up in the *British National Formulary* (*BNF*; Figure 5.7). This book is provided to all registered dentists by the Department of Health and is also accessible online. Further information on how to receive copies is available at www.pharmpress.com.


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BNF
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September 2015
– March 2016
BNF.ORG

Figure 5.7 *British National Formulary*.

The most relevant disorders of the circulatory system are outlined below.

Heart failure

This occurs when the pumping efficiency of the heart itself is inadequate, resulting in its inability to pump enough blood with each beat to allow the body to function normally, and to carry out its normal metabolic activities. It may involve either one of the ventricles or both.

Heart failure occurs either due to a problem with the heart itself or due to a medical condition that increases the workload of the heart as it pumps blood around the body (that is, something that makes the pumping action less efficient or something that restricts the flow of blood away from the heart, so that more effort is required to achieve blood flow).

Those due to a problem with the heart itself include the conditions listed below.

- **Myocardial infarction**: a 'heart attack', where there is a sudden reduction in the supply of oxygenated blood to the heart itself through a coronary artery, often due to blockage by a blood clot (thrombus), and causing a section of the heart muscle to die. This is acute heart failure and often (but not always) results in cardiac arrest (the cessation of the pumping action of the heart).
- **Myocarditis**: inflammation of the heart muscle, usually due to a viral infection.
- **Valvular disease**: affecting any of the four heart valves so that the filling or emptying of the heart is inadequate, and it has to work harder to overcome the resistance to efficient blood movement that the diseased valve causes.

Those due to a medical condition elsewhere that causes an increased cardiac workload include the following:

- **Angina**: a condition of myocardial ischaemia (reduced blood flow) caused by the narrowing and partial blockage of the

coronary arteries which supply the heart itself, and due to the presence of fatty deposits or atheromatous plaques. This is often referred to as 'coronary artery disease'. When the workload of the heart increases, especially during exercise or at times of increased anxiety, the narrowed arteries are unable to supply sufficient oxygenated blood to the cardiac muscle, and symptoms similar to (but not as intense as) a heart attack are felt.

- **Renal failure**: kidney failure results in the sufferer being unable to remove sufficient waste fluids from the body (during urination). This fluid retention causes an increased blood/fluid volume which requires more work by the heart to pump it around the body. Eventually, a point is reached where the coronary arteries are unable to supply sufficient oxygenated blood to the cardiac muscle for it to work effectively, resulting in myocardial ischaemia.
- **Hypertension**: raised blood pressure at rest (rather than during exercise) means that the heart has to pump more strongly to move blood from the left ventricle into the aorta and so out to the body tissues, putting a constant strain on the cardiac muscle. In some patients the coronary arteries are unable to supply sufficient oxygenated blood, and myocardial ischaemia develops.

All these conditions except myocardial infarction are categorised as chronic heart failure, as the ineffectiveness of the pumping action of the heart deteriorates over time, rather than occurring suddenly as it does during myocardial infarction.

Patients suffering from chronic heart failure will experience varying degrees of breathlessness, tiredness and chest pain when they exercise or exert themselves, or when they become anxious such as before or during dental treatment. The reduced flow of oxygenated blood that occurs with chronic heart failure results in that available being diverted to the heart, brain and skeletal muscles and away from other organs, including the kidneys. This results in fluid being retained in the body tissues rather than being urinated, a condition called oedema.

When the right side of the heart is failing, the fluid collects in the body peripheries, especially the ankles (peripheral oedema). When

the left side of the heart is failing, a more serious fluid collection occurs in the lungs (pulmonary oedema) and prevents efficient oxygenation of the blood still further. Eventually, death will occur.

The plaques of fatty cholesterol that become deposited within the coronary arteries of an angina sufferer cause turbulence in the blood flow through these vessels. This not only restricts the volume of blood that can flow through them but it also allows any freely circulating platelets to become attached to the fatty deposits, causing the formation of a blood clot inside the blood vessel itself. This clot is correctly called a *thrombus*.

If the thrombus becomes detached from the blood vessel wall, it will naturally be carried by the circulating blood until it becomes trapped at a narrower point in the circulatory system, causing a sudden obstruction of blood to the tissues beyond. Once circulating, the clot is referred to as an *embolus*, and depending which blood vessel is obstructed, the results may be catastrophic for the patient.

- **Angina**: partial obstruction of one or more coronary arteries.
- **Myocardial infarction**: full obstruction of one or more coronary arteries.
- **Stroke (cerebrovascular accident)**: full obstruction of an artery supplying the brain.
- **Pulmonary embolism**: full obstruction of one of the pulmonary arteries supplying the lungs, often by an embolus originating as a deep vein thrombosis (DVT) in the leg veins.

It is quite possible for patients to be unaware that they are suffering from any of these conditions until an emergency occurs, and then their survival will often depend on prompt and effective BLS until specialist help arrives. Hence the importance of the dental team undergoing regular BLS and resuscitation training.

Cardiac arrest

The sudden failure of the heart to beat at all (asystole) or to beat rapidly but ineffectively without pumping the blood (fibrillation) is called cardiac arrest, and is often the end result of a MI. A cardiac arrest may also occur due to respiratory arrest, electrocution, severe

blood loss, anaphylaxis, drug overdose or for other reasons including severe anxiety, a state that can be seen in some patients who have a profound fear of dental treatment.

Rheumatic fever

This occurs when a patient has suffered a previous illness that has caused damage to the heart valves. Any future episodes of bacteraemia (bacteria in the blood) such as those that can occur following invasive dental treatment, including simple procedures such as scaling, can cause inflammation of the inside of the heart (bacterial endocarditis) with possibly fatal consequences. Until recently, these patients were routinely prescribed prophylactic antibiotics at the time of dental treatment, to avoid developing a bacteraemia. However, this is no longer considered necessary for all patients unless specifically requested by the patient's cardiologist, as the possibility of the bacteria developing resistance to antibiotics and being more difficult to control in future is considered more likely than the patient developing a dangerous bacteraemia.

Anaemias

This is a group of disorders that affect the oxygen-carrying capacity of erythrocytes, so that insufficient oxygen is available for use by the body tissues. This may occur due to heavy blood loss, lack of sufficient erythrocyte production by the red bone marrow (including due to iron deficiency), excessive destruction of erythrocytes by the body, or the production of abnormal haemoglobin as occurs in sickle cell anaemia. The ultimate result is that the patient has poor tissue oxygenation, which may result in an event such as a simple faint. Alternatively, it may become life-threatening if they undergo dental treatment using sedation or general anaesthetic techniques, where the drugs used often reduce the respiratory rate of the patient anyway, so that in combination with an anaemic condition tissue oxygenation becomes dangerously low.

Haemorrhage

Excessive bleeding may occur in patients with clotting disorders (such as haemophiliacs) or in patients prone to thrombus formation who have been prescribed anti-clotting drugs (anticoagulants) such as

aspirin, warfarin or one of the newer drugs such as clopidogrel. Patients who have suffered a stroke or a DVT are routinely prescribed these anticoagulants, and it is normal to find that most elderly patients take a low dose of prescribed aspirin too, to avoid a stroke in the first instance. Routine invasive dental treatment in these patients (especially extractions and other surgical procedures) could result in uncontrolled and life-threatening blood loss, particularly with the newer drugs whose effects cannot be easily reversed in an emergency as they can with warfarin. Their advantage is that regular blood tests are not required to determine their effectiveness, as with warfarin.

The completion of a comprehensive medical history form and its routine updating at the start of every course of treatment will identify any patients with relevant circulatory medical conditions that require careful consideration by the dental team, to ensure that appropriate treatment is provided safely.

Respiration

The main components of the respiratory system are the two lungs, which are immense air-filled sacs situated in the thorax. The heart lies partially over the upper surface of the left lung (Figure 5.8). The lungs are connected to the external environment by a system of air sacs and tubes deep within their structure called alveoli and bronchioles respectively, which join to larger tubes that ultimately become the two main bronchi, and these in turn connect to the trachea or windpipe (Figure 5.9). This travels up the neck and joins the respiratory system to the atmosphere through the larynx in the throat, which connects to the nasopharynx at the back of the mouth and nose (Figure 5.10).

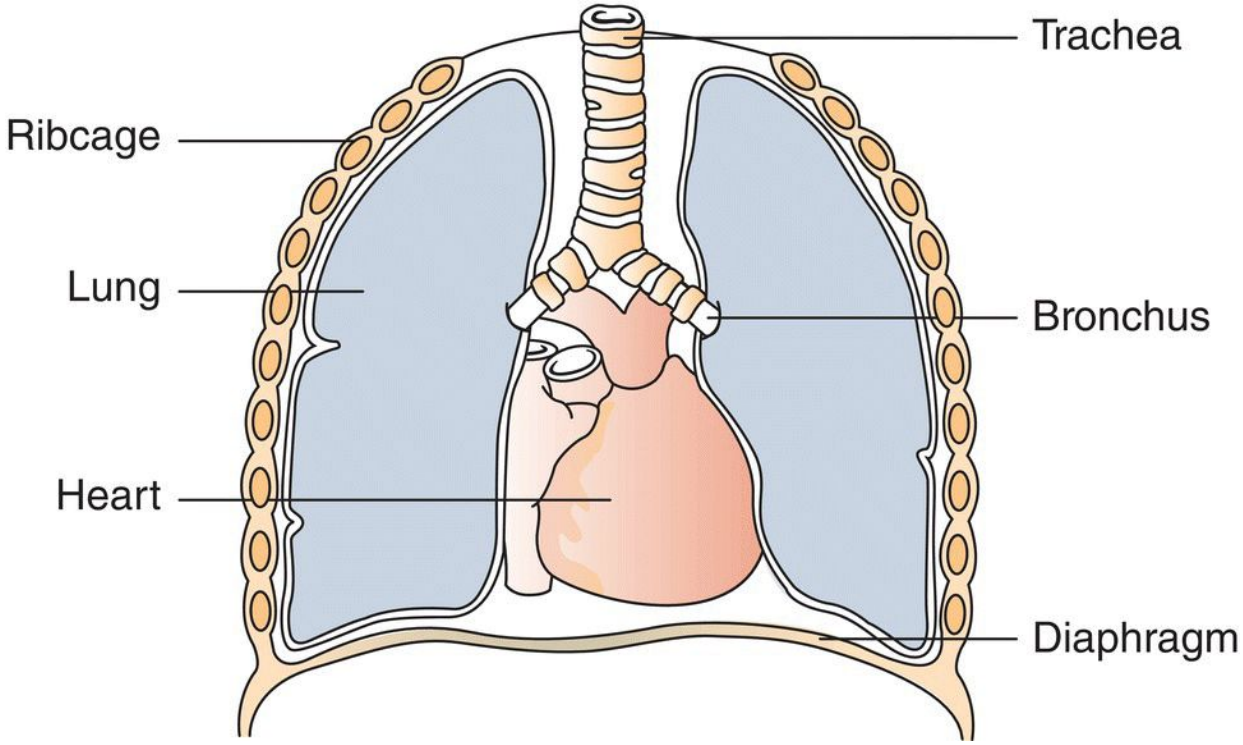


Figure 5.8 The chest contents.

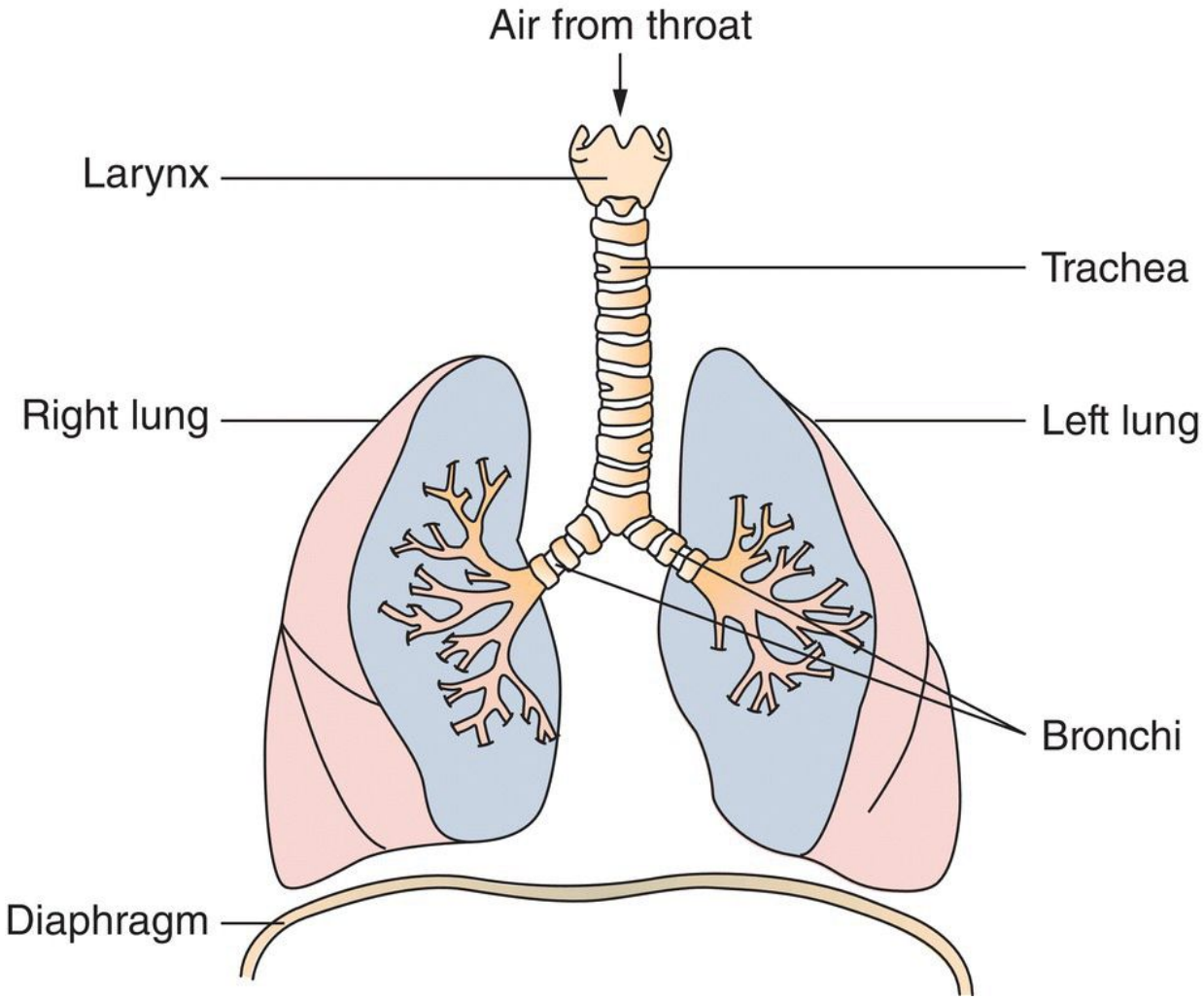


Figure 5.9 Respiratory system.

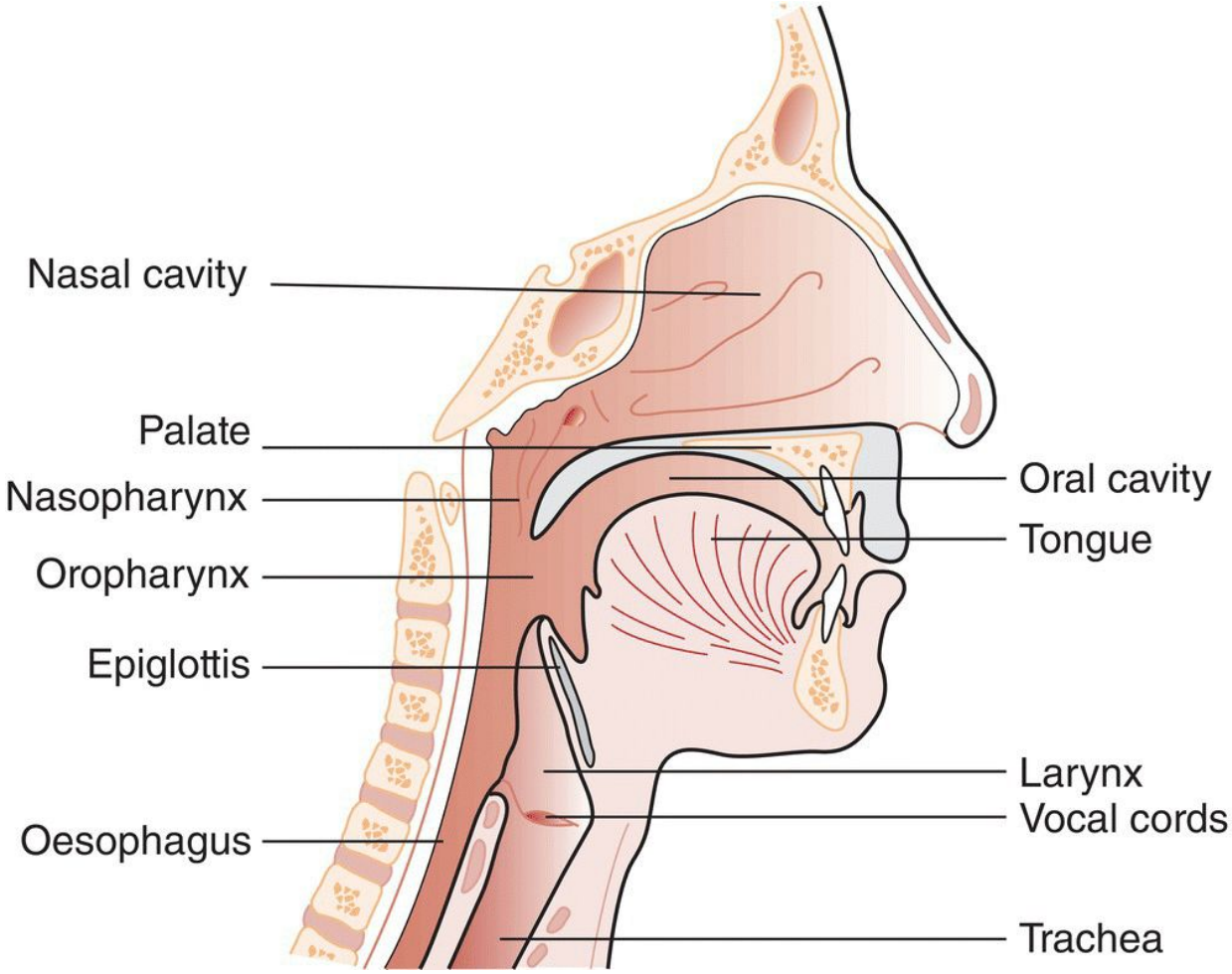


Figure 5.10 Upper respiratory tract.

The functions of the respiratory system are as follows:

- Inhalation of air to provide oxygen for absorption into the circulatory system.
- Expiration of the respiratory waste product, carbon dioxide, from the body.
- Filtering and warming of the inspired air, to remove foreign body particles and prevent irritation of the lung tissues.

The exchange of oxygen and carbon dioxide (external respiration; see Figure 5.3) occurs within the alveoli, which are microscopic air-filled sacs just one cell thick and surrounded by capillaries from the two pulmonary arteries. These vessels transport deoxygenated blood from the whole body to the alveoli, via the right side of the heart. Air

breathed in (inspired) from the atmosphere contains around 21% oxygen and tiny amounts of carbon dioxide, while that breathed out (expired) contains around 16% oxygen. The average 5% difference in oxygen levels is used by the body tissues to help produce energy to function. Expired air contains 4% carbon dioxide too.

The deoxygenated blood taken to the lungs contains carbon dioxide dissolved in the plasma as a waste product formed when energy was produced by the body tissues. This gas has no function in the body; indeed, its presence can cause considerable damage to the cells and organs if not removed, so it passes out of the capillaries into the alveoli and is exhaled with each breath. At the same time, oxygen passes from the alveoli into the lung capillaries and binds itself to haemoglobin in the erythrocytes, and is then transported around the body, via the left side of the heart, as oxyhaemoglobin.

Breathing

The action of inspiring and expiring – breathing – can occur because the thorax is a sealed chamber whose volume can be increased and decreased by the action of the muscles involved with the chest cavity. The thorax is made up of the ribcage with the sternum (breast bone) between, and connected at the back to the spine. The bottom of the ribcage is sealed from the abdominal cavity by a sheet of muscle called the diaphragm.

The contraction of the muscles between the ribs causes them to expand outwards, pulling the lungs out with them because they are attached to the chest wall. At the same time, the diaphragm contracts and pulls the lungs downwards so that the overall result is an increase in the volume of the chest cavity, and therefore also the lungs that are attached to it. This creates a lower atmospheric pressure within the lungs than that of the surrounding environment and consequently air rushes into the expanded lungs and the process of external respiration occurs. Relaxation of the chest muscles and the diaphragm causes a reduction in the volume of the lungs, and expired air is pushed out of them as the person breathes out.

This process of ventilation occurs approximately 16 times per minute in an adult at rest, with an exchange of about a half litre of air at each breath. Both the rate and depth of breathing increase dramatically

during exercise and also when the person is exposed to fearful or anxious situations.

Protective mechanisms

The respiratory system is the only means of supplying the body tissues with oxygen, and as life cannot exist without oxygen, several protective mechanisms have developed as humans have evolved to ensure that the system remains open and functions correctly.

The nose, larynx, trachea and bronchi are all lined with cartilage, a stiff gristly material that is derived from connective tissue. The stiff nature of the cartilage ensures that these areas of the respiratory system remain open at all times, rather than collapsing in on themselves with the pressure changes that occur during the breathing cycle. The nostrils of the nose are also lined by hairs to trap foreign particles that have been breathed in, and the rich blood supply to the nose helps to warm the air as it passes through. Warm air is less irritating to the respiratory tissues than cold air. Larger foreign particles are removed from the nose by sneezing, and from the lower respiratory tract by coughing.

Above the larynx in the throat, the respiratory and digestive systems split off into their own routes, with air passing down the trachea at the front of the throat, and food and drink travelling into the oesophagus behind, and so to the stomach. A special flap of cartilage called the epiglottis falls across the top of the larynx during the action of swallowing, so closing the trachea momentarily and preventing food or drink from passing into the lungs (Figure 5.11).

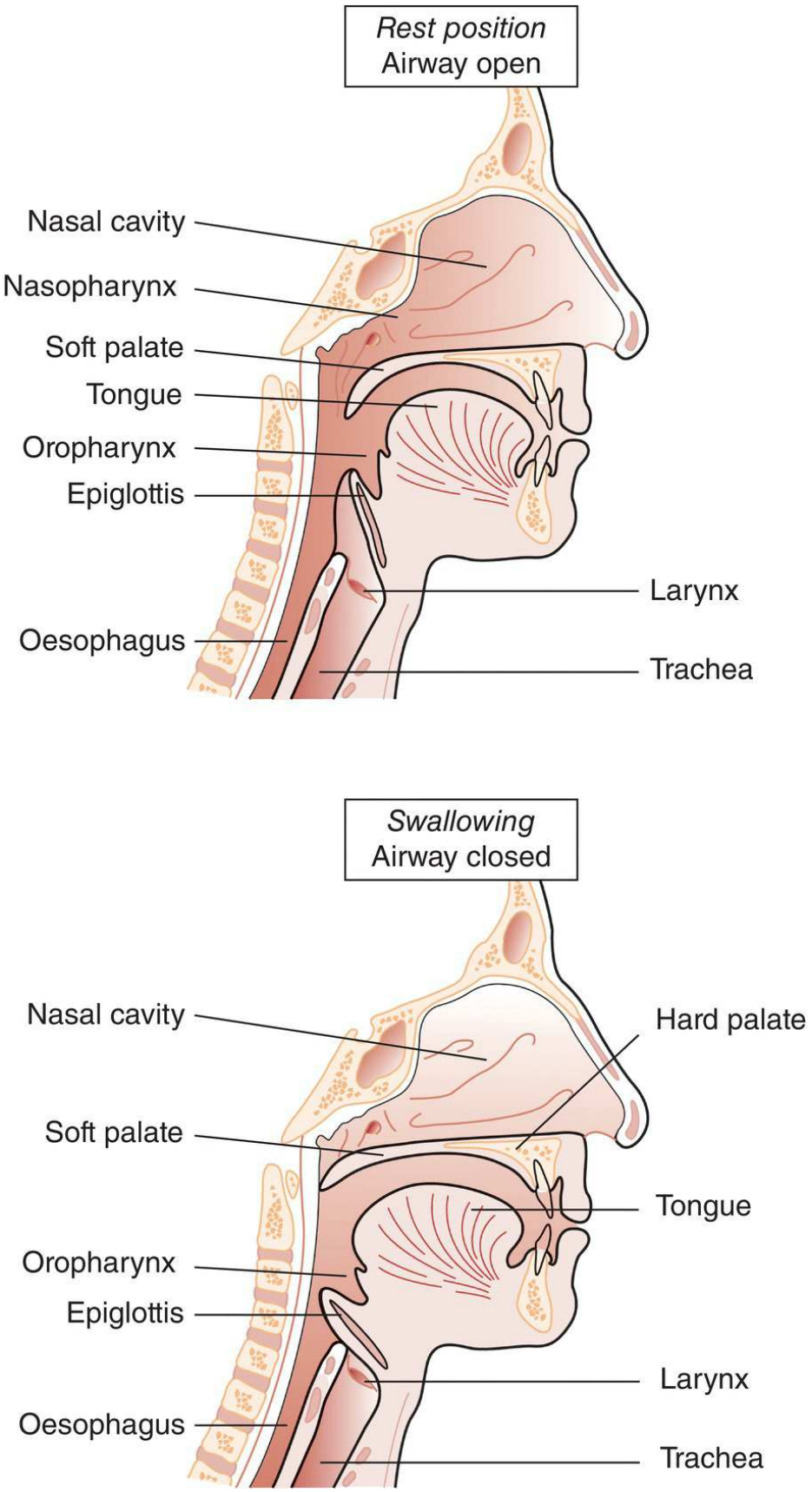

Rest position
Airway open
Nasal cavity
Nasopharynx
Soft palate
Tongue
Oropharynx
Epiglottis
Larynx
Oesophagus
Trachea
Swallowing
Airway closed
Nasal cavity
Hard palate
Soft palate
Tongue
Oropharynx
Epiglottis
Larynx
Oesophagus
Trachea

Figure 5.11 Swallowing action, showing soft palate motion to seal nose and epiglottis motion to seal trachea.

In addition, the whole respiratory tract is lined by cells that produce a sticky coating called mucus, and these cells have microscopic hair-like projections called cilia that together trap any finer particles of dust and dirt, and then gently waft them back up the respiratory system away from the lungs and towards the mouth and nose. The foreign particles can then be expelled from the body by coughing or blowing the nose, or they can be swallowed and enter the digestive system to be expelled that way.

Relevant disorders of the respiratory system

Again, several disorders are of relevance to the dental nurse as they may affect the choices available for dental treatment as well as the manner in which the treatment can be provided. In particular with disorders of the respiratory system, the disclosure of any respiratory disease during medical history taking that may compromise the patient's ability to oxygenate their body tissues, or any specific allergies to dental products (such as latex) that may result in breathing difficulties, should be taken into full consideration by the dental team when considering the patient's dental treatment.

The most relevant disorders of the respiratory system are outlined below.

Bronchial asthma

This is a hypersensitivity response to inhaled particles that compromises the patient's breathing by constricting their airways, making exhalation, in particular, difficult to achieve. Asthma attacks can be brought on by anxiety (including the prospect of dental treatment) and can be life-threatening if the airways are not quickly reopened with the use of appropriate drugs. Asthma may also occur as a response to exercise or exposure to cold air, such as during the winter months. The dental team should also be aware that non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen and aspirin can exacerbate asthma.

Anaphylaxis

Although not strictly a respiratory disorder, the severe allergic reaction of anaphylaxis has a catastrophic effect in shutting down the airways and preventing adequate breathing and tissue oxygenation. Death can occur quickly from either suffocation or cardiac arrest.

Bronchitis

This is inflammation of the bronchi following a respiratory infection (acute bronchitis) or more usually as a slow-onset disease, especially in smokers and those living in areas of heavy industrialisation (chronic bronchitis). Acute bronchitis sufferers are unlikely to be seen in the dental workplace, as they are often bed-bound with the short-lived illness. In chronic bronchitis sufferers, the airways become increasingly narrowed and copious amounts of sputum are coughed up on practically a daily basis. Sufferers are prone to repeated chest infections, which further damage their respiratory system and compromise their breathing. They are unsuitable patients for treatment under conscious sedation in practice, and should only undergo treatment under general anaesthetic as a last resort.

Emphysema

This condition is characterised by abnormal widening and enlargement of the alveoli, preventing the adequate gaseous transfer that occurs during external respiration without the additional help of supplemental oxygen. This occurs in response to damage by inhaled pollutants, such as tobacco smoke and industrial fumes and smoke, including that from vehicle exhausts. Bronchitis and emphysema occurring together is called *chronic obstructive pulmonary disease* (COPD).

Inhaled foreign body

This event can occur at any time, but the dental patient is especially vulnerable during treatment, as fine instruments are used and the patient is often lying supine (laid back flat in the dental chair). If a foreign body is inhaled, it tends to fall into the right bronchus as this lies in a near-vertical line with the trachea. The patient will exhibit sudden signs of choking as the foreign body passes into the laryngeal region of the throat, and if it passes further into the respiratory system its removal may involve chest surgery. Details of the

emergency actions to take in the event of a patient choking are discussed in Chapter 6.

Digestion

The digestive system is composed of the following structures:

- The **mouth** and associated **salivary glands**.
- The **pharynx**, where swallowing occurs.
- The **oesophagus**, which lies behind the trachea and transports food from the mouth to the stomach.
- The **stomach**, where the majority of ingested foods are stored while being broken down for absorption.
- The **small intestines**, where the final stages of digestion and absorption of various nutrients occur.
- The **large intestines**, where digestive waste products are stored before elimination by defecation, and water and salts are reabsorbed into the body.
- Accessory digestive organs: the **pancreas**, **liver** and **gallbladder**.

The oesophagus runs through the thorax and connects the head and neck structures of the digestive system to those lying in the abdominal cavity, namely from the stomach downwards. The digestive system is more correctly referred to as the *gastrointestinal tract* (GIT), and is illustrated in Figure 5.12.

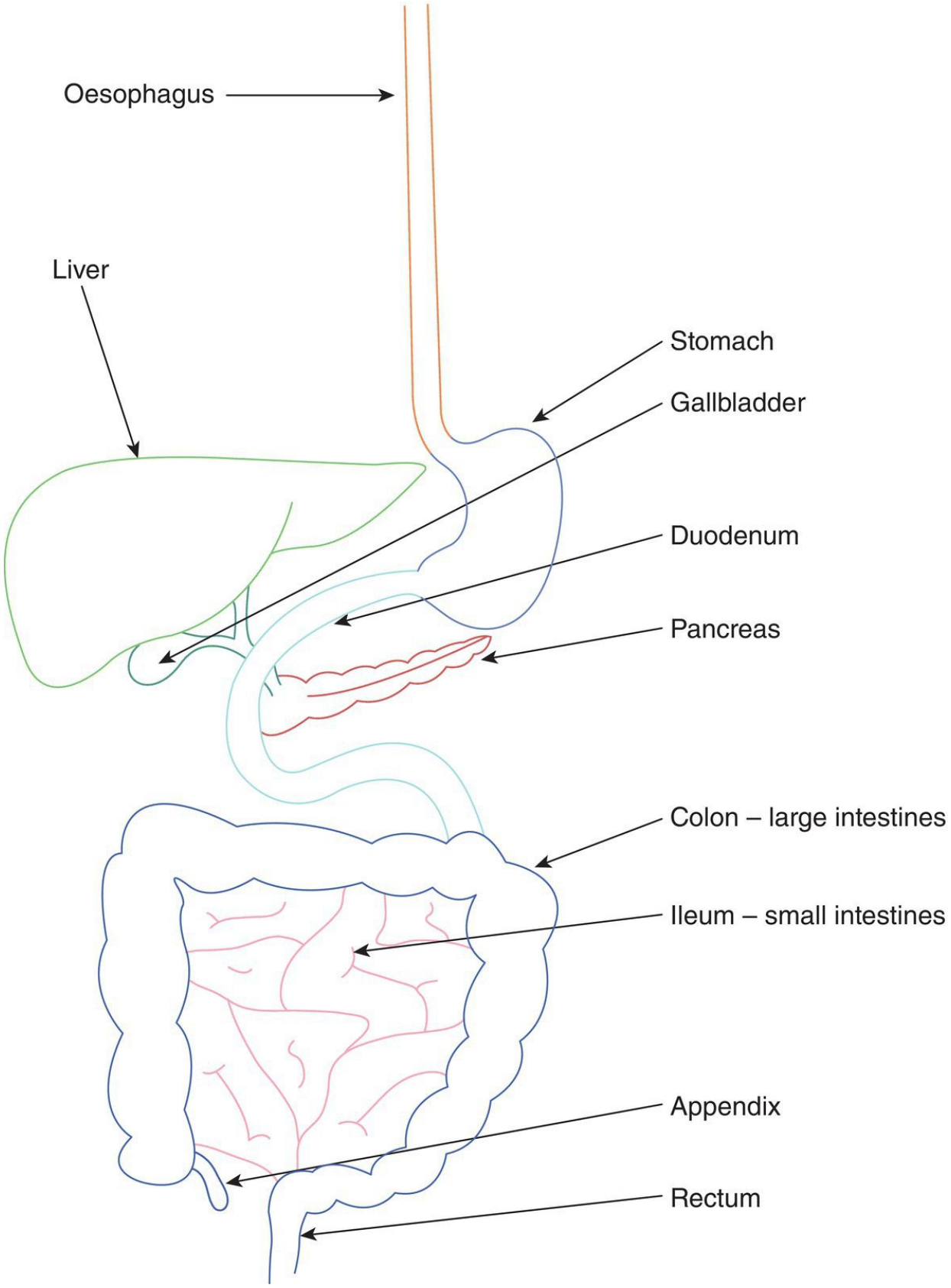

Oesophagus
Liver
Stomach
Gallbladder
Duodenum
Pancreas
Colon – large intestines
Ileum – small intestines
Appendix
Rectum

Figure 5.12 Gastrointestinal tract and accessory organs.

The various digestive organs act to:

- break down and absorb the nutrients within food
- transfer these nutrients to the circulatory system for transport to all areas of the body
- detoxify (make less harmful) any substances not required by the body
- remove any solid waste products from the body during defecation.

All living organisms need food:

- for growth
- for replacement of worn and damaged cells
- as a source of energy to enable normal bodily functions to occur, for the organism to live and survive.

The food we eat cannot be used directly by the tissues to produce energy, but has to be physically broken down and chemically digested into nutrients by the action of powerful chemicals called enzymes. The enzymes involved are very specific for the different classes of food eaten, and these classes can be grouped as follows:

- **Proteins**: these are found in meat, fish, eggs, milk, cheese, beans and some cereals; they are necessary for cell growth and repair.
- **Carbohydrates**: these are found in sugars from fruit, vegetables and processed foods, or in starch from bread, cereals and potatoes; they are necessary for cell energy production.
- **Fats**: these are found in meat, milk, cheese and butter from animals or seed and fruit oils from plants; they are necessary for energy production, and when stored beneath the skin act as insulation against the cold environment and so help to maintain body temperature.

- **Vitamins**: several different vitamins are required for health but only in small quantities, specifically vitamins A, B group, C and D.
- **Minerals**: in very small quantities again, specifically calcium, phosphates, fluoride, sodium and iron.
- **Water**: more than 80% of the body is made up of water, and it is required by all cells and tissues for normal bodily functions.

Digestive system

All food and drink enters the body through the mouth, where it is masticated (chewed) by the teeth and mixed with saliva to begin carbohydrate digestion, before being swallowed. The correct term for swallowing is deglutition. The anatomy of the teeth and the biology and physiology of saliva are covered in detail in Chapter 10. As shown previously, swallowed particles are directed towards the oesophagus and prevented from entering the trachea by the action of the epiglottis in the larynx (see Figure 5.11). The particles are also prevented from entering the nose by the raising and sealing action of the soft palate across the nasopharynx.

The one-way, wave-like muscular action of the oesophagus (called peristalsis) pushes the swallowed foods down the throat, through the thorax (behind the heart and lungs) and into the abdominal cavity to the stomach. The acid and enzymes in the stomach begin digesting any proteins and fats, and removing any iron available for haemoglobin production, before the food passes out into the small intestines, where digestion is completed. The acidic stomach contents (with a pH value of 2) are neutralised by alkaline bile as they pass into the small intestines. Bile is made in the liver and stored before use in the gallbladder. The pancreas also assists digestion by manufacturing and secreting various enzymes into the small intestines, where they act on proteins, carbohydrates and fats to aid food digestion, by breaking these foods down into their chemical constituents. The pancreas is also responsible for the release of the hormones insulin and glucagon directly into the circulatory system, and these hormones act to control the blood glucose levels in the body.

An indigestible mass is all that remains of the original food bolus by the time it reaches the end of the small intestines, after the digestive actions that have occurred. This is moved by peristalsis into the large intestines, where water and minerals are reabsorbed into the circulatory system before the remaining semi-solid mass is excreted through the rectum during defecation.

Liver

As the foods are broken down and digested, they are absorbed through the stomach and intestines into the underlying blood capillaries. The capillaries join to become the portal vein which carries the nutrient-rich blood to the liver for storage. The nutrients are then released by the liver as required by the body cells. The liver acts as the chemical factory of the body, and its functions are as follows:

- Storage and distribution of carbohydrates.
- Storage of vitamins.
- Manufacture of bile for fat digestion and neutralisation of stomach acid.
- Manufacture of plasma proteins for the blood.
- Detoxification of drugs and alcohol.
- Disposal of waste products.
- Storage and distribution of iron.

Relevant disorders of the digestive system

In particular with disorders of the digestive system, the disclosure of any of the following points by the patient during medical history taking should be taken into full consideration by the dental team, with regard to the patient's dental treatment.

- **Regurgitation conditions**: any condition likely to cause acid reflux of the stomach contents back into the oesophagus has the potential to cause enamel erosion of the teeth, in a similar way to consuming acidic foods and drinks regularly. Reflux occurs when

there is an increased abdominal pressure over that in the chest cavity, and common causes are late pregnancy and hiatus hernia.

- **Vomiting**: any medical condition, emotional disorder such as bulimia, or pregnancy, that results in regular vomiting over a period of time will have an erosive effect on the teeth.
- **Liver disease**: any medical condition or lifestyle choice (such as high alcohol consumption or drug taking) may affect the ability of the liver to carry out its detoxification role, so that the effects of any drugs given during dental treatment are increased (potentiated) and/or take longer to wear off.
- **Malnourishment**: any medical condition affecting the ability of the digestive system to absorb nutrients from food, or having a poor diet, may result in the patient becoming malnourished over time so that they may be prone to infections, have poor wound healing abilities, and appear listless and lethargic; this is especially so with elderly patients.
- **Medications**: the use of long-term steroid medication for some digestive conditions may make the patient less able to cope with trauma and stressful situations, as their body's ability to cope with these events becomes inactivated due to the drugs prescribed; this can result in the patient's collapse during times of anxiety, such as when attending for dental treatment.

The most relevant disorders of the digestive system are outlined below.

Dysphagia

Difficulty in swallowing (dysphagia) is usually due to an actual underlying medical condition, including any of the following:

- Dry mouth (xerostomia).
- Mucosal damage due to acid reflux conditions.
- Poor muscular control during swallowing.
- Oesophageal tightening, due to scarring from reflux or from oesophageal tumours.

- Poor nervous control during swallowing, due to a stroke or other central nervous conditions.

Dysphagia does not tend to refer to the intermittent inability to swallow due to psychological reasons, as can occur when the patient is anxious or fearful, especially when taking medicinal tablets, for instance.

Gastro-oesophageal reflux

This regurgitation effect occurs when the stomach contents pass back (reflux) into the oesophagus, and results from an increased abdominal pressure over the thoracic pressure, or when the junction with the oesophagus remains relaxed for extensive periods.

The pressure difference often occurs in the following instances:

- after a heavy meal
- eating just before lying down or bending
- in the late stages of pregnancy, when the size of the fetus displaces the other abdominal contents and pushes against the stomach.

The burning sensation of the acidic stomach contents passing into the oesophagus causes the typical pain of indigestion or ‘heartburn’. In severe instances, this can be mistaken for the pain associated with angina or even a heart attack.

Hiatus hernia

The oesophagus passes through the diaphragm to join the stomach in the abdominal cavity at a natural opening called the hiatus.

When a hiatus hernia occurs, the junction of the oesophagus and the stomach moves up through the opening in the diaphragm and becomes trapped there, so that a portion of the stomach is lying above the diaphragm itself, and in the thoracic cavity. This restricts the normal digestive movements and emptying of the stomach, and causes a reflux of stomach contents into the oesophagus. Again, the pain of indigestion will be felt by hernia sufferers, especially after a meal has been taken.

Hiatus hernias usually require surgical intervention to repair the diaphragm.

Gastric ulcers

During normal function, the stomach protects itself from acid damage by producing a protective layer of mucus and alkaline fluid from its specialised cells, and by preventing acid leakage into the deeper layers of the stomach walls.

Any drug or condition that increases acid production, or slows down mucus production, may allow acid leakage into these deeper layers, resulting in inflammation of the inner lining of the stomach, called gastritis. When the acid damage is severe enough, the stomach wall is eroded and an ulcer develops.

A similar condition can also affect the first section of the small intestines, the duodenum, and develops as a duodenal ulcer.

Drugs and conditions associated with gastric and duodenal ulcers include:

- caffeine, especially from strong coffee
- nicotine
- NSAIDs such as aspirin and ibuprofen
- stress
- infection with the micro-organism *Helicobacter pylori* within the stomach itself.

Bulimia

This is a psychological condition where the sufferer has a profound fear of becoming overweight, and prevents this by self-inducing vomiting after each meal. The constant acidic vomit in the mouth will eventually cause classic signs of erosion on the palatal surfaces of the upper anterior teeth, and this may often be the first signs of the condition that are detectable.

Crohn's disease

A chronic inflammatory disease that can affect any part of the GIT (including the mouth, where it often presents as recurrent aphthous ulceration) but which usually occurs in the small intestines, particularly at the end where they join the large intestines.

The cause is unknown, but it may be an allergic reaction to an infectious agent. With time, the walls of the intestines become thickened and their ability to absorb nutrients from food diminishes, so that the sufferer becomes generally unwell and loses weight.

In severe cases, the intestinal swelling is bad enough to restrict normal peristalsis and GIT obstructions occur. Abscesses and fistulas (abnormal passageways) also occur in a significant number of sufferers.

Many sufferers are prescribed short, intense courses of steroids but others may require long-term steroid treatment for the condition. In severe cases, surgery may be required to remove sections of the GIT that have become badly diseased or obstructed.

Ulcerative colitis

A chronic inflammatory disease that affects the lining of the colon and rectum only, rather than affecting any section of the GIT as does Crohn's disease.

Its cause is unknown, and symptoms tend to be more severe than with Crohn's disease. Anaemia may occur due to extensive blood loss from the ulcerated colon, and in long-standing cases there is an increased risk of developing bowel cancer.

Again, many sufferers are prescribed long-term steroid treatment to help control the symptoms. In severe cases, and at the first indication of bowel cancer, the colon may have to be surgically removed, a procedure called a colectomy.

Diabetes

This is a disorder caused by reduced or non-existent production of insulin by the pancreas. There are two types of diabetes:

- **Type 1 insulin-dependent diabetes**: the more severe form, and developing in younger sufferers, it occurs rapidly following

the destruction of the specialised area of the pancreas where insulin is produced, often following a viral infection.

- **Type 2 non-insulin-dependent diabetes**: develops gradually in older sufferers, and is the result of insufficient insulin production; there is often a genetic predisposition to the disease.

The reduced, or absent, levels of insulin in the undiagnosed sufferer allow a rise in blood glucose levels, which produce the following symptoms to a greater or lesser degree:

- **Excess urine production**: the body attempts to eliminate the free glucose, because it cannot be stored or used by the body tissues.
- **Excessive thirst**: due to the increased loss of fluid from the body by urination.
- **Prone to infection**: the excess glucose levels impair the ability of the body cells to fight infection.
- **Weight loss**: the body cells release stored fat in an attempt to generate some energy.
- **Fatigue**: the body cells are unable to take up and use the circulating glucose for energy production.
- **Peripheral neuropathy**: tingling and numbness in the extremities, as peripheral nerves and blood vessels degenerate more rapidly.

Many people with type 2 diabetes are unaware of their disorder, although obesity is the main factor that generates medical intervention and a diagnosis. The dental team are in a prime position to help recognise undiagnosed type 2 diabetics by offering simple health checks during patient recall appointments. Routine blood monitoring at a dental recall appointment using a fingerprick device (Figure 5.13) can help identify those patients with an abnormal blood glucose level, prompting referral for further investigation by their GP. Once diagnosed, a combination of diet control and/or medication and/or insulin injections will maintain acceptable blood glucose levels, so that the sufferer does not become either *hyperglycaemic* (high blood glucose) or *hypoglycaemic* (low blood glucose). Both of

these conditions can result in the patient slipping into a coma if not diagnosed and treated rapidly.

Figure 5.13 Example of blood monitoring device with lancet and test strip.

People with diabetes also have a tendency to develop infections easily and to experience poor wound healing generally, including with conditions such as periodontal disease.

Sensible dietary measures combined with controlled weight reduction are often all that many people with type 2 diabetes require to keep their symptoms under control.

Liver disease

No matter what the cause, liver disease is likely to affect the ability of the patient to store and use food nutrients efficiently, and to be unable to detoxify many drugs, including local anaesthetics, sedatives and general anaesthetics. The following liver disorders may come to light during the taking of the patient's medical history.

- **Cirrhosis**: chronic damage of the liver cells, producing scarring and gradual loss of liver function; may be associated with high alcohol consumption, but also with diseased bile ducts and with cystic fibrosis.
- **Hepatitis**: inflammation of the liver, and can be due to alcohol and other drug abuse or to viral infections such as hepatitis A, B or C (as these can be transmitted sexually, they are often not declared by the patient).
- **Cancer of the liver**: both of the above conditions can develop into primary liver cancer.

Hepatitis B is of particular concern to the dental team as it is a blood-borne virus, and it is now mandatory for all clinical staff to be vaccinated against the 'B' virus throughout their working lives.

Nervous system

The nervous system is composed of the following parts:

- The brain and spinal cord, forming the **central nervous system**.
- The peripheral nerves, autonomic nerves and enteric nerves, forming the **peripheral nervous system**.
- The **sensory organs** of the eyes, ears, tongue (taste) and nose (smell).

The brain is the organ responsible for the continuation of life, by acting as the control centre of the body. All basic life functions, such as maintenance of the heart rate, respiration and the control of body temperature (*homeostasis*), are controlled by the brain. Damage to the brain, when severe enough and when affecting the areas responsible for these basic life functions, will result in the death of the patient.

Information required by the brain to maintain these functions is received from the body and its surroundings via certain types of peripheral nerves, and the necessary adjustments required to allow the body to respond to this information are then transmitted from the brain to the body by other types of peripheral nerves.

Types of peripheral nerves

The peripheral nervous system is composed of various types of nerves, each with their own specific functions. The cells of the brain receive information from the body and its surroundings via one type of nerve, and specialised central nerve cells found only in the brain analyse and interpret this information, ready to instruct the body on how to respond to it.

Once the message has been interpreted and a suitable response formulated, the brain sends messages to the relevant parts of the body to act on the information accordingly, via various other types of peripheral nerves.

The types of peripheral nerves involved are as follows.

Sensory nerves

These nerves carry information from the body to the brain, to be interpreted and acted upon. The information they carry includes the following sensations:

- **Pain**.
- **Temperature**: both hot and cold.
- **Touch**.
- **Specialised sensations**: sight, sound, taste, smell.

The peripheral nerves of relevance to the dental nurse are sensory nerves which send information from the oral cavity to the brain, and they are discussed in detail in Chapters 9 and 10.

Motor nerves

These nerves carry information from the brain to the body, to allow the body to respond to the information received accordingly. The motor nerves can be subdivided further, depending on their function.

- **Somatic nerves**: carry impulses to the **musculoskeletal system**, to allow voluntary movement (controlled by conscious thought) of the body by the co-ordinated contraction and relaxation of relevant muscle groups.
- **Autonomic nerves**: carry impulses to blood vessels and internal organs, to effect involuntary actions (cannot be controlled by conscious thought), such as blood vessel constriction or dilation.
- **Enteric nerves**: carry impulses specifically to the GIT, to effect peristalsis and digestive secretions, and to regulate blood flow to the area during digestion; these are also involuntary actions.

The motor nerves of particular relevance to the dental nurse are those somatic nerves that supply the muscles associated with the oral cavity (muscles of mastication and facial expression), and the autonomic nerves that control the flow of saliva from the salivary glands.

Throughout the body, the sensory and motor peripheral nerves travel together and with blood vessels, in what are known as *neurovascular bundles*.

Nerve transmission

All information that passes from the body and the external environment to the brain, its analysis, interpretation and the actions that are generated as a consequence are transmitted as *simple electrical impulses* throughout the nervous system.

These electrical impulses are able to be transmitted due to the difference in chemicals on the inside and the outside of each nerve cell (neurone), mainly potassium on the inside and sodium on the outside of the nerve cells. At rest, there is more potassium and sodium outside the neurone than inside, and this means that there is an electrical difference between the outside and the inside of the nerve cell too. When the neurone is stimulated, by a sensation such as the skin being gently touched or a cold drink stimulating the teeth, this electrical difference changes in a wave-like surge along the neurone from the point of stimulation all the way to the brain, as the potassium and sodium flow back into the neurones. This wave-like surge of electricity is called the *nerve impulse*.

The central nerve cells in the brain then analyse the nerve impulse that they have received, and send out a corresponding electrical surge through the motor nerve cells, all the way back to the area of initial stimulation, with instructions for the necessary action that needs to be taken by the body. In the examples given, the gentle touch sensation of the skin will be recognised as pleasant (with no avoidance action to be taken), while the cold sensation on the teeth will be recognised as painful, and avoidance action will be taken to move the cause of the cold away from the teeth. The whole process takes just a tiny fraction of a second to occur.

Once the nerve impulse has passed, the potassium and sodium chemicals will move back out of the neurone and restore the chemical levels to how they were before the nerve was stimulated.

The effect that local anaesthetics have on this nerve transmission process is discussed in Chapter 14.

The brain and spinal cord

The brain and spinal cord are encased respectively within the skull and the vertebral column of the spine. They are both covered by three membranous layers called the *meninges*, the inner two layers being separated by the *cerebrospinal fluid* (CSF). This clear fluid is secreted by specialised areas within the brain itself, and it acts in a shock-absorber capacity to protect the brain and spinal cord. During normal head movements, both structures float gently in the CSF and are therefore prevented from 'bouncing around' and becoming damaged within the confines of the skull and vertebral column.

The brain consists mainly of two *cerebral hemispheres* which take up the vast majority of the skull, and these are formed from four lobes in each hemisphere, named as follows and in line with the bony plates of the skull itself (see Chapter 9):

- **Frontal lobes**, forming the forehead region.
- **Parietal lobes**, forming the top sides of the head.
- **Temporal lobes**, forming the lower sides of the head in the ear region.
- **Occipital lobes**, forming the back of the head.

The areas of the brain are shown diagrammatically in Figure 5.14.

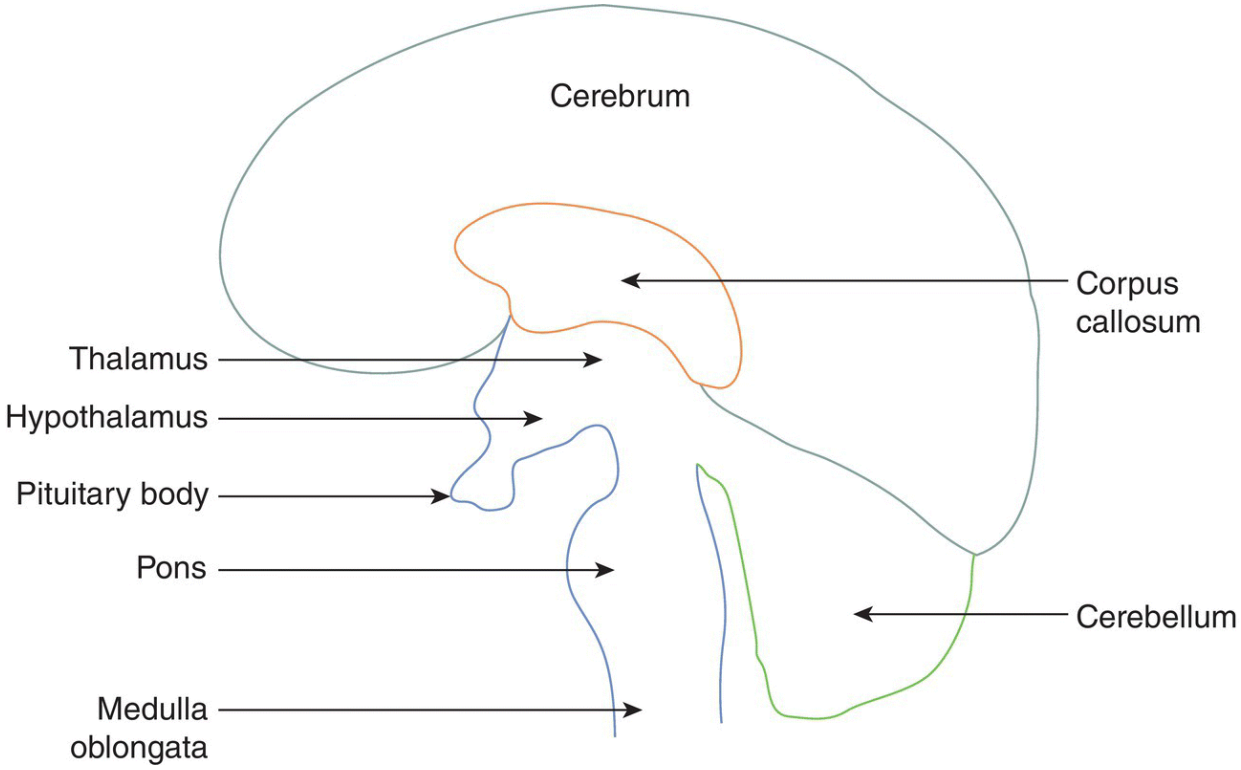


Figure 5.14 Areas of the brain.

The cerebral hemispheres appear as vastly convoluted folds of nerve tissue, the layout of which provides a huge surface area of specialised nerve cells appearing as the characteristic 'grey matter' of the brain itself. It is here that thought, learning, memory and understanding of the world and the environment occur.

At the back of the brain, beneath the occipital lobes of the cerebrum, lies the 'hindbrain' or *cerebellum*, which is concerned with the control of balance and posture and the co-ordination of movement. Beneath the middle region of the brain the cerebral hemispheres lie over a structure called the 'brainstem' or *medulla oblongata*, which is the control centre for all the basic brain functions necessary for life – respiration, heart rate, control of body actions during times of stress, etc.

At the very base of the medulla oblongata, the nerve tissue forms into the top end of the spinal cord, and this then passes out of the skull through the large opening called the *foramen magnum* and runs down the length of the vertebral spine to the pelvis.

As the spinal cord runs down the bony spine, it gives rise to sequential pairs of nerves at each vertebral joint along its full length – sensory nerves entering the column and motor nerves leaving it. These form the *systemic nerves*, which receive sensations from the whole body except the head and neck region, and transmit motor impulses to the same body areas.

The nerves supplying the head and neck region leave the brain directly from its undersurface through various natural bony openings called *foramina*, emerging as the 12 pairs of *cranial nerves*.

The cranial nerves

The 12 pairs of cranial nerves are numbered with roman numerals, but each has its own name too.

Some of the cranial nerves are of particular importance to the dental team because they supply the oral cavity and its surrounding structures. Those relevant to the dental nurse are shown in bold in Table 5.2, which lists the 12 pairs of cranial nerves in full.

Table 5.2 Twelve pairs of cranial nerves: those in bold are relevant to the dental nurse.

Roman numeral	Name of nerve	Nerve function
I	Olfactory	Sensory: smell
II	Optic	Sensory: sight
III	Oculomotor	Motor: external eye muscles Parasympathetic: pupil size
IV	Trochlear	Motor: external eye muscles
V	**Trigeminal**	**Sensory: pain, temperature, touch of teeth and oral soft tissues** **Motor: muscles of mastication**
VI	Abducens	Motor: external eye muscles
VII	**Facial**	**Sensory: taste from anterior two-thirds of tongue** **Motor: muscles of facial expression** **Autonomic: salivary glands**
VIII	Auditory	Sensory: hearing and balance
IX	**Glossopharyngeal**	**Sensory: taste from posterior tongue** **Motor: control of swallowing** **Autonomic: salivary glands**
X	Vagus	Sensory: from the abdominal region Parasympathetic: to the thorax and abdomen
XI	Accessory	Motor: neck muscles and the larynx
XII	**Hypoglossal**	**Motor: tongue muscles**

The first and second column list the relevant roman numeral and name of each nerve respectively, while the third column identifies the

types of peripheral nerve that are present in each, whether sensory, somatic motor or autonomic. None of the cranial nerves is concerned with enteric impulse transmission to the GIT. The cranial nerves of particular importance to the dental team are highlighted in bold, and are the trigeminal (V), the facial (VII), the glossopharyngeal (IX) and the hypoglossal (XII) nerves. All except the hypoglossal nerve are composed of both sensory and motor components, and their various functions are discussed in detail further in the text.

Relevant details of the four cranial nerves that are dentally important are given in Chapters 9 and 10. The specialised sensation of taste is covered in detail in Chapter 10. Full details of all the cranial nerves are available in *Basic Guide to Anatomy and Physiology for Dental Care Professionals*.

Relevant disorders of the nervous system

Some disorders affecting the nervous system are relevant to the dental nurse, as they may have an effect on the dental treatment offered. They may cause difficulty in providing dental treatment or in allowing an adequate level of oral hygiene to be maintained, or sufferers may present as a medical emergency during treatment. The recognition and management of medical emergencies are discussed in Chapter 6.

In particular with disorders of the nervous system, the disclosure of any of the following points by the patient during medical history taking should be taken into full consideration by the dental team, with regard to the patient's dental treatment.

- **Previous stroke**: this may have resulted in poor speech and/or muscular control that may make communication, swallowing and oral hygiene maintenance difficult for the patient.
- **Epilepsy**: a patient with poorly controlled epilepsy may have a seizure at any time, and this is a medical emergency that the dental team should be able to manage successfully.
- **Medications**: stroke sufferers will be taking some form of anticoagulation therapy to prevent a recurrence of their condition, and epileptics may be taking medication that has a detrimental effect on their oral soft tissues.

The most relevant disorders of the nervous system are outlined below.

Stroke (cerebrovascular accident)

The blood supply to the brain is well controlled by numerous normal body mechanisms. In fact, at times of severe blood loss or reduced blood oxygenation, the body will deliberately divert blood from other organs to the brain in an attempt to maintain the cerebral circulation.

A stroke occurs when there is a sudden alteration in cerebral blood flow, due to one of the three following events:

- **Cerebral thrombosis**: the formation of a blood clot within a brain artery, reducing or cutting off the oxygenated blood supply to that region (in a similar fashion to the onset of a heart attack when a coronary artery supplying the heart is blocked).
- **Cerebral embolism**: the blockage of a brain artery by a loose blood clot formed elsewhere in the body, that detaches from the blood vessel wall and circulates to the brain.
- **Cerebral haemorrhage**: when a cerebral blood vessel ruptures and bleeding occurs within the skull, causing increasing pressure on the brain.

The effects of a severe stroke are of sudden onset, but the signs that occur will depend on the area of the brain affected. Also, the nerves supplying the left side of the body cross over to the right side of the brain and vice versa, so a left-sided stroke will show as a range of right-sided neuromuscular weaknesses and a right-sided stroke will have the opposite effects. The speech centre is located in the left side of the brain and can be affected to varying degrees following a left-sided stroke.

Stroke victims who survive the actual medical emergency are routinely prescribed one of various powerful anticoagulants such as warfarin or apixaban, to prevent the formation of another thrombus and therefore another stroke. As the taking of these drugs can allow uncontrolled haemorrhage to occur during surgical procedures (including dental treatment), those patients prescribed warfarin have routine blood tests to monitor the clotting ability of their blood. The results are recorded as an *international normalised ratio* (INR)

score, and this is currently advised to be between 2 and 4 if surgical dental treatment is to be carried out safely. Those patients prescribed the newer anticoagulants such as clopidogrel or apixaban do not have to undergo these regular blood tests, but they are still at risk of haemorrhage during or after dental surgery and, unlike warfarin, there is no specific reversal drug available if haemorrhage does occur. The dental team must therefore take great care and medical advice before providing surgical treatment to these patients.

Transient ischaemic attack

When a small partial blockage of a cerebral artery occurs, the signs and symptoms are far less dramatic, often exhibiting just as a mild visual disturbance or a brief memory lapse lasting minutes. This is known as a transient ischaemic attack or TIA.

The sufferer will make a full recovery but the experience is actually a warning signal that a full-blown stroke could occur in future, in a similar way to angina attacks having the potential to develop into a full myocardial infarction. The TIA indicates that part of the brain has a reduced blood flow.

These patients are usually prescribed aspirin as a mild antiplatelet therapy, to prevent further TIAs or an actual stroke, and again the potential for uncontrolled haemorrhage to occur must be recognised and managed by the dental team during the provision of dental treatment.

Epilepsy

When the usually well-organised and regulated electrical activity of the nerve cells in the brain becomes temporarily abnormal and disorganised, the sufferer is said to have a *seizure*. During a seizure, the normal electrical discharges of the nerve cells become completely chaotic and random, and are often started by a stimulus such as flashing lights or certain sounds. Sufferers experiencing a tendency to seizures are diagnosed as having epilepsy.

The two main types of generalised seizure, where consciousness is lost, are as follows:

- **Grand mal seizure**: the sufferer falls down unconscious, the body stiffens and becomes rigid, and then twitches and jerks uncontrollably; these signs are referred to as **tonic–clonic seizures**.
- **Petit mal seizure**: the sufferer has only a momentary loss of consciousness, with no associated abnormal movements; indeed, they are often thought to be just daydreaming for a period of just seconds. The alternative name for this mild form is therefore **absence seizures**.

While petit mal seizures last just seconds, grand mal seizures can last several minutes before the tonic–clonic phase ends and consciousness returns. In both cases, the sufferer has no memory of the seizure and, especially after a grand mal event, is often confused and disorientated for a time.

The occurrence of a grand mal seizure is a medical emergency that the dental team should be able to recognise and manage successfully. However, when a grand mal seizure lasts for more than 5 minutes or repeat seizures occur rapidly after the first, the sufferer is said to be in *status epilepticus*, an often fatal condition requiring urgent emergency medical treatment.

The commonly prescribed antiepileptic drug Epanutin (phenytoin sodium) has the unwelcome side-effect of causing the gingival tissues to overgrow – a condition called *gingival hyperplasia* – which makes gingival plaque removal and satisfactory oral hygiene levels difficult to achieve for the patient.

Bell's palsy

This is a (usually) temporary paralysis of the VII cranial nerve, the facial nerve. It often occurs following any condition causing inflammation in the region of the facial nerve (such as a viral infection), and results in a one-sided weakness of the facial muscles.

In particular, any inflammation associated with the parotid salivary glands can result in Bell's palsy, as the facial nerve runs across and through this gland to reach the oral cavity. It does not supply the gland itself though.

The condition of Bell's palsy is self-limiting and subsides as the inflammation resolves, although while present it can be difficult for the patient to communicate adequately with the dental team, and treatment may need to be postponed until the patient has made a full recovery.

The trigeminal nerve

Of all the cranial nerves, the trigeminal (cranial nerve V) is the one that is most dentally relevant, and while discussed in detail in Chapters 9 and 10, it is also summarised here. It is composed of divisions and branches, and the nomenclature used to name the various nerves follows that used in other areas of anatomy so *anterior* and *posterior* refer to front and back, respectively, and *superior* and *inferior* refer to upper and lower, respectively. The areas of supply in relation to the teeth and their surrounding soft tissues follow the dental terminology used in naming tooth surfaces, as discussed in Chapter 10.

The name of this nerve indicates that it splits into three divisions, each of which has several branches.

- **Ophthalmic division**: sensory supply of the soft tissues around the eye and the upper face.
- **Maxillary division**: sensory supply of the upper teeth, the maxilla and the middle area of the face.
- **Mandibular division**: sensory supply of the lower teeth, the mandible and the lower area of the face, and motor supply to the muscles of mastication.

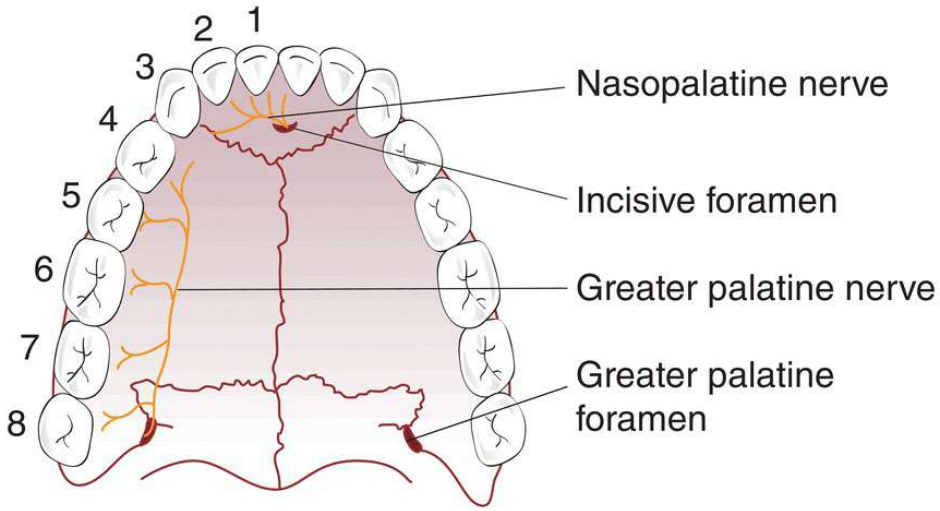
The maxillary and mandibular branches of the trigeminal nerve are of most importance to the dental nurse, as together they relay sensory information from the whole of the oral cavity to the brain, and provide the motor supply to the muscles of mastication, to effect jaw closing and chewing movements.

Jaw opening occurs due to the actions of a separate group of muscles called the suprahyoids, which lie beneath the mandible and are attached to the hyoid bone in the throat.

Maxillary division

The maxillary division of the trigeminal nerve splits further, into five branches, all of which are sensory (Figure 5.15). By definition, then, they transmit sensations (such as heat, cold, pressure and pain) from this area to the brain, including from the upper teeth. It is these branches that have to be anaesthetised before painless dental treatment can be carried out on the upper teeth. The five branches and their general anatomical paths are described below.

- **Anterior superior dental (alveolar) nerve**: supplies sensation from the upper incisor and canine teeth, and their labial gingivae. In addition, it supplies sensation from the soft tissues of the upper lip and around the nostrils of the nose.
- **Middle superior dental (alveolar) nerve**: supplies sensation from the upper premolar and the anterior half of the upper first molar teeth, and their buccal gingivae.
- **Posterior superior dental (alveolar) nerve**: supplies sensation from the posterior half of the upper first molar and the second and third molar teeth, and their buccal gingivae.
- **Greater palatine nerve**: supplies sensation from the palatal gingivae of the upper molar, premolar and posterior half of the canine teeth.
- **Nasopalatine nerve**: previously called the **long sphenopalatine nerve**, this supplies sensation from the palatal gingivae of the upper incisor and anterior half of the canine teeth.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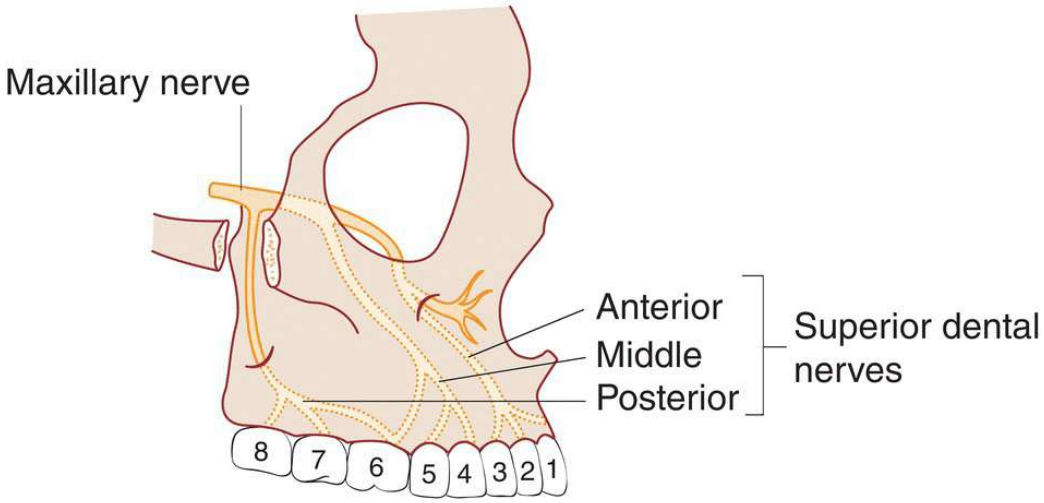
Nasopalatine nerve
Incisive foramen
Greater palatine nerve
Greater palatine foramen


Maxillary nerve
Anterior
Middle
Posterior
Superior dental nerves
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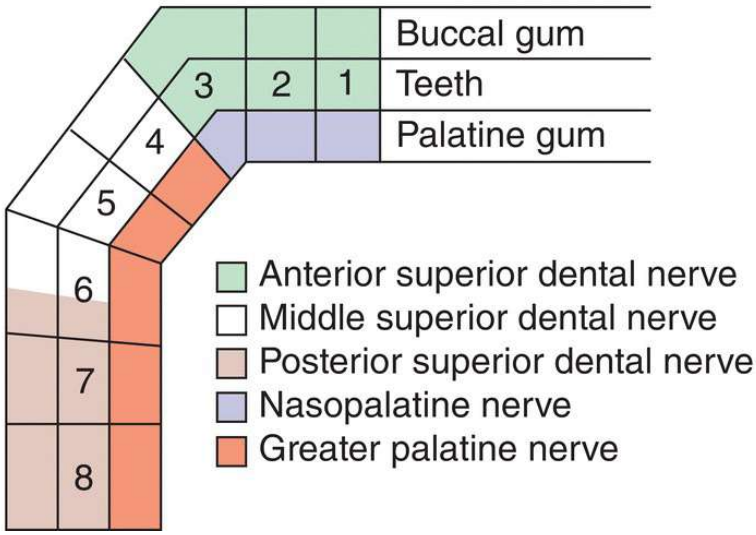
Buccal gum
Teeth
Palatine gum
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Anterior superior dental nerve
Middle superior dental nerve
Posterior superior dental nerve
Nasopalatine nerve
Greater palatine nerve

Figure 5.15 Maxillary division of trigeminal nerve.

The maxillary nerve emerges from the base of the brain, leaves the skull through the foramen rotundum and passes forward through the floor of the eye socket (orbit). Before entering the orbit, it gives off its posterior superior dental and palatine branches. Within the orbit, it gives off the middle and anterior superior dental nerves. It emerges from the orbit through the *infraorbital foramen* on the front of the maxilla to supply the skin and mucous membrane of the lower eyelid, cheek and upper lip.

The posterior superior dental nerve enters the back of the maxilla to reach its destination, while the greater palatine nerve also passes through the back of the maxilla and reaches the surface of the hard palate through the *greater palatine foramen*, opposite the third molar tooth.

The nasopalatine nerve passes through the floor of the nasal cavity to reach the surface of the palate through the *incisive foramen* behind the central incisors, and the anterior and middle superior dental nerves branch off from the maxillary nerve in the floor of the orbit. They pass down inside the maxilla, in the walls of the maxillary sinus, to reach the teeth. The sensory nerve impulses from the upper teeth and their surrounding soft tissue structures pass from the nerve endings back along these nerve pathways to the maxillary nerve trunk, and then enter the skull and join the other two divisions to form the trigeminal nerve trunk, which then enters the brain itself.

Mandibular division

The mandibular division of the trigeminal nerve emerges from the skull through the foramen ovale and splits into four branches which carry both sensory and motor components (Figure 5.16). The sensory branches of this nerve require anaesthetising before painless dental treatment can be carried out on the lower teeth. The four branches and their general anatomical paths are described below.

- **Inferior dental (alveolar) nerve**: supplies sensation from all the lower teeth, and from the buccal or labial gingivae of all *except* the molar teeth. In addition, it supplies sensation from the soft tissues of the lower lip and the chin.

- **Lingual nerve**: supplies sensation from the lingual gingivae of all the lower teeth, the floor of the mouth, and touch sensation from the anterior two-thirds of the tongue.
- **Long buccal nerve**: supplies sensation from the buccal gingivae of the lower molar teeth.
- **Motor branch**: supplies stimulation to the muscles of mastication, to effect jaw closing and chewing movements.

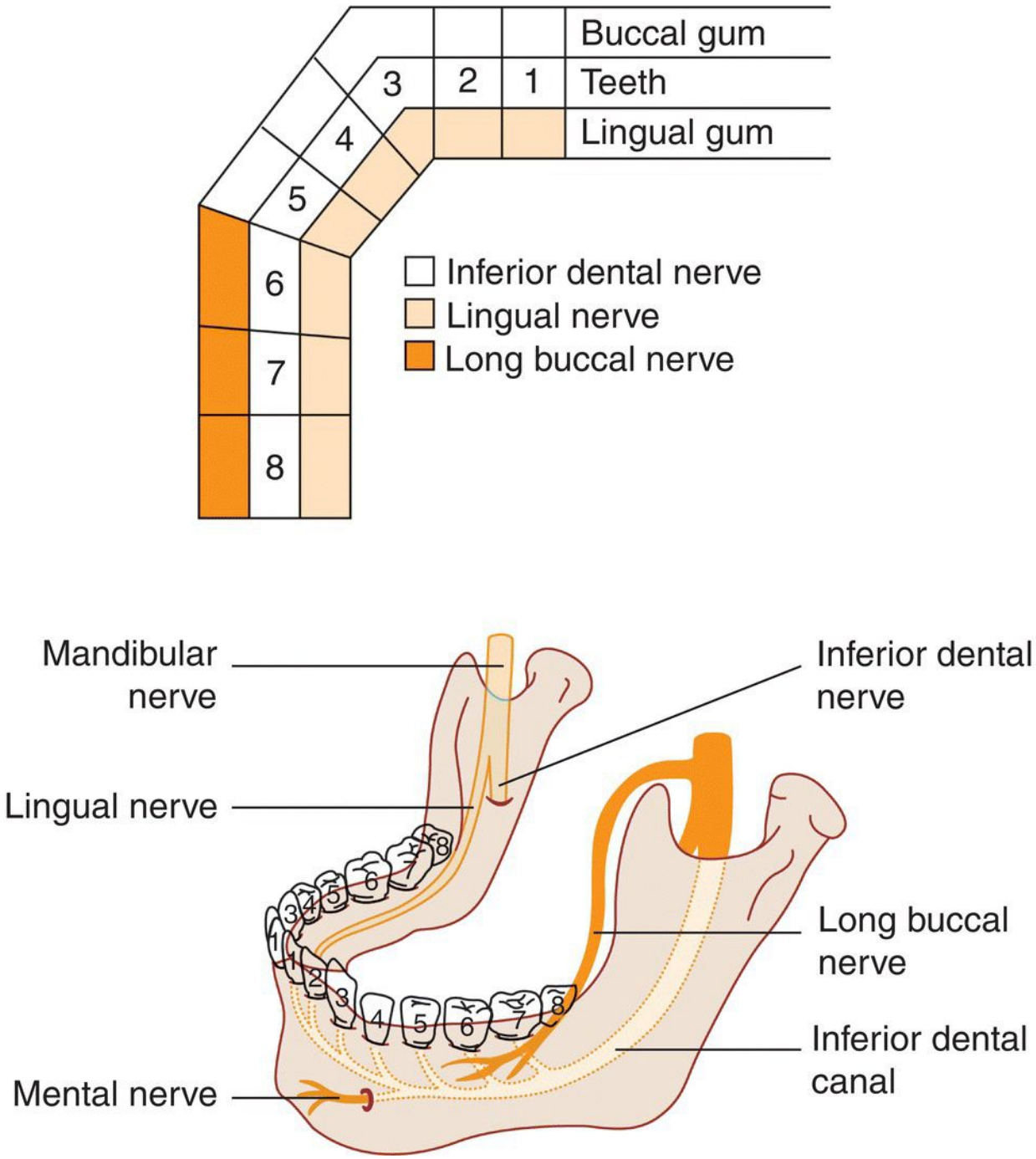


Figure 5.16 Mandibular division of trigeminal nerve.

The mandibular nerve passes down from the base of the skull on the inner side of the ramus of the mandible, between the medial and lateral pterygoid muscles, and divides into the above branches.

The *inferior dental nerve* supplies all the lower teeth and enters the mandible through the *mandibular foramen*. This is situated at the

centre of the inner surface of the ramus and is guarded on its front edge by a small bony projection called the *lingula*. After entering the mandibular foramen, the nerve passes through a canal running inside the mandible, below the apices of the teeth. The end branch of the inferior dental nerve emerges on the outer surface of the mandible through the *mental foramen* which is situated below the apices of the premolars. From this point, it is called the *mental nerve* and supplies the buccal gum of the incisors, canines and premolars, plus the lower lip and chin.

The *long buccal nerve* supplies the buccal gum of the molars. It passes into the gum on the outer surface of the mandible, over the external oblique ridge.

The *lingual nerve* supplies the lingual gum of all lower teeth. It passes along the floor of the mouth on the inner surface of the mandible, where it also supplies the anterior two-thirds of the tongue and the floor of the mouth.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

6
Medical Emergencies

Key learning points

A **working knowledge** of

- the incidence of medical emergencies in the dental workplace

A **factual awareness** of

- basic life support procedures and resuscitation techniques

A **factual knowledge** of

- the use of emergency resuscitation equipment in the dental workplace

A **working understanding** of

- the actions to take in the event of various medical emergency scenarios

Medical emergencies can occur anywhere, at any time, but some may be more likely to occur in the dental surgery setting due to the nature of dental treatment and the anxiety it evokes in some patients. The anxiety that some patients experience may have the following effects:

- Lowers the pain threshold of the patient so that the sensations experienced in the dental setting that they would normally feel as 'discomfort' are instead experienced as 'pain', producing an agitated or even unco-operative patient.
- Perception of being about to feel pain, so that stress levels and anxiety are raised. This can then put a huge strain on the patient's body, especially the heart and circulatory system.
- Fear and anxiety at the prospect of dental treatment may worry the patient enough to prevent them eating beforehand, for fear of vomiting. The patient will then have a low blood sugar and be

more prone to fainting, and in those with diabetes the low blood sugar is likely to precipitate a hypoglycaemic attack.

In addition, the following points also need to be considered by the dental team:

- Many dental treatments involve the injection of a local anaesthetic, and these drugs may interact with some common patient medications.
- Any of the dental materials, antibiotics or local anaesthetics used in dentistry have the potential to cause an allergic reaction in the patient, the worse-case scenario being a full anaphylactic reaction.
- Many dental treatments are carried out with the patient lying *supine* (flat) in the dental chair, and this leaves their airway potentially vulnerable to foreign object inhalation, choking and a full respiratory obstruction emergency.

The dental team can do much to reduce the anxiety levels of their patients merely by creating a friendly, welcoming and pleasant atmosphere within the workplace. Showing sympathy (understanding *how* they feel) and empathy (understanding *why* they feel as they do) to an anxious patient helps to reduce their stress levels and alleviates their concerns over appearing 'foolish' to the staff and to other patients. For those patients whose anxiety is so great that it borders on *phobia* (an exaggerated and illogical fear), all methods of pain and anxiety control should be considered by the dental team, and offered where appropriate. This ensures that these patients will still attend and undergo dental treatment routinely, as they know that suitable anxiety control techniques will be available to them as required.

However, those patients who pose the greatest concern with regard to medical emergencies are those with diagnosed medical risk factors.

- **Heart conditions**: any abnormality or disorder of the heart may potentially allow unexpected problems to arise during stressful episodes, such as when undergoing dental treatment.
- **Hypertension** (high blood pressure): anxiety often causes a raised systolic blood pressure, which can then put a considerable

strain on an already malfunctioning heart.

- **Liver or kidney disorders**: both these organs are responsible for eliminating waste products and toxins from the body, and any amount of malfunction due to disease could result in drugs not being detoxified and removed adequately.
- **Diabetes**: uncontrolled diabetes or failure to take medications accurately may result in a hypoglycaemic attack. In addition, those with diabetes tend to heal poorly and be more prone to infections, including those involving the oral cavity.
- **Allergies**: these patients are often sensitive, or even allergic, to more than one allergen, so great care must be taken to avoid the use of known potential allergens in the dental workplace, such as latex and penicillin-based antibiotics.
- Certain **medications** known to react with some local anaesthetics: these are drugs that can be potentiated (effects increased) by adrenaline-containing local anaesthetics, and include some types of antidepressants, thyroxine and any medication that may cause hypertension, such as some contraceptives and HRT.
- Previous history of **complications** during dental treatment: depending on the complication and its cause, it is possible for some to be a regular occurrence with the same patient.
- **Long-term steroid treatment**: tends to suppress the body's own production of the hormones required to react to and survive stressful events, resulting in shock and a potentially fatal crash in the patient's blood pressure when stressful events do occur.

These patients will be identified by the accurate completion and recording of a medical history before dental treatment begins. This medical history can then be stored with the patient records (computerised or paper, or both) and updated at the beginning of every course of treatment.

Nevertheless, medical emergencies can and do occur in the dental surgery environment (not necessarily the treatment room itself) and the dental team must be able to recognise them and support life where necessary until specialist help arrives (that is, paramedics). All

members of the dental team are expected to hold a BLS certificate if working with patients, and to undergo the necessary CPD requirements to update their medical emergencies knowledge as laid down in the GDC's *Standards for the Dental Team* documentation. The level of knowledge required in this topic is aimed at that of the dental nurse for this text, but for those with a greater interest the publication *Basic Guide to Medical Emergencies in the Dental Practice* (P. Jevon, 2010, Wiley- Blackwell) is highly recommended.

Casualty assessment and chain of survival

When a casualty undergoes a medical emergency, in most cases they exhibit warning symptoms that something is seriously wrong for a significant time before collapse and cardiac arrest occurs. The early recognition of the onset of these warning symptoms and the correct identification of the cause of any emergency is vital if the casualty is to be correctly treated and their life supported until the emergency services can attend. This is done by being able to recognise the warning 'signs' and 'symptoms' of an event, ideally before it becomes a full emergency.

The *signs* are what the rescuer can see.

- Skin colour: is it pink, grey, red, pale?
- Breathlessness: are they gasping, breathing quickly, struggling to inhale or exhale?
- Suddenness of any collapse: did the casualty fall straight to the ground or did they slowly slump down?
- Actions before collapse, such as clutching the chest.
- Condition of the pulse: is it fast, slow, weak, absent?

At the same time, the casualty will feel *symptoms*, which they should be asked about if they are still conscious.

- Any pain: is it sharp, dull, throbbing, made worse by anything?
- Location of pain: where is it felt exactly?
- Nausea: does the casualty feel sick or have they vomited?
- Drowsiness: do they feel sleepy, are they struggling to respond to verbal commands?
- Difficulty breathing: are they struggling to breathe in, out or both?
- Dizziness: does the person feel like they will fall over, is the room spinning?

By assessing the casualty and noting the signs and symptoms exhibited, the rescuer can determine their next course of action, and often this will be to reassure the conscious casualty and to summon more experienced help.

However, there are two signs that should prompt any rescuer to begin BLS immediately.

- **Unconsciousness**
- **Abnormal breathing**

These two signs indicate that the casualty's life is at risk, as sudden unconsciousness may indicate that the heart has stopped beating (*asystole*) or is beating ineffectively (*fibrillating*), and abnormal breathing indicates a compromised airway and possible lack of oxygen to the brain (*hypoxia*). The presence of any of these signs may result in the death of the casualty if not dealt with quickly by the rescuer. The chain of survival for the casualty will depend on the following co-ordinated and timely interventions by the rescuer.

- Early recognition of any warning signs that the casualty is experiencing, before collapse occurs.
- Early call for specialist help to attend and prevent further deterioration and collapse.
- Early BLS if collapse does occur, to maintain oxygenated blood flow to the body and particularly to prevent hypoxia of the brain.
- Early defibrillation to restart the heart and limit any damage due to hypoxia (see later).
- Restoration of life (that is, regain adequate function of the brain and heart) in a timely manner to provide the best possible chance of a good quality of life after the emergency; the longer the brain is starved of oxygen, the more permanently debilitated the casualty will be on survival.

Assessment of the unwell patient

When a patient begins to show concerning signs that they may be becoming unwell, they must be quickly, accurately and methodically assessed by the dental staff to determine if simple interventions are required to improve their condition, or if a medical emergency may develop and specialist help is urgently required. Regardless of the underlying cause of the patient's deterioration, the signs are always similar as the heart, lungs and brain are the organs affected when a patient becomes unwell.

- Increased rate of respiration (faster than 20 breaths per minute): this can be observed by the rise and fall of the chest.
- Increased heart rate (faster than 100 beats per minute): this can be established by taking the pulse (see Chapter 5 and Figure 5.6).
- Falling blood pressure (systolic reading below 90 mmHg, where the average is around 120 mmHg): this can be determined using a blood pressure machine (see Chapter 5 and Figure 5.5).
- Altered level of consciousness (confusion, restlessness, becoming unresponsive to questions): this can be established by communicating verbally with the patient.

Although it is likely in the dental workplace that the team leader will be a dentist, all staff should be aware of the need to recognise an unwell patient by the above signs, and to request support from a senior colleague as soon as possible. Therefore, the basics are covered in this text, and further information is available in the publication *Basic Guide to Medical Emergencies in the Dental Practice*.

As with the steps to follow when carrying out BLS (see later), the recommended assessment of the patient is best carried out as a methodical, easy to remember set of observations and actions and, in line with guidance issued by the Resuscitation Council, assessment of the unwell patient should follow the **ABCDE** approach:

- **A airway**
- **B breathing**
- **C circulation**

- **D disability**
- **E exposure**

Initially, signs that the patient is becoming unwell may be determined by simple observations, such as a change in their physical appearance or their communication skills. While requesting help from other colleagues at this point, simple actions such as placing the patient on oxygen and laying them flat may be all that is required to improve their condition. Once other colleagues are in attendance, the emergency drugs kit (Figure 6.1) and equipment should be collected in case the patient's condition deteriorates further. Where available, the patient should be connected via a finger probe to a pulse oximeter so that the pulse and oxygen saturation levels can be determined automatically (Figure 6.2). In addition, blood pressure readings and blood monitoring for low blood sugar levels are useful tasks to carry out at this point (see later section Causes for collapse).

Figure 6.1 Emergency drugs kit.

Figure 6.2 Pulse oximeter with readings showing.

Dental staff should then proceed to carry out the ABCDE assessment. While carrying it out any life-threatening problems should be dealt with as soon as they are identified, before moving on to the next point. For example, if the airway is found to be compromised (say, if the tongue has fallen and blocked it), this should be corrected before moving on to assess the quality of the patient's breathing movements. Full details of the first four assessment points (A, B, C and D) are discussed in detail in the BLS section later. The last two points (D and E) are also further clarified here.

'Disability' refers to the level of consciousness shown by the patient during assessment, and therefore gives an indication of the functionality of the brain (this is covered under 'response' in the BLS section). 'Exposure' refers to the possibility of having to open or remove some items of clothing to allow full assessment of the patient. All attempts at maintaining their dignity should be made, such as using screens or requesting other patients to leave the area, and the patient's permission to undertake this stage should always be requested before proceeding.

If the patient deteriorates further, despite all the above attempts to stabilise them, it may be necessary for the dental team to carry out BLS to prevent the death of the patient, while awaiting the arrival of specialist help. The patient has now become a medical emergency casualty, whose survival is initially in the hands of the dental team.

Principles of BLS

The aim of BLS is to maintain the flow of oxygenated blood around the casualty's body until one of the following happens:

- They recover (with or without defibrillation): their heart begins to circulate oxygenated blood around their body and they are able to breathe without assistance.
- Their life support is handed over to specialists, usually paramedics.
- The rescuer is too physically exhausted to continue.
- The death of the casualty is confirmed by an authorised practitioner, such as a doctor, at the scene.

Oxygen is the atmospheric gas that is vital for life. It is breathed into the respiratory system through the nose and mouth, and then passes down the trachea to the two bronchi which enter the right or left lung. In the lungs, the oxygen passes out into the circulatory system during external respiration, and is transported around the body in the arterial bloodstream by the continual pumping action of the heart. Where required, the oxygen passes out of the blood vessel and into the surrounding body tissues during internal respiration, where it is used to provide energy for the cells to work (see Chapter 5 for further details).

The actions of the respiratory system in taking up oxygen from the atmosphere and absorbing it into the blood, and the circulatory system in transporting that oxygen around the body to the cells, are carefully controlled by the brain. If any one of the three vital organs involved fails (lungs, heart or brain), the other two will also fail shortly after.

Without oxygen, the cells, and therefore the body, cannot function and death will occur. After only 3–4 minutes without oxygen, the brain cells can suffer irreversible damage which, if not fatal, will lead to some degree of permanent brain damage. The quicker the need for BLS is established and begun, the better the chances of survival for the casualty, and ideally this should be within seconds of their own life support system failing.

So, the fundamental aims of BLS are to maintain the life of the casualty by achieving the following:

- Provide oxygen to the lungs, by some form of **rescue breathing**.
- Circulate the oxygen to the body tissues, by **external chest compressions** to mimic the pumping action of the heart.

Death occurs when there is a permanent cessation of the function of the heart and lungs, and these are the criteria by which a medical doctor will diagnose and certify death. Other specialists, such as paramedics, are able to diagnose and determine that death has occurred by the absence of:

- spontaneous breathing (breathing which occurs without some form of external assistance by the rescuer)
- heartbeat (asystole)
- pupillary response to light (pupils of the eyes remain dilated when exposed to light); lack of pupillary response indicates brain death.

However, only a medical doctor can certify that death has occurred and issue a death certificate, so all rescue attempts must continue until this has been established, or until any rescuers are too physically exhausted to continue in their efforts to resuscitate the individual.

If there is more than one rescuer able to provide BLS, it is important that the compression and ventilation roles are regularly swapped between them, as chest compressions are physically tiring to perform and the rescuer will soon become exhausted.

Current BLS guidelines

In the UK, the general guidelines to be used for BLS are issued by the Resuscitation Council (UK) and should be followed nationally (www.resus.org.uk). Local protocol amendments may exist in some areas or in some workplaces (especially hospitals), and readers should ensure that they are aware of these. However, the current Resuscitation Council advice is that rescuers need to apply 30 chest compressions for each two rescue breaths given, no matter how many rescuers are present. This gives the current compression/ventilation algorithm of 30:2.

Assuming that the casualty has exhibited warning signs of an impending emergency, that specialist help has been summoned and is on route, but that their condition has deteriorated further, the two important signs that should be looked for when determining the need to provide BLS are:

- **unconsciousness**
- **abnormal or absent breathing**.

Unconsciousness indicates that the casualty is unresponsive to all stimuli, and that their heart may have stopped beating – they have gone into cardiac arrest. There is no instance where the heart can have stopped beating and a person remain conscious, as the body cells (especially the brain) will become starved of oxygen very quickly and will be unable to function.

Abnormal breathing, such as infrequent noisy gasps, indicates that there is a possible obstruction in the casualty's respiratory system which is making normal breathing difficult. This will gradually reduce the oxygen supply to the body cells, and once breathing ceases completely, the oxygen supply is cut off immediately. The casualty's skin colour will change from pink, through pale to blue or grey as their body tissues become starved of oxygen. This is more difficult to determine in those with darker skin tones, so the lips, nailbeds and mucous membranes of the mouth may also be checked for signs indicating lack of oxygenation or hypoxia.

The actions that may be required to help the casualty cannot be determined until the rescuer has fully assessed the situation, and

although swift action is necessary to avoid brain damage or death, the following questions must be quickly considered by the rescuer in an effort to determine the correct medical emergency.

- **Why has the individual become unconscious?** Are there any external causes such as trauma, electrocution, poisonous fumes, drowning?
- **How is unconsciousness established?** Are they alert or moving, are they responsive to noise or voices, are they responsive to pain, are they completely unresponsive?
- **Is their breathing abnormal?** Are they gasping, coughing or even clutching at their throat?
- **Are there any breath sounds?** Are they wheezing or gurgling? What do the breath sounds indicate?
- **What does the rescuer do next**? At what point should specialist help be summoned, and what actions are required immediately?

The accepted approach to follow when assessing an emergency situation and determining whether BLS is required can be summarised and easily remembered by the following code:

- **D** for **Danger**
- **R** for **Response**
- **S** for **Shout for help**
- **A** for **Airway**
- **B** for **Breathing**
- **C** for **Circulation**

This is best remembered as **DRSABC** (referred to as 'doctors – a – b – c').

Where a casualty has been discovered unexpectedly in a collapsed state, rather than one who became unwell while with dental staff and then deteriorated further, valuable time can be wasted during this assessment by attempting to open or remove clothing from the

casualty while trying to establish their condition, and should not be attempted by the rescuer. The casualty may actually sustain further injury while clothing is being removed, depending on the cause of their collapse and the mechanism of any injury that contributed to their collapse. In addition, many individuals would become very distressed at finding themselves partially clad and surrounded by strangers. The dignity and rights to decency and privacy of the casualty must be maintained at all times, by all rescuers.

DRSABC in detail

Danger

Check the immediate area for possible dangers, such as electric wires running through pooled water, punctured gas canisters, or spilt chemicals giving off strong fumes. If hazardous chemicals are suspected of being involved in the emergency situation, the workplace COSHH file must be consulted at some point for information on first-aid actions that may be necessary. This action is best delegated to a spare rescuer, while BLS is being carried out by others.

If possible, any dangers should be made safe by the rescuer before approaching the casualty, but not at the risk of endangering themselves in the process. Ideally, this should not involve moving the individual except in extreme circumstances, such as rising water levels that may cause drowning. This is to prevent any further injury being caused.

Response

The level of responsiveness will determine whether the casualty is experiencing reduced consciousness or is actually unconscious. This assessment determines any deterioration in their brain function associated with hypoxia, hypotension, or any other causes such as a CVA (stroke). Call loudly to them, asking if they can hear you or if they are all right, while gently shaking them. Their responsiveness can quickly be assessed and determined by a system referred to as the ACVPU method of disability assessment.

- **Alert**: the casualty is fully conscious and able to communicate fully and spontaneously.
- **Confused**: the casualty is conscious but confused. They may not know where they are or what has happened to them, or be unable to recognise family or friends who are with them.
- **Verbal**: the casualty is not fully conscious but is able to respond to verbal commands and prompts.

- **Painful**: the casualty is semi-conscious at best, but able to respond to painful stimuli such as a gentle pinch of the shoulder area above the collar bone.
- **Unresponsive**: the casualty shows no response to verbal prompts nor painful stimuli; they are unconscious and unable to be roused.

If the casualty shows no response whatsoever, then they are in need of help urgently. Wherever possible, the level of responsiveness should be determined without moving the individual from the position in which they were found, to avoid any further injury.

Shout

If the casualty is unresponsive and therefore unconscious, the rescuer will need help with any attempt at BLS if it is required, as well as to summon specialist help if necessary. If only one rescuer remains to aid the individual while help is being sought, they may need to continue BLS for a prolonged period of time, and ultimately this may result in their physical exhaustion. If attempts at BLS have to then be abandoned before specialist help arrives, the casualty is likely to die.

Shout very loudly to alert anyone else in the vicinity that an emergency has arisen. In the workplace, there may be internal communication systems in place for just such an event, such as intercoms, alarm bells or coded calls, and these must be known and used appropriately by the rescuer.

Airway

The airway needs to be checked for any obstruction, such as vomit or debris or the tongue itself, which may have fallen back and blocked it. Any loose obstruction should be removed by rolling the casualty's head to the side to encourage it to drop out of the mouth. In the dental surgery there will also be electrically operated suction equipment available at the chairside or a manually operated suction device within the emergency kit that all dental workplaces have to have on the premises (Figure 6.3). However, these must only be used by those rescuers who have been trained to do so, as they can push

debris further down the airway or cause soft tissue injury if not used correctly.

Figure 6.3 Portable suction unit.

The casualty's airway can then be opened to allow breathing to occur. This can be achieved by tilting the head back by placing the palm of one hand on the casualty's forehead and lifting the chin with the fingers of the other hand at the same time (Figure 6.4). However, this technique must never be used when an individual has a suspected neck or spinal injury, as to do so would almost certainly cause further damage to the spinal cord. This could result in permanent paralysis. In these cases, the airway can be opened by thrusting the lower jaw forward with both hands, without any head tilting occurring (Figure 6.5). This should reduce the risk of any further neck or spinal injury.

Figure 6.4 Head tilt to open airway.

Figure 6.5 Jaw thrust to open airway.

Breathing

With the airway open, breathing is assessed quickly over a 10-second period. The rescuer needs to determine if any spontaneous breathing attempts are being made, and their quality, by checking for the following (Figure 6.6):

- **Look** to see if the chest is rising and falling.
- **Listen** to any breathing sounds.
  - Are they regular or infrequent?
  - Are they quiet or noisy?
  - Are they normal or gasping in nature?
- **Feel** for movement of air by placing the cheek close to the casualty's mouth.

Figure 6.6 Look, listen, feel for signs of breathing.

If breathing is absent or abnormal, the emergency services must be called as specialist help is required. Ideally, a second person can be sent to do this but if necessary the lone rescuer must leave the casualty and go to call for emergency help.

The rate of breathing and quality of any breath sounds should be determined by the rescuer. Normal rates of breathing range from 12 to 20 breaths per minute, with an average of 16–17 for most individuals. A faster rate indicates an unwell casualty showing the first signs of respiratory distress, while a slower rate indicates a more serious situation of imminent respiratory arrest.

Certain breath sounds may be indicative of the cause for abnormal breathing, such as the following examples:

- Gasping and stridor: sharp intakes of breath (gasps) or high-pitched inspirations (stridor) indicate the upper airway is partially obstructed, either due to foreign body obstruction or due to swelling of the laryngeal area as occurs in anaphylaxis.

- Snoring: occurs usually in a semi-conscious or unconscious casualty who is supine (lying flat), due to the tongue falling back and partially obstructing the pharynx.
- Gurgling and rattling: 'wet' breathing sounds indicate the presence of fluid in the airway, due to either vomit or airway secretions in a casualty who is semi-conscious or unconscious and unable to cough and expel the fluid.
- Wheezing: noisy whistling-type sounds on expiration indicate narrowed bronchi and bronchioles, as occurs during an asthma attack or as a matter of course in casualties suffering from COPD.

Any of these abnormal breath sounds indicate a serious situation which will develop into a medical emergency if no action is taken by the rescuer (see later). Obviously, the complete absence of any breath sounds and no air movement detected during the airway assessment is already a medical emergency.

Once it has been decided that BLS is required to maintain the casualty's life until specialist help arrives, they may require moving to a position where this can be carried out effectively. This is usually achieved by very carefully rolling the individual onto their back with a firm surface beneath them, in a safe area and with enough room to manoeuvre as necessary, as BLS may need to be carried out correctly for a prolonged period until specialist help arrives.

Circulation

Any residual oxygenated blood within the casualty now needs to be quickly pumped around their body to the brain, and this is achieved by the rescuer carrying out chest compressions. These will only be effective if the heart is adequately compressed between the breastbone (sternum) and the spine, on a firm surface, and at a sufficient rate to actually cause the blood to flow through the circulatory system as required, rather than just ineffectively swishing back and forth (Figure 6.7).

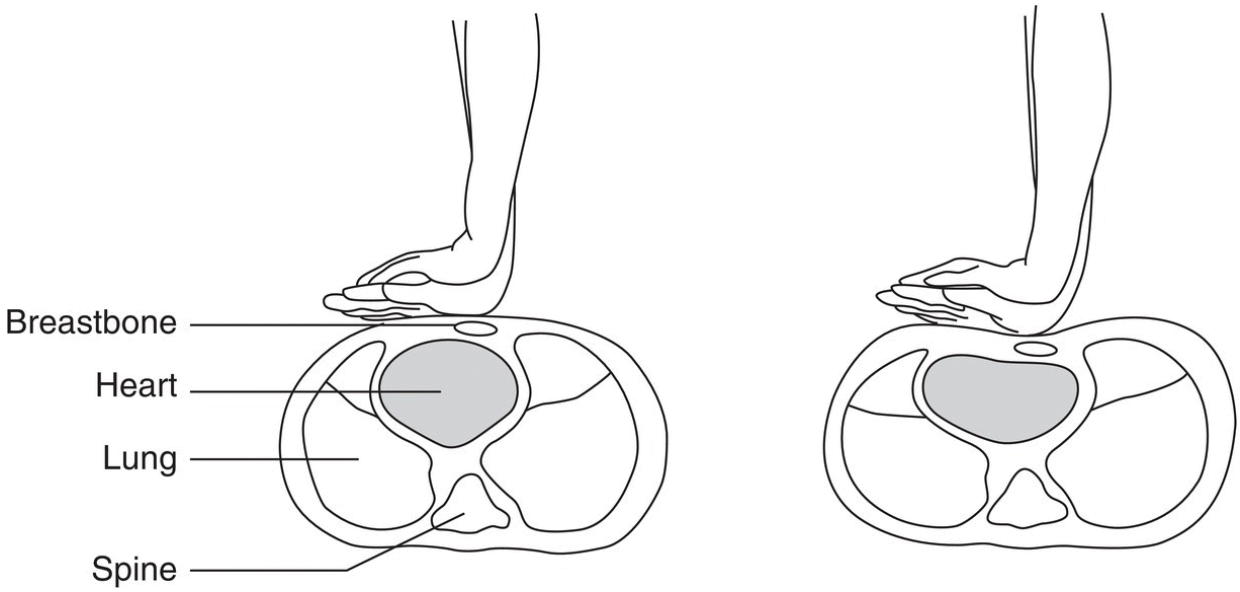


Figure 6.7 External cardiac compression.

If any spinal or neck injuries are suspected, it would be ideal not to move the casualty from the position in which they were found in order to avoid further injury. However, this may not always be possible, especially if their position prevents successful BLS from being carried out. Ideally, several helpers should be used to very carefully roll the casualty onto their back on a hard surface, keeping their head in line with their spine at all times – this is referred to as a 'log roll' technique.

In the dental surgery, dental chairs are designed to be firm enough to carry out chest compressions without having to move the casualty onto the floor.

The correct point at which to apply the compressions is quickly located by:

- kneeling at the side of the casualty, or standing if they are still on the dental chair
- run a finger along the lower border of the individual's ribcage, towards the midline
- once in the midline, the breastbone will be felt with the finger
- place the heel of the other hand adjacent to the finger, towards the head of the individual

- interlock the fingers of both hands over this compression point (Figure 6.8)
- lean over the individual, keeping the arms straight and the elbows locked (Figure 6.9).

Figure 6.8 Hand lock for chest compressions.

Figure 6.9 Arm lock for chest compressions.

Thirty compressions can now be given at a rate of 100 per minute, by compressing the chest by 4–5 cm and then releasing to allow the heart to expand and refill with blood.

Once the initial 30 compressions have been administered, two rescue breaths can be given by the lone rescuer, or ideally by a second rescuer.

Rescue breathing

Once the first 30 compressions have been administered, any residual oxygen in the blood will have been used up by the body tissues, and especially the brain. To maintain life, the oxygen now has to be regularly replaced before being distributed around the body again by chest compressions, and this is achieved by artificial ventilation or rescue breathing.

The atmosphere contains about 21% oxygen but expired (breathed out) air only contains 16%, as our body tissues use up the 5% difference to produce energy for the cells to work. In an emergency situation, rescue breaths are usually given by breathing expired air into the casualty in a mouth-to-mouth technique. If they have facial injuries affecting the mouth, it may be necessary to use a mouth-to-nose technique instead, and with small children or babies the rescuer will breathe into the casualty's mouth and nose together.

The use of emergency oxygen supplies, such as that held by all dental practices, will increase the amount of available oxygen for rescue breathing when given using a pocket mask or a resuscitation ventilation bag, but the technique can only be successfully used by those trained to do so (Figure 6.10). Here, the rescuer is using their knees to clamp the casualty's head in the open airway position, while rescue breathing is carried out. Without these facilities, a mouth-to-mouth technique is used.

Figure 6.10 Use of the ventilation bag.

The airway will already have been cleared of obstructions during the DRSABC procedure, but will need to be held open now to administer rescue breaths, again using the head tilt/chin lift or jaw thrust technique. Two rescue breaths using the mouth-to-mouth technique are then given as follows:

- Maintain the head tilt to keep the airway open.
- Pinch the nostrils closed with the fingers of the hand being used to press onto the forehead.
- Support the chin with the other hand while holding the mouth open.
- Take a deep breath, then seal the mouth over that of the individual to ensure no air escapes (Figure 6.11).
- Breathe with normal force into their open mouth for about 2 seconds, watching from the corner of the eye to ensure that the chest rises.

- With the airway still held open, move away from their mouth and watch the chest fall as the air comes out.
- Repeat the rescue breath.
- If given successfully, follow with another 30 chest compressions as a BLS cycle.

Figure 6.11 Rescue breathing mouth to mouth.

Sometimes problems will be experienced while attempting rescue breathing, the most common one being that the chest does not rise. In the absence of an obstruction, this is usually due to the airway not being fully opened, and the head tilt procedure should be repeated until successful. Otherwise, ensure that the nostrils are fully closed and that a good mouth-to-mouth seal is being achieved.

If the abdomen is seen to rise while the breath is being given, air is being blown into the stomach rather than the lungs, by being too forceful or too prolonged. The rescue breath should stop once the chest stops rising, usually after just 2 seconds at a normal breath force.

Automated external defibrillation

As a medical emergency progresses, the heart will cease to function correctly due to a lack of oxygen to the organ. The commonest early malfunction that is seen is fibrillation of the heart muscle itself, where instead of a rhythmic electrical discharge from the sinoatrial node resulting in a functional heartbeat, the electrical discharge occurs randomly over the heart surface and is ineffective in producing a pumping action. Consequently, blood does not flow around the circulatory system and tissues and organs become permanently damaged by the resulting lack of oxygen. Previously, this emergency could only be diagnosed by specialists able to read an electrocardiogram at the scene, but then automated external defibrillator (AED) devices were developed and this specialist interpretive skill is no longer required before help can be given. Modern AED devices (Figure 6.12) require minimal training to be used effectively, and make a significant difference to the likelihood of survival of a casualty experiencing fibrillation. All dental workplaces should have an AED device on the premises and all staff are expected to be trained in their correct usage. The earlier in an emergency the AED is used, the more likely it will successfully restart the heart, so the dental team would be expected to have used it where appropriate before the arrival of specialist help and therefore annual training is required.

Figure 6.12 Automated external defibrillator.

The AED works by sending an electrical impulse across the fibrillating heart muscle that is sufficient to 'shock' (defibrillate) it out of its ineffective and random action and back into an effective rhythmic heartbeat. Modern devices are able to automatically assess the casualty's condition once the adhesive pads have been correctly placed, and determine whether defibrillation is required. If so, then clear verbal instructions are given to 'stand clear' and then 'shock' the casualty by pressing the button. If the casualty still has a heartbeat or they are not fibrillating, the AED device will instruct 'no shock'.

Various AED devices are available but they all work on the same principle, and annual resuscitation and AED staff training should occur in all dental workplaces so that everyone is familiar with their own device and the emergency procedure to follow.

General points on the successful use of the AED and resuscitation of a casualty are as follows:

- Once a medical emergency occurs, ensure someone on the team calls for specialist help.
- BLS should be carried out while the AED device is collected and opened.
- Follow the diagrammatic guidance of the device when placing the adhesive pads into position (Figure 6.13):
    - One pad is placed on the left side of the casualty near the apex of the heart.
    - One pad is placed on the right front side of the chest just below the collarbone.
- The following will reduce the effectiveness of any defibrillation attempts:
    - Hairy chest: quickly shave the pad placement sites if a razor is immediately available (proceed anyway if a razor is not available).
    - Damp skin: quickly wipe the pad placement sites dry with anything immediately available.
    - Breast tissue: do not place the pads on breast tissue.
    - Poor contact between the skin and the pads: press them firmly onto the skin (regular checks of the device will ensure that the pads do not fall out of date and so lose their stickiness).
- Once the pads are correctly positioned, stop resuscitation attempts while the AED analyses the casualty's heart.
- If fibrillation is occurring, the AED will instruct everyone to 'stand clear'. No rescuer should be in contact with the casualty or any equipment they are lying on, and in particular the emergency oxygen and delivery system must be removed from the casualty before 'shocking' occurs.
- The 'shock' button is pressed when the device instructs the rescuer to do so, although some AEDs are fully automated and will deliver the shock automatically.

- BLS should be continued in the 30:2 algorithm as before until the AED is ready to assess the casualty again, or if the device instructed ‘no shock’.
- BLS and defibrillation attempts should continue as above until specialist help arrives.

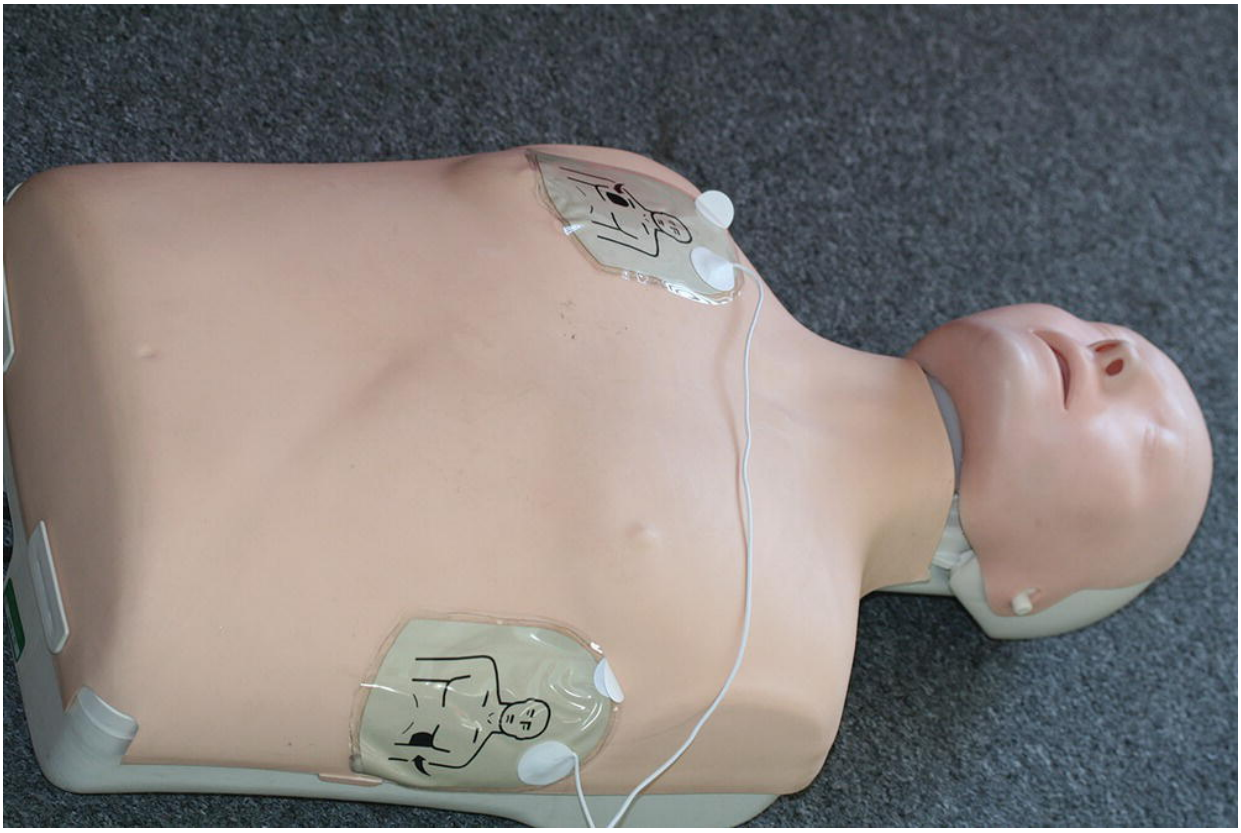


Figure 6.13 Correct positioning of AED pads on adult.

BLS modifications

The BLS protocols described are to be used for adults and children over the age of 8 years. Babies and young children require less force to be used while carrying out both chest compressions and rescue breathing, to avoid injuring their bodies.

The weight of the foetus in a pregnant woman will also hinder BLS attempts if she is lying on her back, and the usual technique must be modified for these groups of casualties.

Babies and young children

Anatomically these age groups are different from adults in the following ways:

- They have narrower air passages in the respiratory system.
- These air passages are more prone to blockages.
- The trachea is more flexible, and so it is easily blocked if airway opening attempts are too severe and the neck is over-extended.
- They have a relatively larger tongue than an adult, which is more likely to obstruct the airway when the baby or young child is unconscious.

Cardiac arrest in these younger casualties is rarely due to heart problems, as in an adult, but is far more likely to be caused by lack of oxygen to the brain due to airway obstruction.

As the DRSABC code is being followed, it will soon become apparent if the young casualty is unresponsive and having breathing difficulties or not breathing at all, and it is imperative that rescue breathing is commenced *before* starting chest compressions. This is because the likely cause of their collapse will be a shortage of oxygen to their vital organs, and any reserves will have been quickly used up by their young bodies and must be replenished as soon as possible.

So the full modified BLS sequence of events in cases involving a baby or a young child is as follows:

- **Danger**: check for dangers as usual.

- **Response**: less reliable in younger casualties, so merely determine whether they are unresponsive only.
- **Shout**: summon help from anyone in the vicinity, without leaving the casualty.
- **Airway**: check the airway for obstruction, especially the tongue, then carefully open the airway, taking care not to over-extend the head tilt and so block the trachea.
- **Breathing**: look, listen and feel for signs of spontaneous breathing for 10 seconds; if they are absent, *give five rescue breaths using the mouth-to-mouth and nose technique*.
- **Circulation**: give 30 chest compressions, using two fingers for a baby or one hand for a young child, aiming to compress the chest by one-third of its depth at a rate of 100 per minute.
- The lone rescuer must continue BLS for a full minute before going for specialist help.

Pregnant women

Any premenopausal woman who collapses and requires BLS could potentially be pregnant. In some cases it will be known or obvious that they are so, but otherwise it should always be considered a possibility, especially if BLS attempts are failing for no other obvious reason.

In a heavily pregnant woman lying on her back, the uterus (womb) tends to lie over the major blood vessels (the inferior venae cavae) that return blood from the lower body to the right side of the heart. If this casualty collapses and requires BLS, the rescuer has the added difficulty of forcing blood through these squashed blood vessels during chest compressions, and the rescue attempt is likely to fail.

Instead, the pregnant casualty should be laid slightly on the left side with some form of support under the right buttock so that these major blood vessels are not squashed by the uterus. BLS can then be carried out in the normal way, while maintaining this angled position of the woman throughout.

Monitoring and evaluating BLS

Once the DRSABC code has been followed correctly, the need for BLS established, and rescue attempts are underway, the situation and condition of the casualty must be carefully monitored by the rescuer to determine if rescue efforts should continue or be stopped.

There are four instances in which BLS attempts should be stopped:

- The casualty recovers and is able to circulate oxygenated blood and breathe without assistance.
- Their life support is handed over to specialists (paramedics).
- The rescuer is too physically exhausted to continue BLS.
- The death of the casualty is confirmed by an authorised practitioner (a doctor at the scene).

Recovery

It is unlikely that spontaneous recovery will occur, as once the heart has stopped beating it usually requires the specialist techniques of either drug administration or defibrillation to start functioning again. The purpose of BLS is to maintain an oxygenated blood flow to the brain to prevent death until specialist help arrives, but if the emergency occurs in the dental workplace then defibrillation attempts must also be carried out by the dental team before specialist help arrives, using an AED.

However, in the rare event that the casualty does regain airway and circulation control, the rescuer must be able to recognise their improved condition and act accordingly until specialist help arrives. In other emergency situations, the casualty may have stopped breathing but still have a circulation, in which case chest compressions should not be attempted.

It is not advisable for the rescuer to waste valuable time attempting to find a pulse to determine if circulation has been re-established; it can be notoriously difficult to do and should be left to specialists to determine. Indeed, a casualty can die through lack of BLS provision if a rescuer mistakenly identifies a non-existent pulse. However, if a pulse oximeter is present the casualty should be attached to it via the

probe device, as this will detect their pulse and oxygen saturation levels automatically.

Other more obvious signs that indicate a functioning circulatory system are:

- movement of the individual
- coughing or signs of attempts to breathe
- change in skin and lip colour, from grey or blue to pink, although this will be more difficult to determine in a casualty with darker skin tones.

Once signs of a functioning circulation are recognised, the rescuer must continue giving rescue breaths until either the casualty begins breathing again themselves or specialist help arrives. The continuation of the circulation should be checked for after every 10 rescue breaths.

Recovery position

If all airway obstructions have been cleared, the airway sufficiently opened and rescue breathing carried out effectively by the rescuer, the casualty may begin spontaneously breathing again. Once breathing has begun, or if the casualty has been found unconscious but still breathing, their airway has to be maintained by the rescuer until specialist help arrives. If left lying on their back, the tongue may well fall back towards their throat and close off the airway, causing an obstruction to the oxygen flow in the respiratory system and precipitating a more serious emergency, an event that lay persons often refer to as ‘swallowing the tongue’.

To ensure that this does not happen, the rescuer must place the casualty into the recovery position so that their tongue and any fluids (vomit or blood) can drain out of the mouth rather than obstructing the airway (Figure 6.14).

Figure 6.14 Recovery position.

The recovery position involves rolling the casualty onto their side and bending their limbs so that they are supported in that position, with the airway open and unobstructed. This can only be fully performed when they have no potential injuries to their spine or limbs, otherwise a modified position must be achieved.

For a casualty lying on their back and breathing, with no injuries, the recovery position is achieved as follows:

- Kneel at one side of the casualty.
- Straighten out their arms and legs.
- Move their nearest arm out at a right angle and bend up at the elbow.
- Gently pull their other arm and furthest leg towards you, so that the casualty begins to roll towards you.
- Place the furthest hand against the side of their face.

- Continue to roll them towards you by pulling the furthest leg, until their knee touches the ground.
- Keep their hand against the face so that their head rolls onto it.
- Once the roll is completed, ensure the airway is open by tilting the head back as necessary.
- Adjust the bent leg to stabilise the recovery position.

The technique is the same for all age groups except babies. A baby will be unstable if placed in the conventional recovery position, and it is much easier to place them in a safe position while holding them. If breathing but unconscious, the baby should be picked up and held on their side, towards the rescuer, with one hand under the baby's head and the other under their side and bottom. They should be tilted down slightly so that the head is lower than their body, allowing the tongue and any fluids to fall forwards away from the airway.

Modified recovery position

If a spinal injury is suspected, such as if the casualty has fallen onto their back from a height, performing the full recovery position manoeuvre may cause permanent spinal injury and should not be attempted.

Ideally the casualty should be left in the position in which they were found until specialist help arrives, but this may not be advisable if there is a possibility that their airway could become obstructed. In this situation, they must be rolled onto their side and supported in that position using anything available, such as rolled-up coats or other rescuers. While rolling them, their head and spine must be kept in alignment at all times (the 'log roll'), so the manoeuvre can only be carried out when more than one rescuer is present.

Similarly, if any limb injuries are suspected, the individual must be rolled without pulling on their limbs, and supported by coats for example, rather than by bending the limbs to achieve stability.

The most important point is that the airway is opened and remains unobstructed, so that life is preserved. The rescuer will need to monitor the breathing and ensure that it continues to be unobstructed until specialist help arrives.

Handing over to specialists

The likely first responders to an emergency call will be paramedics, complete with specialised equipment and drugs to take over the advanced life support of the individual. However, they will require an accurate report of the emergency from all rescuers present to determine how best to proceed, and specifically the following points will require verification:

- **What happened?** Did anyone witness the actual emergency event (trip and fall, road traffic accident, convulsion, heart attack, choking, etc.)?
- **What time?** How long ago did the event occur, and how quickly were rescuers on the scene?
- **Condition?** Was ACVPU gone through by the rescuers and, if so, what was the casualty's initial level of responsiveness?
- **BLS?** Was BLS required, how long was it carried out for, were there any problems in maintaining life before the specialists arrived?
- **Defibrillation?** Where applicable, was defibrillation attempted with the AED, how many 'shocks' were given, and were any attempts successful (was the heart returned to a normal rhythm)?
- **Background knowledge?** Are any relatives or friends present with further information on the casualty (including their name), are any Medic-Alert identifiers present on the casualty's person?
- **Personal items?** Hand over all the casualty's personal items to the specialists; they will be able to check identity and medical status. This is especially important in discovering if any medications are taken, such as an asthma inhaler.
- **Remain at the scene**: do not leave until the specialists are happy that they have all the information they require, including your personal and contact details in case the casualty dies, as a statement to the police will be required.

After the emergency

If the emergency occurred in the workplace, it is likely that all other workplace activities will have been postponed. However, the area will be littered with various used items and equipment that may have been abandoned while all minds focused on the rescue attempt.

The area must be cleaned and closed down in accordance with the local infection control policy, paying particular attention to the following:

- Wear full PPE.
- All sharps should be carefully discarded in the usual sharps container.
- All blood spillages should be cleaned up using the blood spillage kit (Figure 6.15).
- All non-sharp items contaminated with body fluids should be disposed of in the hazardous infectious waste sack.
- All dental equipment should be wiped down and switched off as usual.
- All dental instruments should be disposed of, or debrided and autoclaved in the usual manner.
- Any opened and unused dental materials should be disposed of either in the non-hazardous waste sack or in the appropriate hazardous chemical waste container.
- All work surfaces should be wiped down once cleared, with the usual disinfectant.
- All records should be collated and filed in the usual place, those of the emergency casualty having been written up in full beforehand.


biohazard kit
Body Fluid
Clean-up
reliance
medical
biohazard body fluid
single application
clean up kit

Figure 6.15 Blood spillage kit.

Causes of collapse

The various causes of the collapse of a casualty must be known and understood by the dental nurse, so that they can assist usefully in the emergency treatment of these individuals should the need arise. While knowing and understanding the functions of the emergency equipment that all dental surgeries must hold, the dental nurse would not be expected to administer any of the drugs available, except as a last resort where they are the only rescuer and the casualty is likely to die otherwise, before specialist help arrives.

Knowledge of the various signs and symptoms of the medical emergencies, and their correct treatment, is therefore imperative for students to learn thoroughly, so that on qualification they could deal with a medical emergency effectively. Consequently, medical emergencies is a topic that will always appear in the final Diploma examination, in both the written and practical sections.

The following medical emergencies are all potentially life-threatening events, and are covered in the following sections:

- Asthma attack.
- Anaphylaxis.
- Epileptic seizure.
- Diabetic hypoglycaemia or coma.
- Angina attack that may lead to myocardial infarction.
- Choking.
- Stroke (CVA).
- Adrenal crisis.

In addition, the simple faint (vasovagal syncope) is such a common occurrence in the dental workplace that it is important the dental nurse can recognise and treat this event successfully and it is therefore included in the following text.

All the medical emergencies listed above, except choking, may require the administration of specific emergency drugs to enable the casualty to survive the episode, and the dental nurse must be able to recognise

and draw up these drugs ready for the dentist to administer. The details of the emergency drugs that should be present in all dental workplaces, their doses and routes of administration are shown in Table 6.1.

Table 6.1 Emergency drugs information.

Emergency	Drug and dose	Route given
Asthma attack	Salbutamol metered dose 0.1 mg Oxygen	Inhaler Facemask
Anaphylaxis	Adrenaline 1:1000 Oxygen	Intramuscular injection Facemask
Epileptic fit	Oxygen if possible Midazolam buccal gel if fit is prolonged	Facemask Oral
Hypoglycaemia	Conscious: Glucogel Unconscious: glucagon 1 mg	Oral Intramuscular injection
Angina	GTN metered dose 0.4 mg Oxygen	Sublingual Facemask
Myocardial infarction	Aspirin 300 mg Oxygen	Oral Facemask

The left-hand column details the medical emergency under discussion, while the centre column itemises the drug(s) used and their dosages. The drugs relevant for each emergency are required knowledge for the dental nurse, but not the individual doses to be administered; in fact, the majority of them are supplied in dose increments within the phials, so that they can be drawn up and ready for use immediately. The right-hand column states the administration route for each drug and it should be noted that all are delivered orally or as an intramuscular injection, as some skill is required to administer drugs by the alternative intravenous route, especially in an emergency situation. Oxygen is inspired with the use of a facemask connected to the oxygen cylinder, and can safely be given in all the emergencies listed.

Faint

This is a brief loss of consciousness due to a temporary reduction in oxygenated blood to the brain (**hypoxia**), and is the likeliest medical emergency to be encountered in the dental surgery.

- **Signs**: pale and clammy skin, weak and thready pulse, loss of consciousness.
- **Symptoms**: dizziness, tunnel vision, nausea.

Treatment

- If unconscious: lay casualty flat with their legs raised above the head to restore blood flow to the brain (Figure 6.16).
- Maintain airway and loosen tight clothing around the neck.
- Provide fresh air or oxygen.
- If conscious: sit casualty with head down, loosen tight clothing, provide fresh air.
- Give Glucogel or dextrose tablet (Figure 6.17) when consciousness returns to quickly restore the blood sugar levels.
- Give a source of slow-release carbohydrate (such as biscuits) and a drink to enable the casualty to recover.

Figure 6.16 Faint recovery position: lying supine with legs raised to increase blood return to the brain.

Figure 6.17 Oral Glucogel and dextrose tablets.

Asthma attack

Asthma is a prediagnosed hypersensitivity condition affecting the respiratory airways. The airways narrow in response to exposure to inhaled particles (such as dust, pollen, and some aerosol pollutants), so that exhaled air has to be forced out of the respiratory system and the casualty has difficulty breathing. The same airway response can occur in stressful or fearful situations, or with exercise, especially if the casualty has a respiratory tract infection.

- **Signs**: breathless with wheezing on expiration, cyanosis (blueness of lips), restlessness.
- **Symptoms**: difficulty in breathing, sensation of suffocating or drowning.

Treatment

- Administer **salbutamol inhaler** from emergency drug box (Figure 6.18).
- Give **oxygen**.
- Calm and reassure the casualty.
- Call 999 if the casualty does not make a rapid recovery.

Figure 6.18 Salbutamol inhaler administration.

Anaphylaxis

This is a severe allergic reaction by the casualty's immune system to an allergen, such as with an allergy to penicillin, latex or food products such as nuts. The immune system overreacts to the allergen, causing severe swelling of the head and neck in particular, and a sudden fall in blood pressure (*hypotension*), causing collapse.

- **Signs**: rapid facial swelling, formation of a rash, gasping, collapse.

- **Symptoms**: sudden-onset breathing difficulties, becoming severe, tingling of extremities.

Treatment

- Call 999 urgently.
- Trained rescuer to administer **intramuscular adrenaline** from emergency drug box.
- Maintain airway and give **oxygen** (Figure 6.19).
- Perform **BLS** and defibrillation if necessary until specialist help arrives.

Figure 6.19 Giving oxygen using a facemask.

Epileptic fit

This is a prediagnosed condition in which there is a brief disruption of the normal electrical activity within the brain, causing a fit. The fits can occur mildly (*petit mal*) and the casualty may appear as though

they are just daydreaming, or they may occur in a major form (*grand mal*).

- **Signs**: sudden loss of consciousness, followed by **tonic–clonic** seizure, possible incontinence. In the tonic phase, casualty becomes rigid; in the clonic phase, casualty convulses.
- **Symptoms**: casualty may experience an altered mood (**aura**) just before the fit begins; dazed and sleepy on recovery, with no memory of the fit.

Treatment

- Protect the casualty from injury, but make no attempt to move them.
- Remove onlookers from the area and maintain the casualty's dignity.
- Allow their recovery, then ensure they are escorted home.
- If no recovery within 5 minutes, or seizures recur without regaining consciousness (status epilepticus), call 999.
- Trained rescuer to administer **midazolam buccal gel** from emergency drug box (Figure 6.20).

Figure 6.20 Midazolam buccal gel pack.

Hypoglycaemia and diabetic coma

These two conditions may occur in patients with prediagnosed diabetes who have either not followed their insulin regimen correctly or have not eaten at the correct times. The resulting drop in their blood glucose levels can be catastrophic and cause collapse. The timing of dental appointments involving local anaesthesia is crucial for these patients, as they will be unable to eat without traumatising their oral soft tissues until the anaesthetic has worn off. The dental team must therefore ensure that appointment times fit around the patient's normal insulin and meal regimens.

- **Signs**: trembling, cold and clammy skin, becoming irritable to the point of being aggressive, drowsy, slurred speech, may appear to be drunk.
- **Symptoms**: confusion, disorientated, blurred or double vision.

Treatment

- If conscious, give **Glucogel tube** orally from emergency drug box (see Figure 6.17).
- If unconscious, trained rescuer to administer **intramuscular glucagon** from emergency drug box.
- Maintain airway and give **oxygen**.
- Call 999 if no recovery.

Angina

This usually occurs in prediagnosed patients suffering from coronary artery disease, where these blood vessels supplying the heart are narrowed due to the presence of cholesterol or a thrombus (blood clot). During times of stress or anxiety or while exercising, the reduced oxygenated blood supply to the heart is insufficient to allow full functioning, and the casualty will experience chest pains ranging in severity from indigestion to a heart attack.

- **Signs**: congested facial appearance, casualty clutching chest or left arm, irregular pulse, shallow breathing.

- **Symptoms**: crushing chest pain that may travel into left arm or jaw, nausea, breathlessness.

Treatment

- Administer **glyceryl trinitrate (GTN) spray** under tongue, from emergency drug box (Figure 6.21).
- Give **oxygen**.
- Keep the casualty sitting upright to assist breathing, but maintain airway.
- Calm and reassure the casualty.
- Call 999 urgently if no recovery or consciousness is lost; suspect cardiac arrest.
- Begin BLS and defibrillation if necessary until specialist help arrives.

Figure 6.21 GTN spray administration sublingually.

Myocardial infarction

This usually occurs in patients with a history of heart disease, especially angina, where either their drug regimen has not been followed correctly or they have been exposed to anxiety or stress. During an angina attack, the turbulence caused by the increased coronary artery blood flow may be sufficient to dislodge any blood clots present, and these may lodge and completely obstruct the blood vessel. This will prevent oxygenated blood from supplying that section of the heart muscle, which will then die.

- **Signs**: sudden clutching of chest, grey appearance, possible collapse.
- **Symptoms**: sudden crushing chest pain that is not relieved by GTN spray.

Treatment

- Call 999 urgently.
- Administer **aspirin tablet** from emergency drug box, either crushed or instructing the casualty to quickly chew and swallow it.
- Give **oxygen** and keep the casualty sitting upright to assist breathing.
- Maintain airway.
- Calm and reassure casualty.
- Perform **BLS** and defibrillation if necessary until specialist help arrives.

Choking in adults

Like the simple faint, choking is an emergency that may occur in the dental surgery from time to time, due to the nature of dental treatment. However, unlike the simple faint, choking is a very serious situation that could result in the death of the casualty if not dealt with promptly. It can occur in both the conscious and unconscious casualty, by the partial or full blockage of the respiratory tract causing

lack of blood oxygenation. The body tissues will become *hypoxic*, and this can be catastrophic when the brain or heart is affected.

- **Signs**: sudden coughing or wheezing, laboured breathing, inability to speak, blue lips.
- **Symptoms**: aware of respiratory obstruction, breathing difficulties, dizziness.

Treatment

- Calm and reassure the casualty.
- Support them leaning forward and encourage coughing.
- Give five **back slaps** between the shoulder blades to dislodge the obstruction (Figure 6.22).
- Begin abdominal thrusts (Heimlich manoeuvre) to cause artificial coughing if the obstruction is still present (Figure 6.23).
- If the casualty becomes unconscious, clear and open the airway as for BLS.
- Call 999 if this is unsuccessful.

Figure 6.22 Back slaps between shoulder blades.

Figure 6.23 Abdominal thrusts.

The technique of giving abdominal thrusts is as follows:

- Stand behind the casualty.
- Rescuer wraps their arms around the casualty, just below their ribcage.
- A fist is formed with one hand and grasped by the other, positioning both in the upper abdomen.
- Both hands are pulled in sharply below the ribcage, to cause an artificial cough.
- Air will whoosh out at each thrust, hopefully dislodging the obstruction.

Choking in young children

The signs and symptoms of choking in a young child will be as for an adult casualty, and they are more likely to experience this emergency

due to their lack of awareness of danger and their tendency to put objects into their mouths without realising the consequences.

The procedure to follow is very similar to that for an adult but with less force, and depends on whether the young child is conscious or not. The important point is that rescue breathing should only be carried out on an unconscious child, as their airway often becomes clear as their muscles relax during their loss of consciousness, and rescue breaths may not be necessary.

The procedure in a choking *conscious* child is as follows:

- Keep calm and keep the casualty (and any attending parent) calm.
- Get the child to cough to try to expel the obstruction.
- If unsuccessful, give five back slaps and recheck their mouth.
- If unsuccessful, give five chest thrusts from behind against their breastbone, then recheck their mouth.
- If unsuccessful, send for help then repeat the back slaps and recheck their mouth.
- If unsuccessful, give up to five abdominal thrusts but with less force than that used for an adult, then recheck the mouth.
- Continue alternating all three techniques until the obstruction is cleared, the child loses consciousness or specialist help arrives.
- If successful, have the child medically checked for any signs of respiratory system damage.

If the choking episode is severe and prolonged, or the obstruction is complete, the child will collapse and become unconscious. The rescue procedure is then as follows:

- Check the mouth for any obstruction and remove, then open the airway.
- Try five times to give two rescue breaths; if the chest rises successfully then carry out chest compressions to circulate the oxygen around the body.

- If the chest fails to rise, give five back slaps followed by five chest compressions if the child is still choking.
- Recheck the mouth and open the airway, then give another five rescue breaths.
- If unsuccessful, give another five back slaps followed by five abdominal thrusts.
- Continue the cycle until specialist help arrives or the obstruction is removed.

Choking in babies

Babies are easier for the rescuer to handle during a choking episode, as they can be held face down for back slaps and carried towards help while still being aided, rather than having to be left. Obviously, the force used to attempt to dislodge an obstruction must be significantly less than that used for a young child. Also, under no circumstances should abdominal thrusts be attempted on a baby, as their internal organs would be easily damaged by this technique.

Again, as with a young child, rescue breathing should not be attempted unless the baby is unconscious. If the baby is conscious and choking, the procedure is as follows:

- Check the mouth for any obvious obstruction and remove it.
- With the baby held face down along the rescuer's arm, give five back slaps using fingers only (Figure 6.24).
- Turn the baby face up and remove any obstruction.
- If unsuccessful, give five sharp chest compressions (as for BLS).
- If unsuccessful, call for specialist help and continue the cycle until the obstruction is removed or the baby becomes unconscious.

Figure 6.24 Baby back slaps using fingers.

If the baby becomes unconscious:

- recheck the mouth and open the airway
- try five times to give two rescue breaths
- if the chest rises, continue chest compressions to circulate the oxygen
- if not, give five back slaps followed by five chest compressions
- recheck the mouth for any obstruction and open the airway, then repeat the cycle until specialist help arrives.

Stroke (CVA)

A stroke occurs when one of two events affects the blood supply of the brain:

- Cerebral infarction: a blood vessel supplying the brain becomes blocked by a clot formed within the vessel (thrombus) or by a clot

which travels to the vessel from elsewhere in the body (embolism).

- Cerebral haemorrhage: a blood vessel supplying the brain either begins to leak or ruptures, causing haemorrhage within the skull which presses onto the brain.

Either event causes damage and death of the brain tissue supplied by the blood vessel involved, and the survival and long-term disability of the casualty will depend on the area of the brain involved. A mini-stroke (TIA) is a temporary disruption of the blood supply to an area of the brain which presents in the same way as a stroke, but its effects resolve completely within 24 hours. TIAs are often the precursor of a full stroke and should be medically investigated as a matter of urgency.

The signs and symptoms of a stroke will depend on the area of the brain affected and the extent of the damage caused, and may include any or all of those listed below.

- **Signs**: sudden weakness of the face or limbs on one side of the body, sudden difficulty in speaking, sudden loss of balance or fall.
- **Symptoms**: sudden numbness of face or limbs, sudden headache or visual disturbance, sudden confusion, sudden dizziness.

Treatment

The likelihood of the casualty having suffered a stroke needs to be determined quickly, as their chance of survival or the level of disability they suffer worsens with time. The Stroke Association (UK charity providing support to stroke victims and their families) recommends the 'FAST' approach to assessment of the casualty.

F	Facial weakness: any signs of eye or mouth drooping, can they smile or furrow their brow equally?
A	Arm weakness: can they raise both arms (or legs) equally, can they pull back on the rescuer's hands equally?
S	Speech problems: can they speak clearly, can they understand

	given commands?
T	Test all three signs quickly, and if there is any deficit it is TIME to call 999.

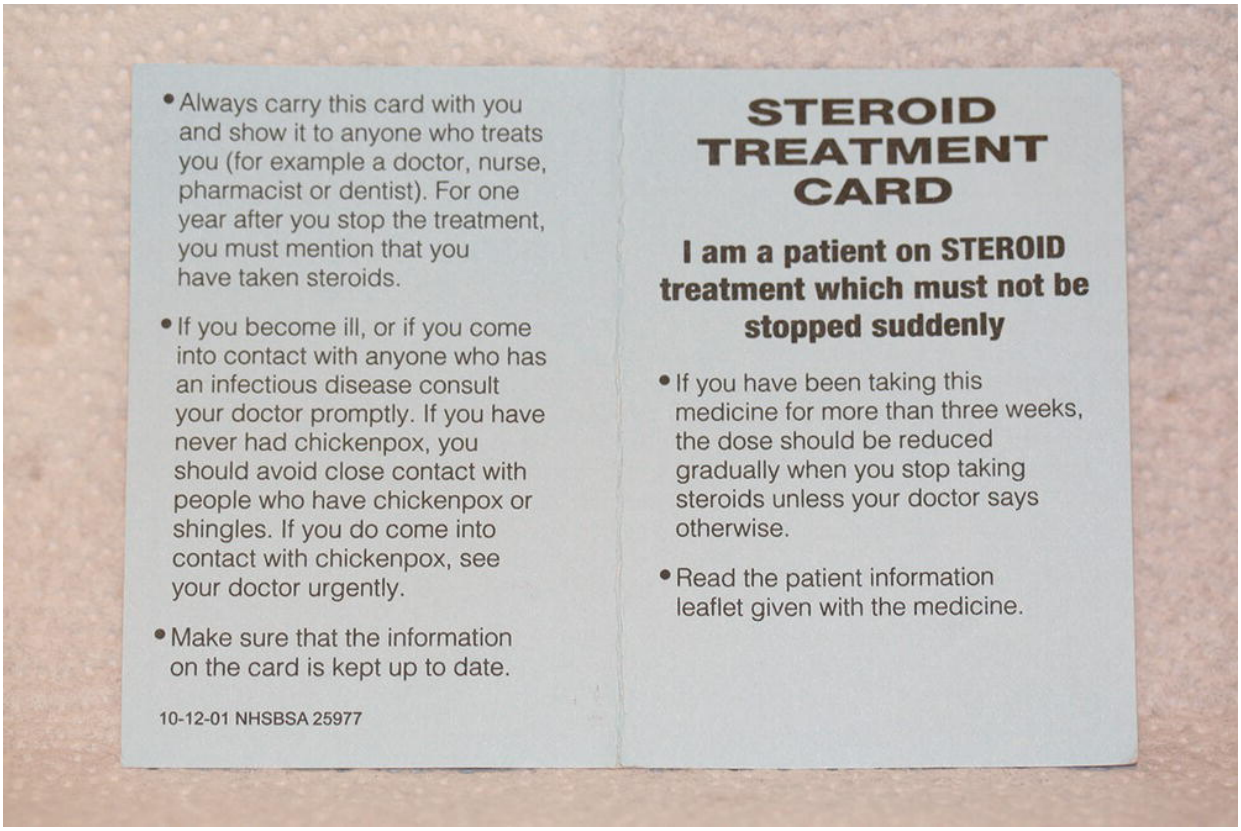
Once specialist help has been called, the rescuer must maintain the casualty's airway whether they are conscious or not, and provide supplemental **oxygen** using a facemask. The casualty's cough reflex and swallowing ability may be impaired, so suction may be required to remove saliva and vomit from their mouth. The level of consciousness must be monitored (ACVPU) and if the casualty becomes unconscious they should be placed in the recovery position, on the side showing any facial weakness so that any oral fluids will drain more easily. If conscious, the casualty *must not* be given any food or drink.

Adrenal crisis

There are several medical conditions which require a patient to be prescribed long-term steroid treatment by their medical doctor, and over time this treatment reduces the ability of their adrenal glands to naturally produce their own body steroids. Our body produces these natural steroids during times of crisis to assist us to survive stressful or fearful situations, often referred to as 'fight or flight' situations. When a stressful situation is encountered, the natural steroids enable the heart and lungs to work harder so that the brain and skeletal muscles receive increased volumes of oxygenated blood, and the body can cope and deal with the stressful situation (such as attending for dental treatment). When inadequate or no natural steroids are available at these times though, the attempts of the heart and lungs to deal with the situation results in a catastrophic fall in blood pressure and the casualty may go into clinical shock – this is a medical emergency. Prescribed steroids can have this effect on the body's adrenal glands for several years even after they have been discontinued, so patients are expected to carry a 'steroid warning card' (Figure 6.25) which should be shown to, and noted by, the dental team.

- **Signs**: low blood pressure (hypotension), fast heart rate, pale, vomiting.

- **Symptoms**: nausea, abdominal pain, feeling lethargic and weak.



• Always carry this card with you and show it to anyone who treats you (for example a doctor, nurse, pharmacist or dentist). For one year after you stop the treatment, you must mention that you have taken steroids.

• If you become ill, or if you come into contact with anyone who has an infectious disease consult your doctor promptly. If you have never had chickenpox, you should avoid close contact with people who have chickenpox or shingles. If you do come into contact with chickenpox, see your doctor urgently.

• Make sure that the information on the card is kept up to date.

10-12-01 NHSBSA 25977

STEROID TREATMENT CARD

I am a patient on STEROID treatment which must not be stopped suddenly

• If you have been taking this medicine for more than three weeks, the dose should be reduced gradually when you stop taking steroids unless your doctor says otherwise.

• Read the patient information leaflet given with the medicine.

Figure 6.25 Steroid warning card.

Treatment

- Call 999 urgently.
- Lay the casualty supine.
- Administer **oxygen** via a facemask.
- Be prepared to carry out **BLS** and defibrillation if necessary until specialist help arrives.

Preparation of the dental team for medical emergencies

Besides the legal obligation of complying with the GDC *Standards for the Dental Team* regulations, ensuring that all team members not only have current BLS certificates but that they are updated annually, the dental team can do much to prepare for a medical emergency. In particular, the team can have regular in-house emergency training practice sessions that are carried out and recorded accurately.

Although it is not currently a legal requirement for dental workplaces to have an AED on the premises, evidence shows that their use by experienced staff in a medical emergency significantly increases the chances of survival for the casualty. However, the availability of an AED in the dental workplace is considered to be an appropriate safety precaution in the event of a cardiac arrest on the premises by organisations such as the Resuscitation Council (UK) and the CQC, and the lack of one may be seen as a failure to adopt common practice. The acquisition of an AED and thorough training in its use by all dental workplace staff should therefore be encouraged.

In addition, a policy must be in place to detail all the following points:

- Designation of the team leader (usually the senior dentist).
- All staff must stop work and be available to assist with the emergency immediately.
- The location of the emergency drugs box, the AED and oxygen cylinders must be known by all staff.
- Duties will be delegated by the team leader and must be carried out correctly by those involved, in particular duties to collect the emergency drugs box, the AED and the oxygen, to call 999, to clear other patients away, to direct the specialist emergency personnel to the casualty.
- No duties should be undertaken that staff have not been specifically trained for.
- All staff must be competent in BLS and defibrillation techniques and able to assist as necessary.

- Commands from the team leader must be followed immediately and accurately.
- Duty of care to the casualty must be upheld at all times.

The dental team is also well advised to familiarise themselves with the emergency equipment, and to practise the use of it on a regular basis. In particular:

- use of the resuscitation masks and Ambu-bags
- the use of the portable suction unit for clearing the airway
- the use of artificial airways
- switching on the oxygen supply, and connecting the tubing and masks correctly
- opening drug phials and correctly drawing up their contents.

If a medical emergency does occur, accurate written records must be kept of the whole event for legal reasons. Any failure to do so, or any altering of the record contents, would cause the offender to be liable to GDC proceedings or even prosecution in serious cases. The dental nurse would be personally responsible for their own actions, and can no longer assume that the senior dentist would be vicariously liable and held to account for everyone else's performance.

The importance of a full written account cannot be over-emphasised, not only for the protection of the public but also for that of all staff. If it is shown that everything possible was done to avoid an emergency, and that the full and correct actions were taken by all when one occurred, no one can be held to account for what is then an unfortunate and unavoidable accident.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

7
Microbiology and Pathology

Key learning points

A **factual knowledge** of

- pathogenic micro-organisms

A **working knowledge** of

- disease processes
- pathology relevant to oral health

A **factual awareness** of

- drugs used to combat oral diseases

Pathology is the study of disease, and disease is the condition of suffering from an illness. Many diseases are caused by contamination of the body cells by microscopic living organisms, collectively called *micro-organisms*. The study of these different micro-organisms, how they live and function, and how they cause disease within the body is called microbiology.

Micro-organisms that have the capability of producing a disease are referred to as *pathogenic organisms*, or *pathogens*, as opposed to those that cannot cause illness or disease which are called *non-pathogens*.

The three main groups of pathogenic micro-organisms are as follows:

- **Bacteria**: microscopic single-cell organisms that survive as inactive spores when conditions are not favourable for them to grow and reproduce.
- **Viruses**: ultramicroscopic organisms that live within the cells of other organisms.
- **Fungi**: types of microscopic plant organism that grows across cells and tissues as an extensive branching network of fungal tissue.

A fourth type of micro-organism, called *protozoa*, also exists but has no relevance to dentistry, as protozoa do not cause any diseases within the oral cavity.

More recently, research has uncovered the existence of *prions*, which are not living micro-organisms but rather a type of special infectious protein that is therefore capable of causing disease. Those diseases caused by prions that have been discovered so far include kuru in humans, and 'mad cow disease' and its human variant called Creutzfeldt–Jakob disease (CJD).

The transmission of CJD and its new variant (vCJD) is becoming more of a concern in dentistry as prions are not killed by the usual decontamination and sterilisation techniques used in the dental surgery environment. This means that an infected patient could pass on CJD to another patient when supposedly sterile instruments are reused. As the prions are known to specifically affect nerve tissue, all endodontic instruments (those used for root canal treatment, such as barbed broaches and files) now have to be considered as single-use disposable items in dentistry, as they will come into contact with the nerve tissue found within the pulp of the teeth during normal use. These instruments must all be safely discarded in sharps boxes after being used on just one patient, and then new instruments are used on the next patient. This avoids the possibility of passing prions from the first patient to the second.

The new instruments will have been sterilised at the manufacturing stage, using an industrial sterilisation technique such as gamma irradiation. The topics of decontamination, sterilisation and infection control are discussed in detail in Chapter 8.

The oral cavity provides the ideal conditions for micro-organisms to live, especially bacteria, being warm and well oxygenated and providing many sheltered areas between teeth and in the gingival crevice for them to lodge without being disturbed and removed. A healthy oral cavity normally contains many different bacteria, many of which are harmless, but others cause disease within the oral cavity when their numbers increase. Other micro-organisms not normally present in health can be transferred to the oral cavity and cause disease, such as by using contaminated crockery or cutlery, or by

sharing a toothbrush between individuals. The pathogenic micro-organisms relevant to dentistry are described below.

Bacteria

These single-cell micro-organisms have rigid outer walls which determine their shape, and help to categorise them into named groups (Figure 7.1).

- **Cocci**: circular micro-organisms; colonies living in clusters are *staphylococci*, while those living in chains are *streptococci*.
- **Bacilli**: rod-shaped with pointed ends; round-ended ones are *lactobacilli*.
- **Spirochaetes**: spiral shaped, like a helix.

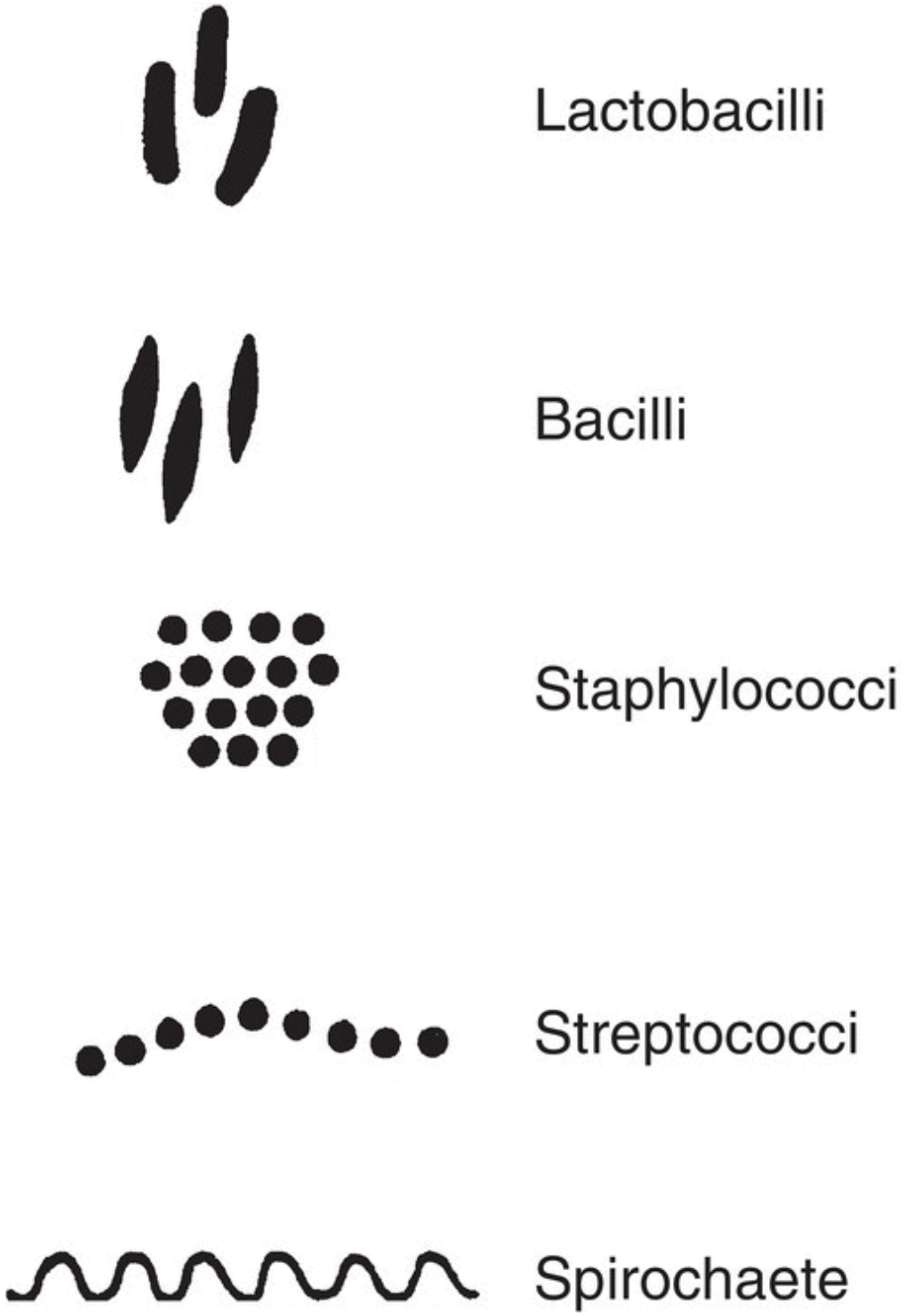


Figure 7.1 Types of bacteria by microscopic shape.

When living conditions are not ideal for the colony to grow and expand, bacteria survive as *spores*, in a similar way that flowering plants produce seeds to survive the winter while the parent plant dies

from the cold. The spores have a very hard outer coating that protects the bacteria within from chemicals, from drought, and from wide variations in temperature. Many can therefore survive the action of chemicals used in dentistry for disinfection purposes (such as bleach), and the only sure way of removing the risk of bacterial contamination on dental instruments is to either sterilise them or to only use them once before they are discarded (single-use items). Dental instruments are expensive to buy, so wherever possible they are manufactured to withstand the sterilisation process and can then be reused safely.

Some bacteria found in the oral cavity have adapted to exist in areas of low oxygen levels, such as deep within a carious lesion or a periodontal pocket. They are referred to as *anaerobic bacteria* and are particularly harmful because they are more difficult to reach and remove physically, and often require different drug treatment methods to those used against the more usual *aerobic bacteria*.

Although the body's natural defence mechanisms will help to protect it to some extent from attack by micro-organisms, by the existence of its *natural immunity* (see later), drugs have also been developed to fight against them, and for bacteria the important drug groups are the following:

- **Antibiotics**: taken to kill bacteria causing a severe illness, but can also kill some of the helpful bacteria naturally found within the body, especially those in the digestive system. Treatment with antibiotics is therefore often associated with stomach pain or diarrhoea. Different types are required when treating infections caused by either aerobic or anaerobic bacteria.
- **Bactericidal agents**: chemicals used to clean externally (such as surgery work surfaces) that act to kill bacteria.
- **Bacteriostatic agents**: chemicals used to clean externally that do not kill bacteria, but prevent them reproducing and multiplying.

Some of the more important bacteria associated with dentistry are shown in Table 7.1. The specific micro-organisms associated with causing certain bacterial diseases are listed in the left-hand column and the actual disease in the right-hand column. So, for example, six

micro-organisms are listed as being associated with periodontal disease (although still more are being identified), and two with dental caries (the initial infective agent as well as the micro-organism found in established dental cavities). The names of some of these micro-organisms should be familiar to the dental nurse.

Table 7.1 Dentally related bacterial diseases.

Bacteria name	Associated disease
Streptococcus mutans	Initial infective bacterium found in dental caries, as a cavity first forms, and the micro-organism responsible for most of the production of the weak organic acids that cause enamel demineralisation
Lactobacillus	Later colonisation of an established carious lesion, as the deeper tooth tissues become infected
Actinomyces *Porphyromonas gingivalis* *Prevotella intermedia* *Treponema denticola* *Fusobacterium nucleatum* *Campylobacter rectus*	Periodontal disease, the bacterial infection of the supporting structures of the teeth (gingivae, periodontal ligament, cementum, alveolar bone)
Staphylococci	Skin boils and gingival boils, impetigo
Bacillus fusiformis *Borrelia vincentii*	Acute necrotising ulcerative gingivitis, a specific periodontal infection often seen in young adults when their oral hygiene is particularly poor

Dental caries and periodontal disease are caused by bacterial infection of the dental hard tissues or the supporting structures of the teeth, respectively. Prevention of these diseases and their treatment when present in a patient are the mainstay of the work carried out by the dental team on a daily basis.

Viruses

These micro-organisms are far smaller than bacteria, being visible only with an electron microscope. They live within the cells of other organisms, including human tissue cells, existing as a protein capsule that contains all the chemicals the virus needs to reproduce within the cells of its host (Figure 7.2). The protein capsule is unique for every virus and causes the body cells to react against it (as an *immune response*) while trying to fight off the disease that the virus has produced.

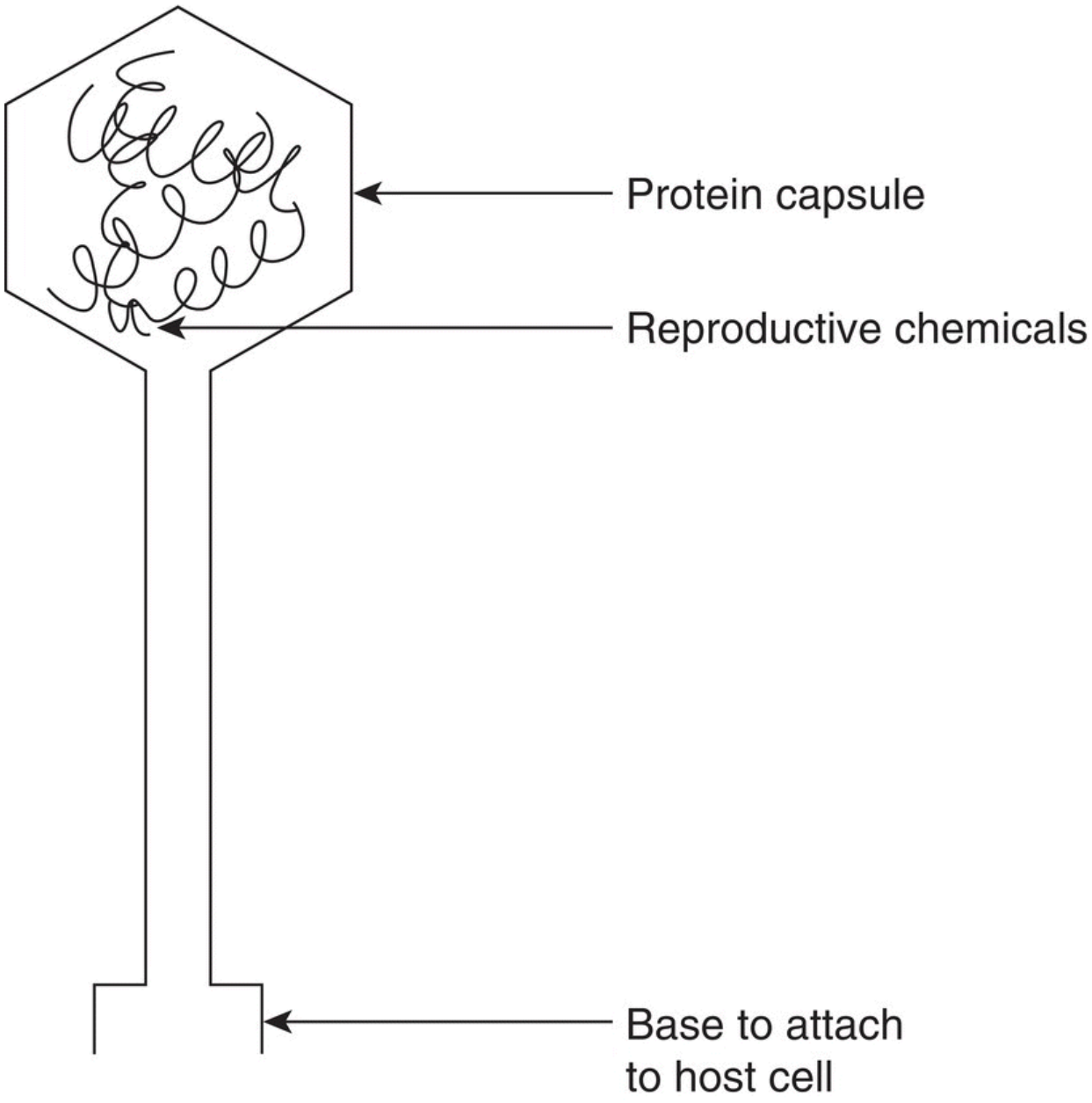


Figure 7.2 Structure of a virus.

Viral diseases are more difficult to cure than those caused by other micro-organisms because very few drugs have been developed against them, although some antiviral agents do exist. One such agent of relevance to the dental team is the drug aciclovir, which is used as a topical cream to treat 'cold sore' lesions of the lip caused by herpes simplex type 1 virus. Others are being developed in the ongoing battle against more serious or fatal viral diseases such as AIDS.

Fortunately, *vaccinations* have been developed to prevent many (but not all) viral diseases instead. They consist of a harmless dose of the dead virus or its protein capsule which is injected into the individual or given orally. The presence of the dead virus or capsules causes the body's immune system to fight against them by making *antibodies*, although the disease itself cannot develop fully and make the person unwell. If the individual is then exposed to the same viral disease again in the future, these antibodies already present in their body will fight off the viral attack and prevent the person from becoming ill. This is called *acquired immunity*.

Viruses are also more difficult to kill than bacteria, and either the process of sterilisation or the use of specialised viricidal chemicals is required to do so. Unless stated on the labelling as viricidal, routine disinfectants are not usually active against viruses.

Some of the more important viral infections of relevance to the dental team are shown in Table 7.2.

Table 7.2 Dentally related viral diseases.

Virus name	Associated disease
Hepatitis A, B, C, etc.	Various inflammatory liver diseases, some of which are fatal Hepatitis B vaccinations are an occupational health requirement for all clinical dental personnel
Human papillomavirus (HPV)	Certain types of this virus have been linked to oral cancer, especially those occurring in the oropharyngeal region
Herpes varicella	Chickenpox, which usually occurs in childhood (but not always) and which affects the area supplied by the trigeminal nerve (cranial nerve V) as well as the torso
Human immunodeficiency virus (HIV)	AIDS, a blood-borne and fatal viral infection which was initially only found in certain patient groups (e.g. intravenous drug users and homosexuals), but has now spread beyond them and can be found in the wider population
Herpes zoster	Shingles, a very painful blistering skin rash which can involve the area supplied by the trigeminal nerve (cranial nerve V) as well as the torso
Herpes simplex type 1	'Cold sores': blister lesions occurring on the lips, and which are highly infectious in their initial stages if touched
Epstein–Barr virus	Glandular fever, a debilitating viral infection which results in painfully swollen lymph glands, including those found in the neck
Paramyxovirus	Mumps, a viral infection of the parotid salivary glands (either one or both), but which seems not to affect any other salivary glands
Coxsackievirus	Hand, foot and mouth disease, a common infection seen in young children, which presents as painful blistering in the oral cavity, on the palms of the hands and the soles of the feet

There are relatively more viral diseases of importance to the dental team than there are bacterial diseases, although none affect the teeth or their supporting structures and are therefore not associated with caries or periodontal disease. The viral diseases are important from an infection control point of view, as staff should be vaccinated against several of them and their infectivity is usually greater from person to person than for bacterial diseases. Indeed, when a patient is suffering from viral infections such as cold sores, mumps or chickenpox, it is best if their treatment is delayed and so avoid the risk of spreading the infection to the workplace personnel.

Fungi

These are plant-like organisms similar to microscopic colonies of mushrooms or toadstools. They grow as an extensive network of branches lying across the body tissues (called *hyphae*) and reproduce by budding out from the ends of the hyphae, or by the production of spores from fruiting bodies (like microscopic mushrooms). They tend to live on the outer surface of the body, such as on the skin, the oral cavity lining, the nails and the surface of the eye, rather than growing within the body tissues.

The only fungal infection of dental importance is that caused by *Candida albicans*, which is responsible for several oral lesions and diseases, including the following more common ones:

- **Acute oral candidosis (oral thrush)**: appears as a removable white film with underlying red, sore patches occurring on the soft tissues of the oral cavity, especially the hard palate and the cheeks, and associated with general ill health, especially in the elderly or those suffering from other serious diseases such as AIDS. When present in an otherwise healthy individual, oral candidosis will have developed because of a disruption in the populations of the normal oral bacteria, usually following a course of antibiotics (a condition known as denture sore mouth).
- **Chronic oral candidosis**: also known as denture stomatitis, this occurs in healthy patients beneath both dentures and removable orthodontic appliances as a reddened but painless area lying exactly under the palatal section of the appliance. It is associated with poor appliance hygiene and raised moisture levels beneath the appliance, allowing the fungus to colonise the underlying oral tissues.
- **Angular cheilitis**: a *Candida* infection that specifically involves the angles of the mouth, appearing as a localised area of inflamed and cracked skin which is often crusted over. Wide mouth opening will split the lesion and cause bleeding and further splitting. It is associated with constant saliva leakage into the angle areas, allowing the fungal infection to occur – patients usually have deep tissue folds here or have a ‘crumpled face’ appearance due to loss of their occlusal face height. This may be

due to edentulousness, worn dentures or tooth surface loss with age or in severe cases of attrition.

Fungal infections are treated with antifungal agents, usually provided as systemic tablets, oral gels, oral solutions or as a pastille to be sucked and dissolved in the mouth. Antifungal agents in current use include topical nystatin pastilles or solution, amphotericin lozenges, miconazole gel and systemic fluconazole tablets.

Any suspected underlying illnesses also need diagnosing and treating, and appliance hygiene needs to be reinforced by the dental team in cases of denture stomatitis. Patients suffering from angular cheilitis will require treatment to restore their occlusal face height to an acceptable size so that the folds of tissue at the angles of their mouth are eliminated. This may involve the provision of new or replacement dentures, or the rehabilitation of their dentition to replace the tooth tissue lost by attrition.

General effects of disease on the body

So, the body cells may be attacked by one of many pathogenic micro-organisms to produce an infection which results in a disease or illness. In addition, tissue damage, illness and disease may occur due to other (non-infective) occurrences such as trauma, body cell/tissue malfunction, and genetic mutation or predisposition. Whatever the cause, the effects on the body will occur as one of the following:

- Infection and/or inflammation.
- Ulceration.
- Oral white and red patches.
- Formation of a cyst.
- Formation of a tumour (benign or malignant).
- Congenital or developmental defect.

Infection and inflammation

Infection is the actual invasion of the body cells by the pathogens, resulting in an *inflammatory response* of the cells that produces the five signs of inflammation: *heat*, *swelling*, *pain*, *redness*, *loss of function*. Examples of dentally relevant infections include:

- dental caries
- periodontal disease
- herpes simplex.

Inflammation may also affect any of the oral mucosal tissues before infection occurs, and will often be related to an underlying medical disorder instead.

- **Stomatitis**: a general inflammatory condition affecting the oral cavity.
  - Often occurs in the elderly and in denture wearers.
  - Mucosa appears red and inflamed and often has an overlying *Candida* infection present.

    - Responds well to improved oral and denture hygiene in most cases.
    - Can be due to general debilitation and malnutrition, especially in the elderly.
- **Angular cheilitis**: inflammation at the corners (angles) of the mouth.
    - Often occurs in the elderly and in denture wearers, as an extension of stomatitis.
    - Appears as red and inflamed angles, often with cracking of the surface on mouth opening.
    - Often due to a loss of facial height which allows saliva pooling in the area.
    - Wet conditions produced allows infection with common skin micro-organisms, such as *Staphylococcus aureus*.
- **Glossitis**: inflammation of the tongue which appears as red and smooth, and is sore.
    - Often seen in iron deficiency anaemia.
    - Also occurs when extensive *Candida* infection is present in debilitated patients.
    - May also indicate vitamin B deficiencies.
- **Burning mouth syndrome**: usually occurs in elderly women, and described as the oral cavity feeling 'as though on fire'.
    - Usually no physical abnormality is found on examination.
    - Considered psychogenic in many cases, due to depression, fear of cancer or of other serious disorders.

Ulcers and ulceration

An ulcer is a shallow break in the skin or mucous membrane, leaving a raw and painful circular base that may bleed when touched. Ulcers are probably one of the commonest soft tissue lesions seen in the dental workplace, and they have many causes and vary considerably in appearance.

- **Recurrent ulceration**: this affects around 20% of the population and is so called because ulcers occur again and again in the same patient, usually with no diagnosed cause although they are linked to nutritional deficiencies in some patients.
    - **Minor aphthous ulcers**: small, shallow, painful ulcers which heal within 14 days and cause no scarring.
    - **Major aphthous ulcers**: larger, painful ulcers which take weeks or months to heal and cause scarring.
    - **Herpetiform aphthous ulcers**: very small multiple ulcers which occur sometimes up to 100 at a time.
- **Ulceration due to systemic disease**: various diseases affecting the digestive system often exhibit oral ulceration, although the patient is likely to have already been diagnosed with the overlying disease before being seen by the dental team, and this should be noted in the medical history:
    - **Crohn's disease**
    - **Ulcerative colitis**
    - **Coeliac disease**
    - **Inflammatory bowel disease**.
- **Ulceration due to viral infection**: two viral diseases in particular are associated with, and often diagnosed by, the presence of specific oral ulceration.
    - **Herpes simplex virus**: as the primary infection of the patient, causes ulceration of most of the oral soft tissues and recurs throughout later life as herpes labialis ('cold sores').
    - **Coxsackievirus**: hand, foot and mouth disease in childhood, with small ulcers present in all these areas at the same time, specifically on the soft palate and back of the mouth in the oral cavity.
- **Ulceration due to skin disorders**: the relevant condition in this category is that of **lichen planus**.
    - An inflammatory skin condition that often causes oral ulceration in sufferers.

    - Oral lesions are recognised as being **premalignant**, that is, they can undergo cell mutation and develop into malignant (cancerous) lesions.
    - Ulcers appear orally with white striae (stripes) around them.
- **Malignant ulceration**: **squamous cell carcinoma** is the predominant manifestation of oral cancer, and usually develops as an ulceration in the floor of the mouth, or on the sides of the tongue (see later).
    - Painless ulcer with no obvious cause, such as trauma from a sharp tooth, and which does not heal within 2–3 weeks of its first appearance.
    - Aphthous-like ulcer with a 'punched-out' floor and rolled edges: this is the classic appearance of an advanced malignancy.
    - Very usually (but not always) diagnosed in smokers, users of other tobacco products, and heavy alcohol drinkers.

Oral white and red patches

Oral white patches can occur as transient or persistent lesions, and have several causes.

- **Oral candidosis**: commonly occurring infection with the fungus *Candida albicans*, producing a transient white patch that can be wiped off the oral mucosa to leave a raw-looking area beneath.
    - Often occurs following the use of broad-spectrum antibiotics, which disturbs the normal micro-organism balance in the body and allows the overgrowth of the fungus (denture sore mouth).
    - Also occurs in immune-compromised patients, and those who are seriously ill with systemic disorders.
    - Can occur particularly on the hard and soft palate in patients using long-term steroid inhalers, such as asthmatics.

- **Leukoplakia**: a white patch that has no obvious local cause, such as chronic trauma from a sharp tooth, and which cannot be removed from the mucosa by wiping.
  - Often appears as white striae on the buccal mucosa or tongue, similar to lichen planus.
  - Regarded as a potentially **premalignant** condition, although it sometimes has no sinister consequences.
  - Associated with smoking in particular, and also with heavy alcohol intake.
- **Erythroplakia**: a red patch on the oral mucosa, in isolation or sometimes adjacent to an area of leukoplakia, and regarded as a sinister sign of premalignancy of the soft tissues involved.

Cysts

A cyst is an abnormal sac of fluid that develops within the body tissues over a period of time. Examples of dentally relevant cysts are:

- dentigerous cyst (develops around an impacted, unerupted tooth)
- periapical cyst (develops around the tooth apex)
- trauma to minor salivary glands, producing a cyst called a **mucocele** (usually occurs on the lower lip).

Tumours

A tumour is a swelling within any body tissue due to uncontrolled and abnormal overgrowth of the body cells. When the swelling causes no harm other than to displace any surrounding structures it is called *benign* but when the swelling invades and damages the surrounding structures it is called malignant and is usually referred to as *cancer*. Examples of dentally relevant tumours are:

- squamous cell carcinoma of the oral epithelium (see later)
- osteosarcoma of the mandible or maxilla
- salivary gland tumours (benign or malignant)

- lymphoma affecting the lymph glands of the neck.

Congenital/developmental defect

An inherited condition or a genetic mutation that produces an illness or condition that is present at birth. Examples of dentally relevant defects are:

- cleft lip or palate
- congenital absence of some teeth (hypodontia)
- defect of tooth formation, such as amelogenesis imperfecta.

Response of the body to pathogen attack

For the dental nurse, the most relevant potential cause of illness and disease in a patient is that due to attack by pathogenic micro-organisms, as an infection. An understanding of the way that the body responds to the pathogen attack, and either fights off the invaders or succumbs to illness and disease, is important for the dental nurse to grasp when considering their role in infection control.

The body has three natural lines of defence against attack by pathogens which, in fit and healthy individuals, are often enough to prevent a serious illness developing.

- Intact skin and mucous membranes act as physical barriers against the pathogens, preventing them from invading the deeper tissues of the body.
- Surface secretions onto the skin or mucous membranes help to dilute and neutralise the pathogens and their poisons (*toxins*), such as saliva in the mouth, gastric juice in the stomach, sweat on the skin and tears in the eyes.
- Inflammatory response within the body tissues if the skin or mucous membranes are breached.

Problems may occur in individuals who are not fit and healthy when their body is attacked by pathogens, as they may be unable to defend themselves so that a disease takes hold and they become ill. Those most likely to suffer are the following:

- **Elderly**: the functioning of the body cells in older patients is not as efficient as when they were younger, as cells and tissues wear out with age and cannot be replaced as easily, and other age-related disorders may be present that affect the ability of the body to repair itself.
- **Young children, including babies**: the natural immune systems of this group will not be functioning fully for some time, so they are more prone to developing diseases after attacks by pathogens. In addition and depending on their age, they may not have developed acquired immunity to certain pathogens as they

receive various vaccinations at certain life stages rather than all at the same time.

- **Debilitated**: those patients of any age who are said to be *immunocompromised* because they have an underlying illness that affects the ability of their immune system to fight off pathogens. This includes those with diabetes, those suffering from a range of illnesses such as leukaemia, kidney failure, AIDS and various cancers, and those taking drugs that suppress their immune systems due to organ transplant or cancer treatment.

Infection occurs when the pathogenic micro-organisms breach the skin or mucous membrane and gain entry to the deeper body tissues. In the dental workplace, this can happen in a variety of ways.

- **Direct contact**: with body fluids, such as saliva, blood or vomit.
- **Airborne droplets** of body fluids, due to the infected host sneezing, coughing or spitting.
- **Aerosol spray**: created during the use of dental handpieces and water sprays, spraying blood and saliva into the atmosphere.
- **Direct entry**: through damaged skin or oral epithelium, from cuts, grazes, piercing of the cornea of the eye.
- **Inoculation injury**: piercing of the skin or oral epithelium with a contaminated instrument, as occurs with a dirty needlestick injury.

Inflammatory response

If the body tissues are breached by the pathogen, then an inflammatory response occurs. This is the normal reaction of the body to exposure to an irritant such as an infective micro-organism, but it may also occur when exposed to physical and chemical irritants such as cuts, fire burns or chemical burns. Microscopically, the reaction of the body is the same, irrespective of the cause.

- Huge increase in blood flow to the affected area, so that many leucocytes (white blood cells) can be transported there to fight the pathogens.

- This sudden increase in blood volume in the area will cause the tissues to appear *red* and *swollen*, and feel *hot to touch*.
- The swollen tissues will also press against the surrounding nerve cells, causing *pain*, and the affected area will then become too painful to use, resulting in *loss of function*.
- Leucocytes pass out of the capillaries and into the invaded body tissues to fight the pathogens by surrounding and eating them. They are helped to destroy the pathogens by the movement of blood plasma into the tissues, which contains antibodies and antitoxins that act to neutralise the poisons produced by the pathogens.
- Toxin production by the pathogens may be severe enough to cause a rise in body temperature from the normal 37 °C, indicating an intense infection; this rise in body temperature is called *pyrexia*.
- During the battle between the pathogens and the body's inflammatory response cells, both leucocytes and pathogens are killed, and their debris collects to form *pus* in the body tissues.
- If the pus remains contained in the area of invasion, it forms an *abscess*, but if it manages to spread into the surrounding tissues it is called *cellulitis*.
- When the inflammatory process occurs as above, it is described as *acute infection* but when it occurs over a long period of time with few of the symptoms (especially pain) being evident it is described as *chronic infection*.
- If the infecting micro-organism is very powerful and difficult for the inflammatory response to control, it is described as *virulent*.
- The elderly, the young and the debilitated may be unable to fight off an infection without the use of drugs such as *antibiotics*, *antivirals* or *antifungals*, and these may also have to be used in healthy individuals when a virulent organism is involved.

So, to reiterate, the five classic signs of inflammation are *heat*, *swelling*, *redness*, *pain*, *loss of function*.

When the inflammatory response occurs in the absence of micro-organisms, no infection will occur nor pus form, and the body tissues will repair any damage caused by the irritant.

Tissue repair

Once the inflammatory response has overcome the infecting micro-organisms, or the physical or chemical irritant has been removed, the body will repair itself. New leucocytes will travel to the area and remove any damaged or dead tissue, and they will then lay down a temporary layer of repair cells called *granulation tissue*. This consists of basic tissue cells and capillaries which form a fibrous framework for the more specialised tissue cells to grow and develop onto. So if the damage occurred in skin, skin cells will be formed; if in bone, bone cells will be formed, and so on.

If a chronic infection is persistently present, the body's attempts to repair the damage will only be partially successful, and a state will exist where tissue is being repaired at the same time as chronic infection is still present. This is the usual case with infections such as chronic periodontal disease. The infecting micro-organisms are never completely eradicated, the chronic infection is always present and its severity swings between low grade and held at bay, with intermittent acute episodes that require treatment and drug therapy to overcome.

Immune response

During the inflammatory response, certain leucocytes are not involved in fighting the micro-organisms, but are stimulated to release *antibodies* and *antitoxins* into the blood plasma instead. The stimulation occurs because these leucocytes recognise the invaders as being foreign to the normal body tissues – they are identified as *antigens*. Other antigens that will cause a similar response are transplanted organs, foreign bodies (such as splinters and thorns), toxins from plant and animal tissues, and incompatible blood transfusions.

The antibodies and antitoxins released are quite specific for an invading micro-organism, and their presence in the body provides

immunity against that specific disease. The types of immunity that may be present are listed below.

- **Natural immunity**: present from birth by being randomly inherited.
- **Passive immunity**: present from birth and specifically inherited directly from the mother's own pool of antibodies and antitoxins.
- **Acquired immunity**: creation of the necessary antibodies and antitoxins by the leucocytes during an initial pathogen attack, so that the disease is overcome. These new antibodies and antitoxins then remain in the body for life and prevent a recurrence of the same infection.
- **Vaccination to produce acquired immunity**: by giving a harmless dose of a pathogen (often by injection) to stimulate the leucocytes to develop the antibodies and antitoxins, but without actually causing the disease to develop.

Unfortunately, acquired immunity does not occur for every micro-organism and, in addition, many of them (especially viruses) can go through a process called *mutation*, by which they change their chemical make-up slightly and effectively produce a new variation of a disease. The individual will then have to be exposed to this new variant before suitable antibodies and antitoxins can be made by their leucocytes. This is why, for example, influenza vaccinations are necessary on an annual basis, as the virus mutates easily and creates new strains of the micro-organism every year. New vaccines then have to be developed, and the population vaccinated each autumn before the variant disease becomes widespread.

With the use of vaccines, individuals can be protected against serious and fatal infections without having to be exposed to, and survive, the actual attack. Because of the close-up and hands-on nature of dental treatment, the team are exposed to many infections daily and are at risk of catching any of them. Consequently, all clinical dental staff must be vaccinated against the following:

- Hepatitis B.

- MMR: measles, mumps and rubella (German measles).
- Tuberculosis and whooping cough (pertussis).
- Poliomyelitis.
- Diphtheria and tetanus.
- Chickenpox (if not already naturally immune).
- Meningitis.

Some serious and fatal diseases have no vaccination available at present, and one of the most important in relation to the dental team is AIDS because this is transmitted mainly by blood and many dental procedures produce bleeding. Avoidance of infection by any micro-organism can only occur if procedures are in place with regard to the following factors:

- Staff vaccination.
- Use of PPE during treatment and cleaning procedures.
- Use of single-use disposables where possible.
- Correct decontamination and sterilisation of reusable instruments and equipment.
- Correct cleaning of the clinical area.
- Thorough hand washing.

Allergy

Occasionally the normal immune response goes into overdrive after exposure to some substances, and the body completely overreacts to the presence of an antigen. An *allergic reaction* occurs, and results in sudden swelling of the tissues and the production of copious fluids from the body tissues. The substance that stimulated the overreaction is called an *allergen*. The effects of the allergen on the individual can range in severity from hayfever-like symptoms, to a mild rash, to a full anaphylactic shock episode, which is potentially fatal (see Chapter 6).

Often, individuals prone to an allergic reaction will already suffer from disorders such as asthma, eczema or hayfever, so they should be

identified from their medical history and treated with caution. Particular precautions to be taken during dental treatment include the avoidance of known allergens, such as *latex products* (gloves, rubber dam sheets, local anaesthetic cartridge bungs) and certain drugs such as the antibiotic *penicillin* and its derivatives.

There is also an increased incidence of a condition called *contact dermatitis* amongst dental and medical staff nowadays, possibly due to the increased use of hand-cleaning agents in the workplace. In addition, the increased use and variety of surface cleaning sprays and wipes that are necessary to comply with current infection control legislation are thought to be linked to an increase in staff numbers experiencing upper respiratory tract hypersensitivity reactions and occupational asthma. It is hoped that as new products are developed, their effects on the staff exposed to their increased use will be taken into consideration by the manufacturers.

Dentally related pathology

With an understanding of the various types of micro-organism that may cause disease and illness in the body, a summary of the lesions and conditions that may occur in the oral cavity and be seen by the dental nurse is given below. Oral cancer will be discussed in detail.

- **Dental caries**: bacterial infection of the hard tissues of the tooth.
- **Periodontal disease**: bacterial infection of the gingivae and periodontal supporting tissues.
- **Oral thrush**: fungal infection of the oral soft tissues.
- **Periapical abscess**: bacterial infection of the tooth pulp causing abscess formation at the apex (can be acute or chronic, Figures 7.3 and 7.4 respectively).
- **Periodontal abscess**: bacterial infection within a periodontal pocket causing abscess formation.
- **Aphthous ulcers**: ulceration of the oral soft tissues that is not related to infection.
- **Herpetic ulceration**: viral infection of the oral soft tissues causing ulceration.
- **Acute necrotising ulcerative gingivitis**: acute bacterial infection of the gingivae causing ulceration.
- **Dental cyst**: cyst formation associated with a tooth, either erupted or unerupted.
- **Alveolar bone cyst**: cyst formation within the jaw bone.
- **Pericoronitis**: acute bacterial infection of the soft tissues (operculum) associated with a partially erupted tooth, especially the lower third molars.
- **Localised osteitis**: bacterial infection of the bony walls of an extraction socket (also called ‘dry socket’).
- **Cellulitis**: bacterial infection spreading from a tooth into the surrounding deep soft tissue structures.

- **Cleft palate**: developmental defect of the palate (roof of the mouth) where the two bony halves fail to join together completely during embryonic development.
- **Oral cancer**: malignant tumour usually affecting the oral soft tissues initially, and then spreading into the underlying tissues if not treated.

Figure 7.3 Acute abscess presenting as a large and painful swelling.

Figure 7.4 Chronic abscess with sinus.

Oral cancer

Oral cancer is one of the few cancers which is increasing in incidence in the UK, particularly among younger patients, but it continues to have high death rates too with just an average of 50% survival after 5 years. It is one of the most disfiguring of cancers, as treatment often involves the surgical removal of parts of the mouth, jaws or face, leaving the patient seriously debilitated and requiring reconstructive surgery. As the dental team are in a unique position of examining patients orally on a regular basis (for those patients who attend), the GDC has set oral cancer and its early detection as a highly recommended CPD topic for all clinical registrants, to ensure that the team are knowledgeable about the risk factors involved, can recognise the appearance of the various cancers, and understand the need for early referral of suspicious lesions.

Cancer Research UK and the BDA have made available a series of downloads collectively called the 'Oral Cancer Recognition Toolkit'

which provides an invaluable lesion recognition resource for each area of the mouth that may be affected by oral cancer. The toolkit can be downloaded and kept as a pictorial reference guide in the dental workplace, with access for the whole team (contact www.bda.org for further information).

Oral cancers include all those affecting the lip, tongue, floor of the mouth, gingiva, and other oral soft tissues, while those affecting the tonsils and oropharynx region (back of the mouth) are referred to as oropharyngeal cancers, the majority of which are caused by the human papillomavirus (HPV). Cancers affecting the major salivary glands (parotids, submandibulars and sublinguals; see Chapter 10) are classified separately according to the gland and type of tumour involved.

Ninety percent of oral cancers affect the soft tissues initially, as a lesion called *squamous cell carcinoma* (SCC). The known risk factors for oral cancer are listed below.

- **Tobacco habits**: all tobacco products contain chemicals capable of causing cancer (*carcinogens*). All tobacco products are considered risk factors, including betel quid, areca nut, gutkha and snuff.
- **High alcohol consumption**: alcohol acts as a solvent for the carcinogens, and allows their easier entry into the deeper layers of the soft tissues. Binge drinking has been found to be more harmful than drinking lower volumes of alcohol on a more regular basis.
- **Both together**: smokers who also drink to excess are at most risk of SCC.
- **Sunlight**: in fair-skinned people, sunlight is associated with SCC affecting the lower lip.
- **Diet**: research is ongoing into links between SCC and diets high in fats and red meat, or low in vitamin A and iron intake. A definite link has been established between SCC and diets low in fresh fruits and vegetables (especially green and yellow vegetables), as well as with other cancers; hence the advice to eat a minimum of five portions of fruit and vegetables per day.

- **Genetics**: some people are genetically predisposed to developing SCC, as with other cancers.

As stated previously, the dental team are in a unique position to help prevent some oral cancers and to improve the survival rate of afflicted patients by carrying out the following:

- Keeping up to date with CPD involving oral cancer and its early detection, so that suspicious lesions are recognised.
- Carrying out a soft tissue examination at every recall appointment to identify suspicious lesions at the earliest opportunity.
- Identifying patients with known risk factors, and providing lifestyle counselling where necessary.
- Referring suspicious lesions appropriately and in a timely manner for further investigation by specialists.

Soft tissue examination is discussed in detail in Chapter 12, where an example of a soft tissue assessment sheet is shown (see Figure 12.5) for recording any notable findings. Alternatively, the BDA and several dental computer software suppliers have produced a useful 'mouthmap' (Figure 7.5) which is available to dentists from the BDA shop (www.bda.org/shop) or is actually installed in the software system. Alternatively, an intraoral photograph can be taken of a suspicious lesion and forwarded to specialists as necessary, through the encrypted NHSnet referral service.

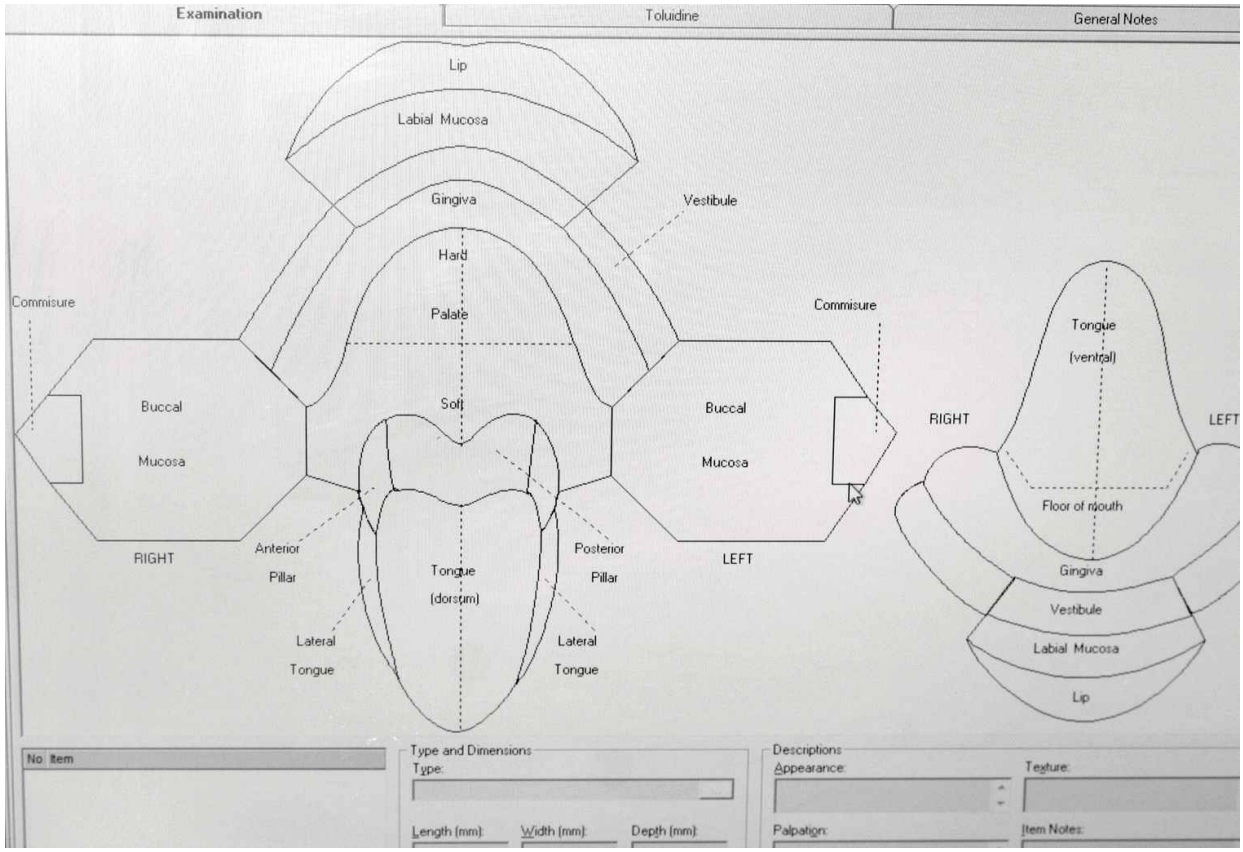


Figure 7.5 Example of a ‘mouthmap’.

The signs and symptoms of oral cancer may present in many ways but any of the following findings should raise suspicions if found during an examination, whether the patient has known risk factors or not. This is in line with the NICE referral guidelines issued in 2015 and the Cancer Research UK referral pathway recommendations.

- Painless ulcer that has no obvious cause, and fails to heal fully within 3 weeks.
- In particular, an ulcer occurring beneath or on the side of the tongue or in the floor of the mouth.
- Presence of a red or red and white patch on the oral soft tissues, whether associated with an ulcer or not, and which persists for more than 3 weeks.
- Growth of soft tissues producing a lump which is not related to a dental cause (such as an abscess) and which persists for more than 3 weeks.

- In particular, a fungating growth with a cauliflower-like appearance.
- Unexplained tooth mobility which is not associated with periodontal disease.
- Persistent and unexplained lump in the neck.

Any of the above findings should be referred to the local oral and maxillofacial surgery unit as an urgent finding, to be seen within 2 weeks by specialists. Oral soft tissue white patches without any associated redness are recommended for prompt (rather than urgent) referral by the NICE guidelines.

Years ago, the typical oral cancer sufferer was a 60-plus male patient, usually from a lower socioeconomic background, who was a lifelong smoker and drinker. In recent years, this has changed and those being diagnosed with oral cancer are more likely to be younger patients in their forties (some even in their twenties or thirties), both male and female, usually smokers and especially binge drinkers, and also those who use sunbeds or sunbathe with little ultraviolet protection for their lips. Additionally, this last group will also be at much greater risk of developing skin cancer (melanoma).

Lifestyle counselling and support

The dental team has a vital role to play not only in early detection of SCC but also with patient education about the risk factors, especially in patients deemed to be at high risk (smokers and heavy drinkers). Once identified (from medical history sheets with lifestyle questions included), the patients who admit tobacco use should receive a brief one-to-one consultation in line with the National Centre for Smoking Cessation and Training (NCSCT) publication titled 'Very Brief Advice on Smoking'.

1. **ASK** and record their smoking status: is the patient a smoker, an ex-smoker, or a non-smoker?
2. **ADVISE** on the best way of quitting: for the majority of patients this is with a combination of medication and specialist support.
3. **ACT** on the patient's response: build their confidence and refer them to the local stop smoking service.

Some patients will not be amenable to advice nor wish to be referred at the time, although rejected offers of help by the dental team on one occasion may be accepted another time. The point is to make the patient aware of the health benefits of quitting all types of tobacco usage, and that help is available if they wish to access it. Even providing the patient with suitable resources to access themselves at their leisure can be considered a success, two of the most accessible being www.nhs.uk/smokefree and 'Action on smoking and health' at www.ash.org.uk.

The abolition of smoking in public places in the UK has gone some way to improve the situation, and recent evidence suggests that the use of electronic cigarettes (e-cigarettes; Figure 7.6) is 95% less harmful than smoking conventional tobacco products, as they allow the user to inhale nicotine without most of the harmful effects of smoking. In recognition of the alarming increasing incidence of smoking-related cancers and illness in the population, the Department of Health has developed the excellent national 'Quit Smoking' scheme that is freely accessible to anyone wishing to stop smoking, and information on local help and support is widely available, even in supermarkets (Figure 7.7).

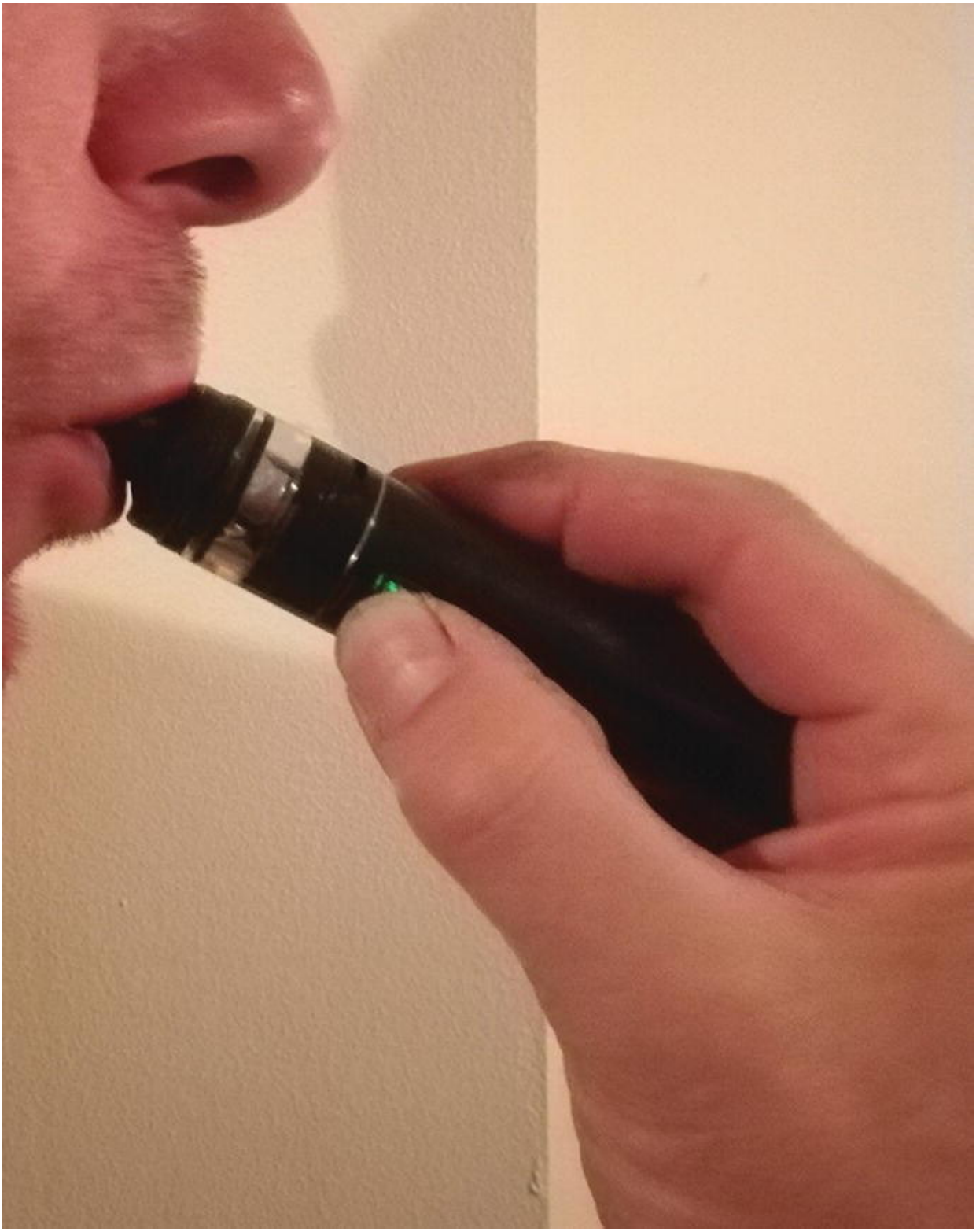


Figure 7.6 Example of an e-cigarette.

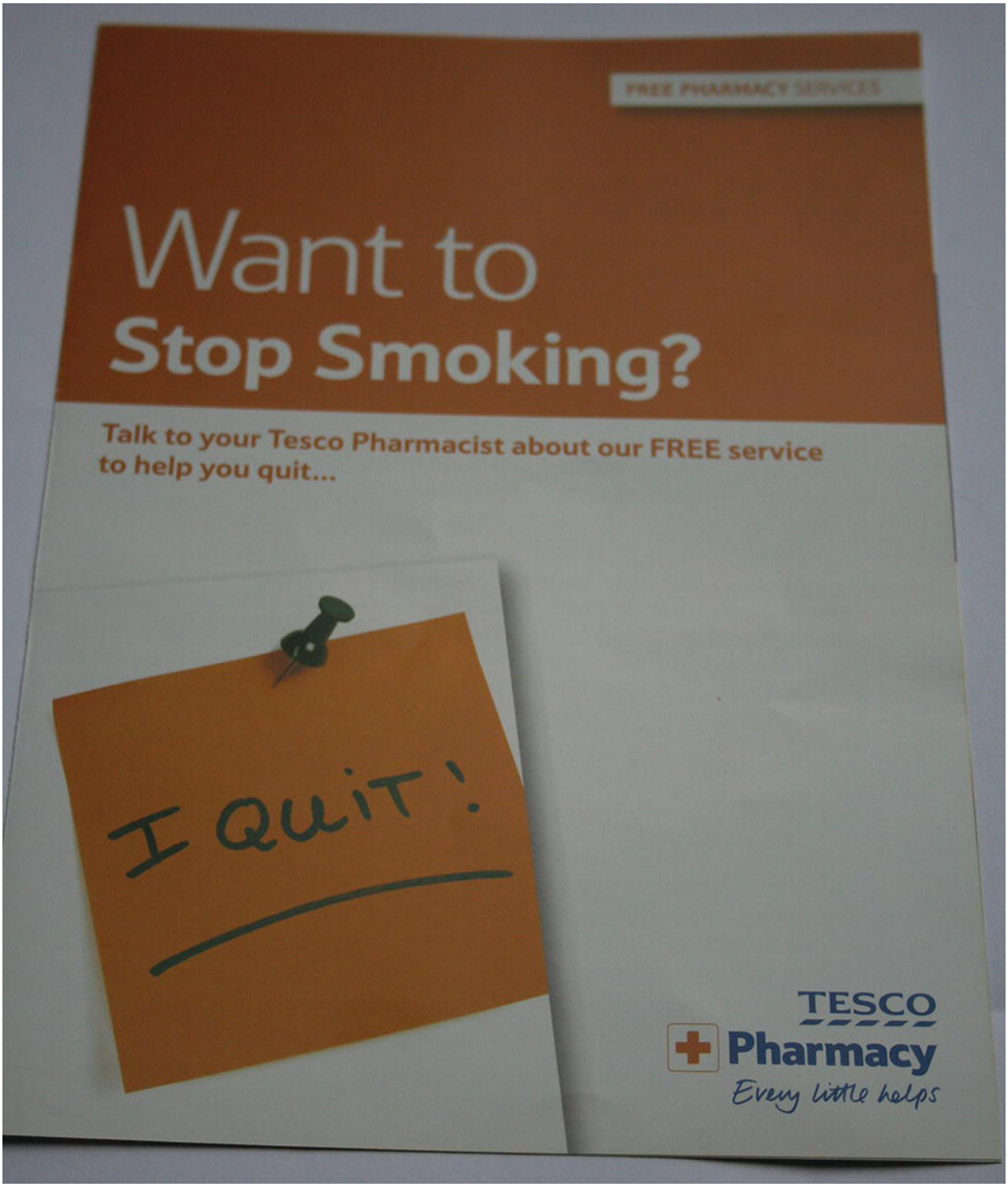


Figure 7.7 Example of a 'Quit smoking' leaflet.

In a similar fashion to those who admit tobacco usage, patients who admit to drinking alcohol on a regular basis on the medical history form should also be given sensitive one-to-one counselling with

regard to their oral cancer (and other health) risks, and information and support on reducing their alcohol consumption.

Public Health England and NHS England has helped several area commissioning groups to develop various patient-friendly information devices about their alcohol consumption levels, such as the example shown in Figure 7.8. This is an easy-to-use interactive tool with which the patient can find the true alcohol units content of many commonly consumed drinks, and help them determine their own unit intake. An example of an alcohol disorder identification test is shown in Figure 7.9, and can be used in private by the dental team and the patient to screen for those who are drinking higher than normal levels of alcohol. Those with a high total score can then decide if they wish to access local specialist services, various helplines or advice centres, such as www.drinkaware.co.uk and www.alcoholconcern.org.uk.

Figure 7.8 Drink Responsibly alcohol wheel.

Figure 7.9 Alcohol disorder identification test.

General advice that the dental team can give to receptive patients who drink regularly and who wish to seek help and advice on alcohol consumption is as follows, in line with current guidelines:

- Do not drink more than 14 units of alcohol per week: this applies to both men and women.
- Spread the 14 units over 3 days or more, rather than binge drinking in one session.
- Regular drinking any amount of alcohol can increase the risks of cancers and other illnesses.
- Try to have several alcohol-free days per week.
- Pregnant women are best not to drink alcohol during the pregnancy, as this is the safest option for the baby.

Other health effects of tobacco and alcohol usage

The other potential effects of smoking, tobacco usage (Figure 7.10) and excess alcohol consumption (Figure 7.11) on dental and general health should also be discussed with those patients identified as high risk, and should cover all the following topics.

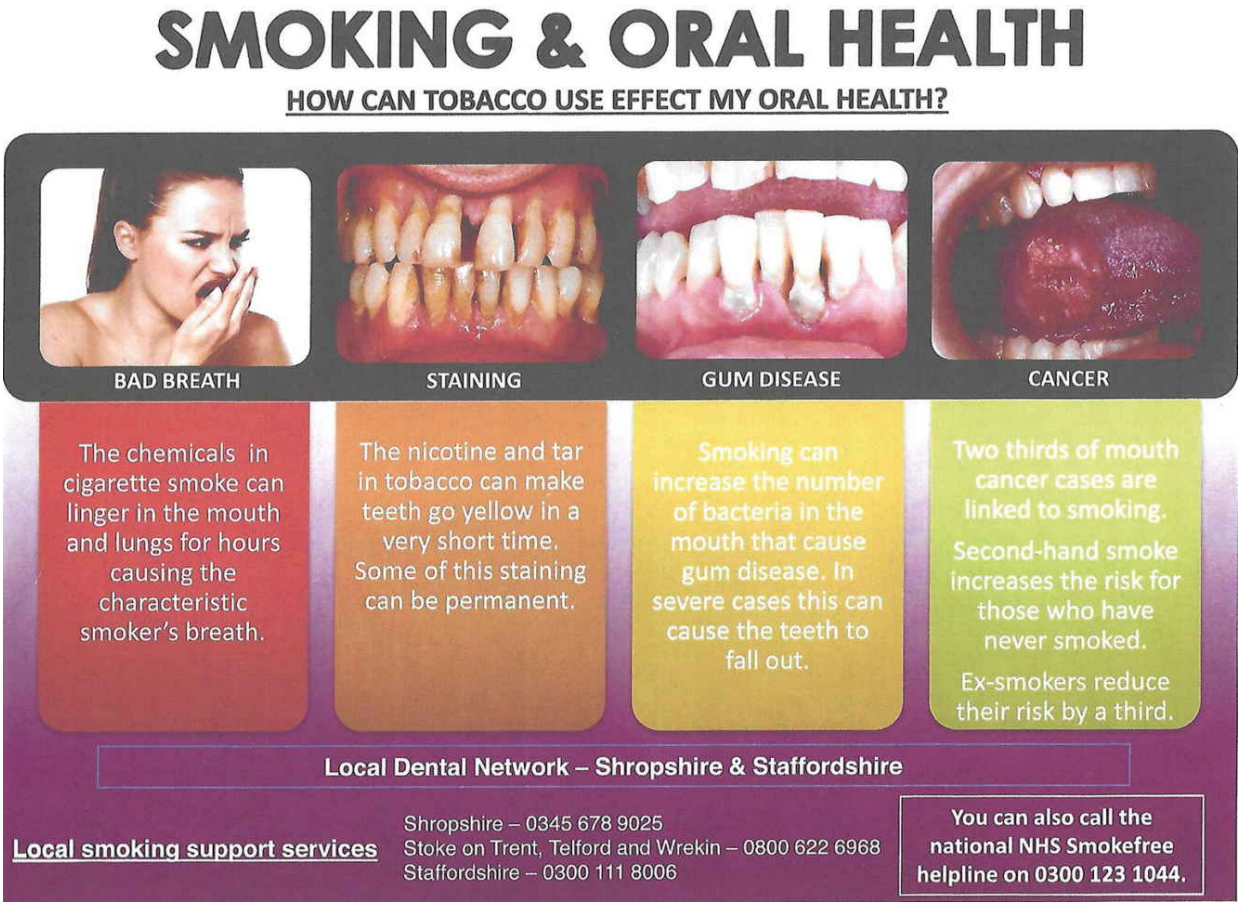


Figure 7.10 Patient information on smoking poster.

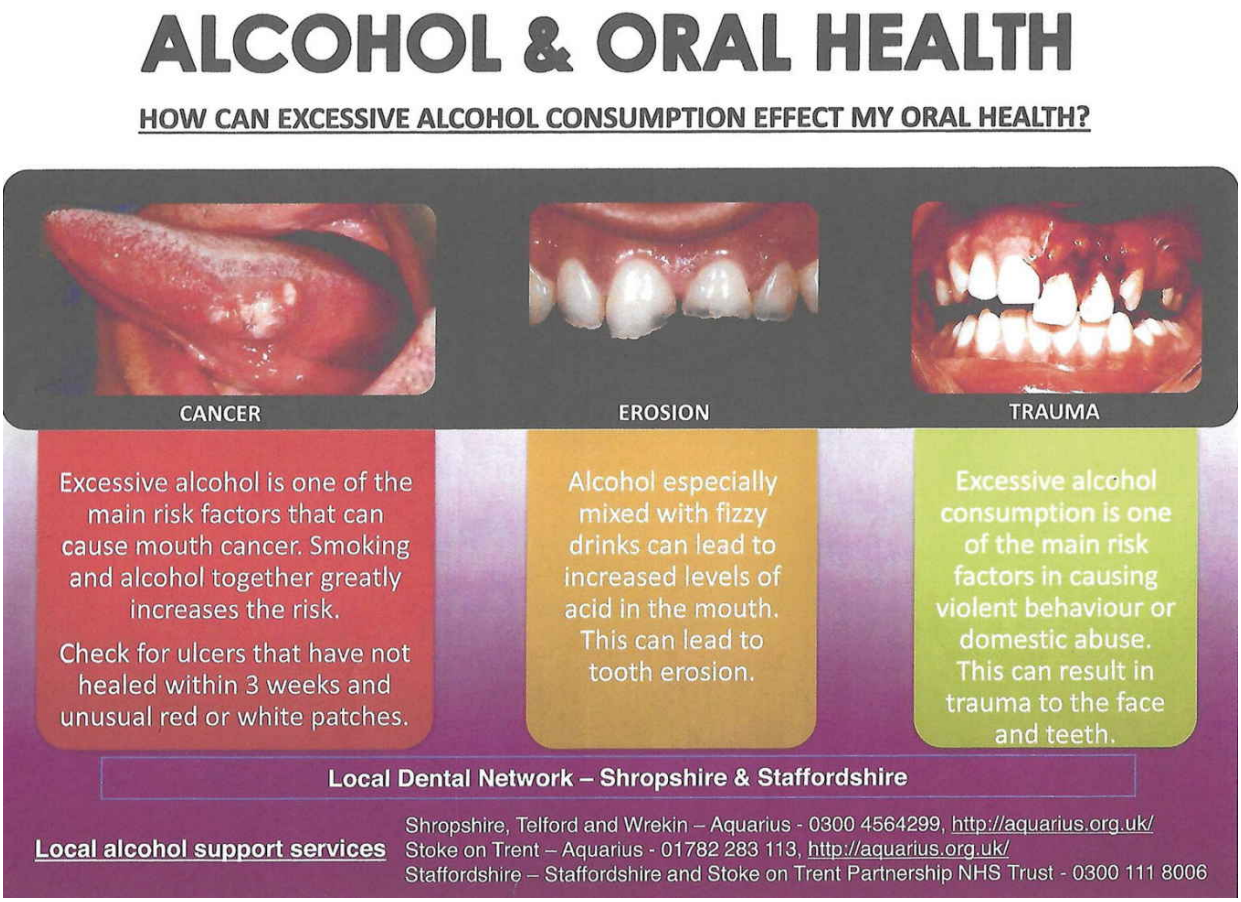


Figure 7.11 Patient information on alcohol poster.

Oral health effects

- Development of oral precancerous lesions (especially white patches in the mouth).
- Periodontal disease and its exacerbation.
- Poor wound healing, especially after trauma or surgery.
- Tendency to develop a ‘dry socket’ after extraction.
- Stained teeth.
- Halitosis (bad breath).
- Tooth erosion, especially when alcoholic drinks contain ‘mixers’ such as lemonade, soda or other fizzy soft drinks.
- Dental and facial trauma, due to falls, accidents, fights and domestic violence assaults.

General health effects

- Heart disease, in particular hypertension and coronary artery disease.
- Stroke.
- Respiratory disease, in particular chronic bronchitis and emphysema.
- Other cancers, in particular throat, lung and stomach cancer.

Other medical conditions that affect the oral tissues

Various pre-existing medical conditions can have a detrimental effect on the oral tissues, either directly as an effect of the disease itself or as a side-effect of drugs used to treat it.

Herpes

This group of viruses can affect the oral soft tissues in three specific disease conditions.

- **Herpes simplex type 1**: as a primary infection in childhood which takes the form of an acute inflammation of the oral soft tissues, called gingivostomatitis, appearing as multiple painful ulcers within the oral cavity.
- **Herpes labialis**: the recurrent condition that occurs after the initial primary herpes simplex infection, commonly called a 'cold sore' and occurring on the lip. Lesions tend to appear when the patient is run-down, stressed, has suffered a recent 'cold' or has been exposed to sunlight.
- **Herpes zoster (shingles)**: occurs as a reactivation of the virus in patients previously infected with chickenpox (herpes varicella), and can affect the area supplied by the trigeminal nerve (the face and oral cavity) as well as the skin of the torso.

Human immunodeficiency virus

This virus is the causative agent of the fatal condition known as AIDS, and the progressive immune-deficiency conditions that it causes may well present as an oral lesion.

- **Oral candidiasis**: usually as an extensive fungal infection of the oral cavity, with heavy coatings of the white 'thrush' lesions over the tongue and palate.
- **Herpes zoster**: shingles, but typically affecting more than one body area, so the trigeminal nerve region may be affected at the same time as areas of the torso.

- **Kaposi's sarcoma**: this is a characteristic tumour of AIDS sufferers that may occur as a purplish brown lesion on the palate, as well as in the skin.
- **Oral hairy leukoplakia**: this is an oral white patch that has a distinct microscopic appearance at biopsy, is always associated with HIV infection, and is premalignant.

Hepatitis

Cross-infection following a needlestick injury is a very real occupational hazard for the dental team, but carriers or patients suffering from hepatitis are not likely to be easily identified unless they give a truthful medical history. There are no specific oral lesions associated with the medical condition of hepatitis, but is included here due to the potential mechanism of infection for the dental team.

Diabetes

This is a group of disorders affecting the pancreas which is characterised by a raised concentration of glucose in the blood, and results in an inability of the body cells to metabolise glucose correctly. The two types of diabetes are referred to as type 1 (insulin dependent) and type 2 (non-insulin dependent). The effects of the disease on the oral cavity are the same for both types of diabetes.

- **Xerostomia**: some degree of dry mouth is experienced by most patients, but in diabetics the cleansing and lubricating effects of saliva will be reduced and they are more at risk of developing dental caries.
- **Poor wound healing**: the peripheral blood supply is reduced in all areas of the body, including the oral cavity, and patients tend to heal poorly and be more prone to conditions such as chronic periodontal disease.
- **Infection**: peripheral vascular disease and peripheral neuropathy result in reduced blood flow and nerve sensation in the oral cavity, so infections are more likely and can often develop more readily into abscesses and more serious conditions.

Epilepsy

This is a condition where the electrical activity in the brain becomes suddenly and temporarily disrupted, resulting in a seizure. One of the drugs used to control the occurrence of seizures (Epilim) has the side-effect of causing gingival tissue overgrowth, called **gingival hyperplasia**. This can make adequate plaque removal difficult for the patient as the overgrown gingival tissue covers the tooth surface and any plaque present and prevents its routine removal by toothbrushing. The patient may have to undergo regular gingivectomy procedures to remove the worst gingival overgrowths.

Eating disorders

Bulimia is an emotional disorder where the sufferer, usually a young adult female, follows periods of compulsive overeating with periods of self-induced vomiting or fasting. The regular vomiting has the following oral effects:

- **Enamel erosion**: often severe pitting and enamel loss is present on many teeth, due to the acidic nature of the stomach contents present in the vomit; the palatal surfaces of the upper anterior teeth are particularly affected.
- **Soft tissue burns**: the acidic vomit will also cause a burnt, reddened appearance to the oropharynx region, at the back of the mouth.

Anorexia is a psychological disorder characterised by 'voluntary starvation' of the sufferer, induced by an obsessive wish to lose weight to the point of becoming life-threateningly emaciated. When forced to eat food, the sufferer will also self-induce vomiting to avoid putting weight on, and will consequently experience the same oral effects as a bulimic.

Digestive disorders

The oral cavity forms the first part of the digestive system, so it is not surprising that several digestive system disorders manifest with oral lesions.

- **Crohn's disease**: a chronic inflammatory disease that can affect any part of the GIT, and shows orally as ulceration throughout the oral cavity.
- **Ulcerative colitis**: a chronic inflammatory disease that affects the colon and rectal areas only of the GIT, and shows orally as aphthous ulcers.
- **Coeliac disease**: an absorption disorder of the small intestines, which have an intolerance to the cereal protein gluten, and shows orally as ulceration, glossitis and stomatitis.

Relevant drugs used in dentistry

All drugs available by prescription from the dentist to a patient (prescription-only medicine or PoM) or available to buy 'over the counter' without prescription are detailed in the Dental Practitioners' Formulary (DPF) section of the *BNF*, and this is available to access online at www.bnf.org or can be issued in hard format on request to any practising dentists by the Department of Health in exceptional circumstances (see Figure 5.7). It is an invaluable guide to the drugs available, as well as giving details of their actions, dosages, contraindications and side-effects. The dentist may prescribe any other drugs on a private basis to a patient, although special rules and regulations apply to those categorised as controlled drugs (pethidine, midazolam, etc.).

The drugs discussed in this section are those used in dentistry to fight disease, specifically those used against micro-organisms. Many other drugs are used for other purposes by the dentist while providing treatment, and these will be discussed later in their relevant chapters.

Drugs are classified into groups with a specific action, although some may have more than one use. Those of relevance here are:

- antibiotics
- antivirals
- antifungals
- analgesics.

Drugs may be applied externally, such as ointments and creams, or taken internally, such as tablets, capsules and oral solutions. When applied externally, their strength tends to be recorded as a percentage, while those used internally are recorded as milligrams for solids or millilitres for liquids. The drugs used more frequently to fight micro-organisms and alleviate the symptoms of infection are discussed below.

Antibiotics

These are drugs used specifically to fight against infection by bacteria. Many different bacteria exist that can cause dental problems, including dental caries, periodontal disease, dental abscesses and pericoronitis. Some bacteria thrive in the oxygen-rich environment of the mouth and are referred to as aerobic bacteria but others prefer to live in oxygen-poor areas such as deep within the periodontal pockets of a patient with periodontal disease. These bacteria are called anaerobes and they often require the use of different antibiotics for their eradication. The benefits to the patient of taking antimicrobials is always limited by problems of their usage.

- Side-effects: some antibiotics cause nausea, vomiting and diarrhoea.
- Allergic reactions: range from sensitivity reactions to the colour dyes used in some capsulated antibiotics, to full anaphylaxis reactions to the drugs, especially the penicillins.
- Interactions with other drugs: either prevents them working effectively or produces serious side-effects (such as penicillins and methotrexate).
- Resistance: the overuse of antibiotics allows resistant strains of bacteria to evolve, which are then not killed by the usual antibiotics.

The bacteria can become resistant to the antibiotics if used over a prolonged period or repeatedly, so their use must always be justified. In particular, the dentist should always determine if a dental problem can be resolved by operational means rather than resolved temporarily by the use of antibiotics; for example, by lancing an acute abscess and draining the pus it contains rather than prescribing a course of antibiotics which may or may not reduce the swelling. Often, the key determining factor is if adequate local anaesthesia can be achieved at the time of treatment so that it can be carried out painlessly and successfully, and then antibiotics are often not required. However, the risk of injecting into an infected area and spreading micro-organisms in the soft tissues must also be considered; a good knowledge of anatomy and the nerve distribution in the oral cavity is invaluable in these situations, so that potential alternative injection sites can be used where possible.

Recent changes have been made to the prescribing guidelines for antibiotics, and the effective doses required and up-to-date information can be obtained from the *BNF*; the latest edition can be accessed at www.medicinescomplete.com. Background information and advice on antimicrobial prescribing is also available in the FGDP (UK) publication *Antimicrobial Prescribing for General Dental Practitioners* (updated 2016). Typical antibiotics used in dentistry are shown in Figure 7.12 and are described below.

Figure 7.12 Various antibiotics.

The following antibiotics are recommended when a patient is suffering from acute or chronic dento-alveolar infections, or a periodontal abscess, when there is evidence of local spread of the infection (as a diffuse oral swelling) or there is systemic involvement shown by an elevated temperature (pyrexia) or the patient looks and feels generally unwell.

- **Amoxicillin** (or phenoxymethylpenicillin): as a 500-mg dose three times daily for up to 5 days (reduced dose for children as recommended in *BNF*).
- **Metronidazole**: as a safe alternative to amoxicillin, or the two drugs together when a severe spreading infection is involved, at a dose of 400 mg three times daily for up to 5 days (reduced dose for children as recommended in *BNF*). Adults must be warned not to take alcohol during the course of treatment, as the two interact.
- **Clarithromycin or erythromycin**: as alternatives to penicillin, at a dose of 250 mg twice daily for up to 5 days. Erythromycin is less well tolerated by many patients, and many organisms are also resistant to it so its use may be less effective (reduced dose for children as recommended in *BNF*).
- **Clindamycin**: not recommended for dento-alveolar infections as it offers no advantage over the above drug options. While it is still the recommended antimicrobial in other severe infections, its overuse will allow resistant strains of bacteria to develop if not restricted.

The following antibiotics are recommended when a patient is suffering from acute necrotising ulcerative gingivitis or from pericoronitis, but as an adjunct (that is, in addition) to operational measures to treat the infections. With acute necrotising ulcerative gingivitis, thorough scaling and appropriate oral hygiene instruction should be given, especially the use of chlorhexidine mouthwash. With pericoronitis, thorough cleaning in the area and irrigation with warm salt water or a specialist mouthwash such as Peroxyl should be given.

- **Metronidazole**: as a dose of 400 mg three times daily for up to 5 days.
- **Amoxicillin**: for those patients who cannot take metronidazole (pregnant, alcohol dependent, or drug interactions), as a dose of 500 mg three times daily for up to 5 days.

Although the routine use of antibiotics during the placement of dental implants is not the norm, some implant manufacturers do

recommend them to prevent postoperative infections and pain, and peri-implantitis. If recommended for use, the following are advised:

- **Amoxicillin**: as a dose of 2 g (four 500-mg capsules) taken 1 hour preoperatively.
- **Clindamycin**: for those patients allergic to penicillin, a dose of 600 mg (four 150-mg capsules) taken 1 hour preoperatively.

Routine antibiotic prophylaxis (giving the antibiotic to prevent an infection occurring, rather than eliminating an infection that is already present) against infective endocarditis is no longer recommended. Patients with certain heart conditions or valve or even joint replacements were previously considered at risk from developing dangerous infections within the heart or joint following dental treatment. Evidence-based research over 10 years ago determined that the use of prophylactic antibiotics for these patients was not necessary. However, more recent research has noted an increase in the number of cases of patients suffering from infective endocarditis, although this may not be directly related to reduced prophylactic antibiotic usage. Consequently, NICE updated their guidelines in 2016, and they do not rule out the use of antibiotics in these cases. The dentist will consider the case of each patient at risk of developing infective endocarditis during dental treatment and follow the guidelines accordingly, prescribing antibiotics where deemed necessary and usually after consultation with the patient's cardiologist or orthopaedic surgeon.

Antivirals

These are drugs used specifically against infections caused by a virus, but the only infection of dental relevance is the cold sore (herpes labialis) produced on the lip after a primary infection with herpes simplex type 1 virus. Aciclovir antiviral cream applied to the lesion five times daily for 5–10 days may prevent the full development and blistering of the cold sore infection. The lesions are highly infective while present, and the dental team must protect themselves by wearing full PPE during treatment. Ideally, the patient should not be seen while a cold sore is present, unless they require emergency dental treatment.

Antifungals

These are drugs used specifically against fungal infections, and the relevant dental lesion is in cases of infection causing oral thrush. This may appear as denture stomatitis beneath removable appliances or as sores at the angle of the mouth called angular cheilitis. Both are due to infection with the fungus *Candida albicans*. When present within the mouth, patients are prescribed antifungal lozenges or pastilles to suck, or oral gels or solutions to apply while their appliance is removed. Other antifungals may be prescribed as capsules to be taken internally, and all of the following presentations are available:

- **Fluconazole**: used in difficult fungal infections as a once-daily 50-mg capsule dose for between 7 and 14 days.
- **Nystatin**: as an oral suspension or as lozenges to be used four times daily after food for 7 days.
- **Amphotericin**: as 10-mg lozenges to be slowly dissolved in the mouth four times daily for between 10 and 15 days.
- **Miconazole**: as an oral gel to be swilled around the mouth four times daily.

Analgesics

These are drugs used primarily to relieve pain, although some have other effects too. They are invaluable to dental patients experiencing pain (especially toothache), although dental treatment is also usually required to solve the problem and eliminate the pain completely. All analgesics should be avoided during pregnancy.

Frequently used analgesics are shown in Figure 7.13 and are all available as over-the-counter analgesics or they can be prescribed by the dentist.

- **Paracetamol**: an analgesic and has *antipyretic* properties – it reduces body temperature when fever is present. It has no anti-inflammatory effect. Causes serious liver damage if the recommended dose is exceeded, and this may be fatal.

- **Ibuprofen**: an NSAID and analgesic which is safer than paracetamol but can cause stomach ulcers if used to excess. It should not be given to asthmatics.
- **Aspirin**: an analgesic with anti-inflammatory properties. It has several contraindications that limit its use: it acts as an anticoagulant so must not be given after surgical procedures (including tooth extraction), and can cause stomach ulcers. It should be avoided in asthmatics and must not be prescribed to children under 16 years of age because of the rare complication of *Reye's syndrome* (an often-fatal brain disease).

Figure 7.13 Various analgesics.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

8
Infection Control and Cleanliness

Key learning points

A **factual knowledge** of

- the basic principles of infection control
- the legislation surrounding infection control

A **working knowledge** of

- decontamination, disinfection and sterilisation techniques
- hand hygiene
- *Legionella* management and dental unit water lines
- personal protective equipment and its correct usage in the dental workplace

A **factual awareness** of

- cross-infection and inoculation injury and their avoidance in the dental workplace

The maintenance of a high standard of cleanliness and the control of infection are topics of fundamental importance in the dental workplace, as they are in any clinical environment. All members of the dental team (including trainee dental nurses) have a duty of care to protect their patients and themselves from coming to harm while on the premises, and one potential area of vulnerability is to become contaminated by, or to acquire, an infection from another patient or a member of staff, or from a dirty instrument. This is called *cross-infection*.

The safe systems of working with respect to cross-infection control and decontamination are the foundations of good clinical infection control, and of the principles of maintaining an adequate standard of cleanliness. As well as having an understanding of this topic and being able to follow the workplace policies with regard to it, many

dental nurses are tasked by their employers with developing and updating the necessary relevant documentation and systems in their own workplace, and in carrying out the necessary compliance audits too. While some may consider this an onerous task, it is a necessary one, and many dental nurses have risen to the challenge admirably and become essential lynchpins in achieving the compliance and therefore the smooth running of their workplace.

Legislation and national variation

Over the last decade, many changes and updates in the safe running of the dental workplace have occurred throughout the UK, including in the area of infection control. Unfortunately, separate guidelines in relation to infection control and decontamination have been produced by the four health departments of England, Wales, Scotland and Northern Ireland. This has resulted in a complicated set of work practices in the dental environment that still must be understood and followed by dental staff, irrespective of where they work in the British Isles.

For the purposes of this text, the legislation and guidelines applicable in England will be described in detail, and further information is available at www.dh.gov.uk. Students working in Northern Ireland are advised to access further specific information at www.dhsspsni.gov.uk. One main difference between the four countries is that dental workplaces in England and Wales should be working towards providing a separate decontamination room and the installation and usage of a washer-disinfector, but dental workplaces in Scotland and Northern Ireland are already required to have these facilities in place.

Those areas of general knowledge common to all countries (definitions, basic principles, standard precautions, etc.) will form the bulk of the text.

In England, the guidelines applicable to decontamination in general dental practice (primary care dental practices) are covered by the Department of Health publication *Health Technical Memorandum* (HTM) 01-05, and its 2013 update. Northern Ireland and Wales have their own modified versions of this document, while Scotland has not adopted it but instead has a number of organisations which provide guidance on compliance with decontamination standards (Scottish Dental Clinical Effectiveness Programme, Health Facilities Scotland, and Scottish Dental). The BDA has produced very useful advice sheets covering the topic of infection control for each of the four countries of the UK, and these are available for BDA members to download at www.bda.org.

HTM 01-05 is produced as a guide on decontamination techniques for use in the dental workplace itself, and is a 'working document' in that it will be updated as evidence of better techniques and systems becomes available. It is intended to help dental workplaces establish a programme of continuous improvement in their decontamination techniques. Those currently included are listed in two categories.

- **Essential quality requirements**: describes the basic level of decontamination standards that all workplaces should have implemented within the first year of the publication of the document.
- **Best practice**: outlines the 'gold standard' to be aimed for in the future (no timescale has currently been set); the additional improvements required to achieve best practice cover the following main points:
    - Use of a washer-disinfector to clean instruments.
    - Separate facility for decontamination tasks, away from the clinical treatment area.
    - Separate storage area for sterilised items, away from the clinical treatment area (a 'clean zone' within the decontamination room would be adequate).

Although it is accepted that many dental workplaces will be unable to achieve full best-practice status due to the limitations of their building layout, all will need to assess the improvements they can make and have a plan in place to implement what is achievable.

Throughout this chapter, the impact of HTM 01-05 on decontamination techniques will be highlighted. Dental workplaces can assess their compliance with the recommendations within HTM 01-05 and identify areas for improvement using the on-line audit tool and 2013 edition user guide originally produced by the Infection Prevention Society (Figure 8.1), although it is now accessed directly from the Department of Health (DoH England) website via www.gov.uk. Alternatively, the BDA have produced a hard copy self-assessment audit tool based on the DoH/Infection Prevention Society document which is available to members for download at www.bda.org.

Infection Prevention Society

IPS Dental Audit Tool

2013 User Guide

Revised 19 June 2013

Figure 8.1 Infection Prevention Society audit tool guidance notes.

Recently, registration for healthcare providers, including all dental practices in England (private, NHS or mixed practice), has been introduced and is overseen by the CQC. Compliance with the *essential quality requirements* of HTM 01-05 will ensure that each dental workplace satisfies the registration requirements of the CQC in the areas of patient safety and decontamination. Initially, and in line with clinical governance requirements (see Chapter 3), the registration system relied on self-audit and effective management within the dental workplace, although practice inspections by the CQC then followed.

Full registration with the CQC is provisional on each dental workplace showing that it meets essential standards of quality and patient safety in all its regulated activities, not just decontamination. The code of practice on the prevention and control of infections (Figure 8.2), which was introduced under the Health and Social Care Act 2008, identifies the criteria against which the CQC determines whether a dental workplace is compliant with the cleanliness and infection control requirements. The majority of compliance with the code will be met by compliance with HTM 01-05. The code is discussed in further detail later in the chapter.

Department
of Health

The Health and Social Care Act 2008

Code of Practice on the prevention and control of infections and related guidance

July 2015

Figure 8.2 Code of Practice document.

The overall role of the CQC and its impact on the dental workplace is discussed in more detail in Chapter 3. The CQC acts only in England, and is not recognised in the other countries of the UK.

Need for infection control

As discussed in Chapter 7, the mouth is full of micro-organisms, some of which are harmful to the patient and to others. Consequently, instruments and equipment used while providing dental treatment to patients become contaminated with these micro-organisms whenever they are used, whether they are drilled into teeth, used to cut into soft tissues or are simply placed in the contaminated oral cavity. If no action were taken to clean these items after use, this micro-organism contamination would be passed on from patient to patient, from patient to dental staff, and from staff to patient. In addition, the use of dental high-speed drills creates an aerosol (an airborne suspension of fine particles and liquids from the patient's mouth) in the surgery environment, which falls onto the working surfaces and contaminates them too. If staff are not personally clean while taking part in chairside dental procedures, they can also contaminate patients and other staff.

The transfer of infection from person to person is called *direct cross-infection*, and that from person to equipment and onto a second person is called *indirect cross-infection*. The techniques, policies and safeguards in place to prevent the occurrence of cross-infection form the basic principles of infection control procedures.

Basic principles of infection control

A system of *standard precautions* (previously referred to as 'universal precautions') has been adopted in healthcare work, which is designed to protect staff from inoculation and contamination risks, and to protect patients from being exposed to the risk of cross-infection. Standard precautions should effectively be carried out as routine procedures for all patients.

The basic principle is to assume that any patient may be infected with any micro-organism at any time, and therefore they could pose an infection risk to all dental staff and to other patients. A detailed medical history questionnaire, completed at the patient's initial attendance and updated at every appointment thereafter, will identify the majority of problems.

However, a patient may be infected with a micro-organism without showing any signs of disease, and therefore be unaware of the risk they pose to others – these patients are called *carriers*. Also, a patient may choose not to disclose their full medical history to the dental staff, and would then mistakenly be assumed to be 'safe' to treat.

So, if all patients are considered to be a possible source of infection and treated as such, the infection control techniques used in the dental environment will be good enough to reduce all cross-infection risks to a minimum. The other general basic principles of infection control to be adopted are summarised below.

- Apply good basic personal hygiene with regular appropriate hand washing, to remove any micro-organism contamination from the skin and reduce the risk of cross-infection.
- Cover existing wounds with waterproof dressings, to prevent the entry of micro-organisms through the wound.
- Do not undertake invasive procedures if suffering from chronic skin lesions on the hands, such as eczema or dermatitis, as these types of skin condition will allow easy access to micro-organisms through the lesion.
- Wear non-latex clinical gloves at all times when assisting in the surgery, and discard after single use to avoid cross-infection.

- Institute approved procedures for decontamination of instruments and equipment, in line with the infection control policy of the workplace.
- Apply good basic environmental cleaning procedures, in line with the infection control policy of the workplace.
- Clear up blood and other body fluid spillages promptly, using the appropriate spillage kit where necessary.
- Follow the correct procedure for safe disposal of contaminated waste and sharps (see Chapter 4).
- Ensure all staff are aware of, understand and follow infection control policies and procedures.

In the dental surgery environment itself, special methods of infection control are now routinely practised, as well as following the general points listed above. Best practice dictates that good general infection control is achieved by the following:

- Up-to-date written infection control policy in place, which is followed by all staff.
- Standard precautions are used for all patients.
- Correct cleaning of the clinical area.
- Correct cleaning and/or disposal of dental equipment, handpieces and instruments.
- Correct segregation and safe disposal of hazardous waste.
- Validation, maintenance and testing of all decontamination equipment is carried out in accordance with the manufacturer's instructions.

In addition, personal infection control procedures must also be in place and followed by all staff.

- All clinical staff must be vaccinated against hepatitis B, with records held of the immune status of all staff.
- All staff should be immunised against the current common illnesses as determined by local occupational health services

(including all childhood immunisations).

- Follow the correct hand-cleaning procedure of the workplace.
- Use all PPE provided appropriately and as directed.
- All inoculation injuries are dealt with immediately and in accordance with the practice policy.

Each point is discussed in detail later in this chapter.

HTM 01-05 implications: infection control policy update

Under clinical governance requirements, all dental workplaces have had to have a written infection control policy in place for some time. Under HTM 01-05 guidance, the policy requirements were amended in 2013 to ensure they reflect the specific infection control and decontamination standards required in England and Wales, and should be section headed as shown below. The specific details for each section are given later, and should be summarised for inclusion in the policy document itself.

The policy should start with an introduction stating that the document is the specific dental workplace infection control policy, which must be followed by all staff at all times.

Minimising blood-borne virus transmission

- Hepatitis B
- At-risk staff
- 'Safer sharps' are used where it is reasonably practicable to do so, or traditional sharps are used in conjunction with procedures identified in a risk assessment for safe use and disposal
- Inoculation injury (see practice policy)

Decontamination of instruments and equipment

- Staff will receive recorded training to competently decontaminate existing and new reusable dental instruments correctly, wearing appropriate PPE

- Single-use instruments and equipment are disposed of safely, wearing appropriate PPE
- All new dental instruments are decontaminated fully before first use, according to the manufacturer's instructions
- Contaminated instruments are transferred to the decontamination area for reprocessing using the appropriate lidded boxes (where a separate decontamination area is available)

Cleaning

- Washer-disinfector
- Ultrasonic bath
- Rinsing
- Manual cleaning

Inspection

- After suitable cleaning, instruments are inspected for residual debris (and re-cleaned as necessary) and checked for wear or damage using an illuminated magnifier

Sterilisation

- Vacuum autoclave (type B or type S)
- Non-vacuum autoclave (type N)
- Unwrapped instruments held in a non-clinical area can be stored for 1 week (England only)

Impressions and laboratory work

- All impressions must be rinsed until visibly clean
- All impressions must then be disinfected using the product provided, either by immersion or dipping (as recommended by the product manufacturer)

- All impressions are then labelled as ‘disinfected’ before being sent to the laboratory
- Similarly, all stages of denture or fixed prosthodontic work should undergo the same process when being sent to the laboratory, and by the laboratory when being returned to the dental workplace

Hand hygiene

- Information on nail requirements
- Hand-washing techniques to be followed and when to use them
- Use of antibacterial hand rubs and gels
- Use of hand cream

Personal protective equipment

- Training in the correct use of PPE
- Details of items of PPE available, and when they should be used

Waste disposal

- Details of hazardous waste receptacles to be used (sacks and boxes)
- Segregation and storage of other waste
- Consignment notes

Blood spillage procedure

- Details of procedure to be followed
- Details of correct items to be used

General cleaning

- Details of cleaning schedule to be followed
- Details of colour coding of cleaning items to be used in various areas of the workplace

- Information on audits to be carried out

Review of the infection control policy should occur periodically to ensure it is still up to date with current guidelines, and is amended as required if not, in line with the requirements of the Health and Social Care Act 2008 Code of Practice, or at 2-yearly intervals if shorter.

General definitions

The terms ‘cleaning’ and ‘cleanliness’ in a clinical context are quite different from a lay person’s concept of them, and the relevant terms used here are defined below.

- **Social cleanliness**: clean to a socially acceptable standard for personal hygiene purposes but not disinfected or sterilised.
- **Disinfection**: the process used to kill or inactivate bacteria and fungi, but not spores or some viruses (the technique usually involves the use of special chemicals).
- **Sterilisation**: the process of killing all micro-organisms and spores to produce asepsis (involves the use of autoclaves, which produce high temperatures and pressure within the sterilising chamber).
- **Asepsis**: the absence of all living pathogenic micro-organisms.
- **Decontamination**: the combination of processes used to remove contamination from reusable items, so that they are safe for further use on patients and for staff to handle. This may also be referred to as ‘reprocessing’ and involves the following stages:
    - cleaning
    - disinfection
    - inspection
    - packaging (where relevant)
    - disposal of single-use items
    - sterilisation
    - transport (to and from decontamination area)

- storage.

All areas of the dental workplace should be socially clean, as a minimum standard. All clinical areas of the dental workplace must be cleaned to a higher standard still, by disinfection of the contaminated work surfaces using specific cleaning agents. Equipment and instruments that are not used in the patient's mouth but are contaminated by aerosol or splatter must also be decontaminated by disinfection. Some items may be protected by coverage with disposable plastic barrier sheets. All instruments that are used directly in the patient's mouth and that are not single-use disposable must be sterilised before being safe to reuse on another patient.

Cleaning of the hands and general appearance

Hand washing is the most important method of preventing cross-infection, and the technique used should be that stipulated by the Health and Safety Council. Recent studies have suggested that many instances of hospital-based infection of patients with micro-organisms such as MRSA are due to poor hand hygiene amongst hospital staff and visitors.

When working in the clinical area, nails should be kept short and wounds covered with a waterproof dressing to reduce the number of areas for micro-organisms to contaminate. False nails should never be worn when working at the chairside. The minimum amount of jewellery (earrings, rings, bracelets and watches) should be worn by those working in a clinical environment, for the same reason. Professionally, facial piercings and tattoos should be kept to an absolute minimum, and preferably are removed or discreetly covered wherever possible.

HTM 01-05 implications: hand hygiene update

Hand hygiene covers the topics of hand washing as well as the recommended use of hand gels for disinfection purposes, as an alternative or in addition to washing, depending on the circumstances. Hand hygiene is a required topic of coverage in staff induction training, under the essential quality requirements, and is a recommended topic for regular CPD activities. In addition, a hand

hygiene audit should be carried out in the dental workplace on a regular basis, to ensure that the policies and procedures in place to prevent cross-infection are adhered to by all staff.

The previous reference to ‘levels of hand hygiene’ (social, hygienic, and surgical) has been removed from the guidance, but the need for a hand hygiene policy and a flow diagram showing the accepted hand cleaning techniques, either as a hand-rub or a hand-wash technique, remain (Figure 8.3).

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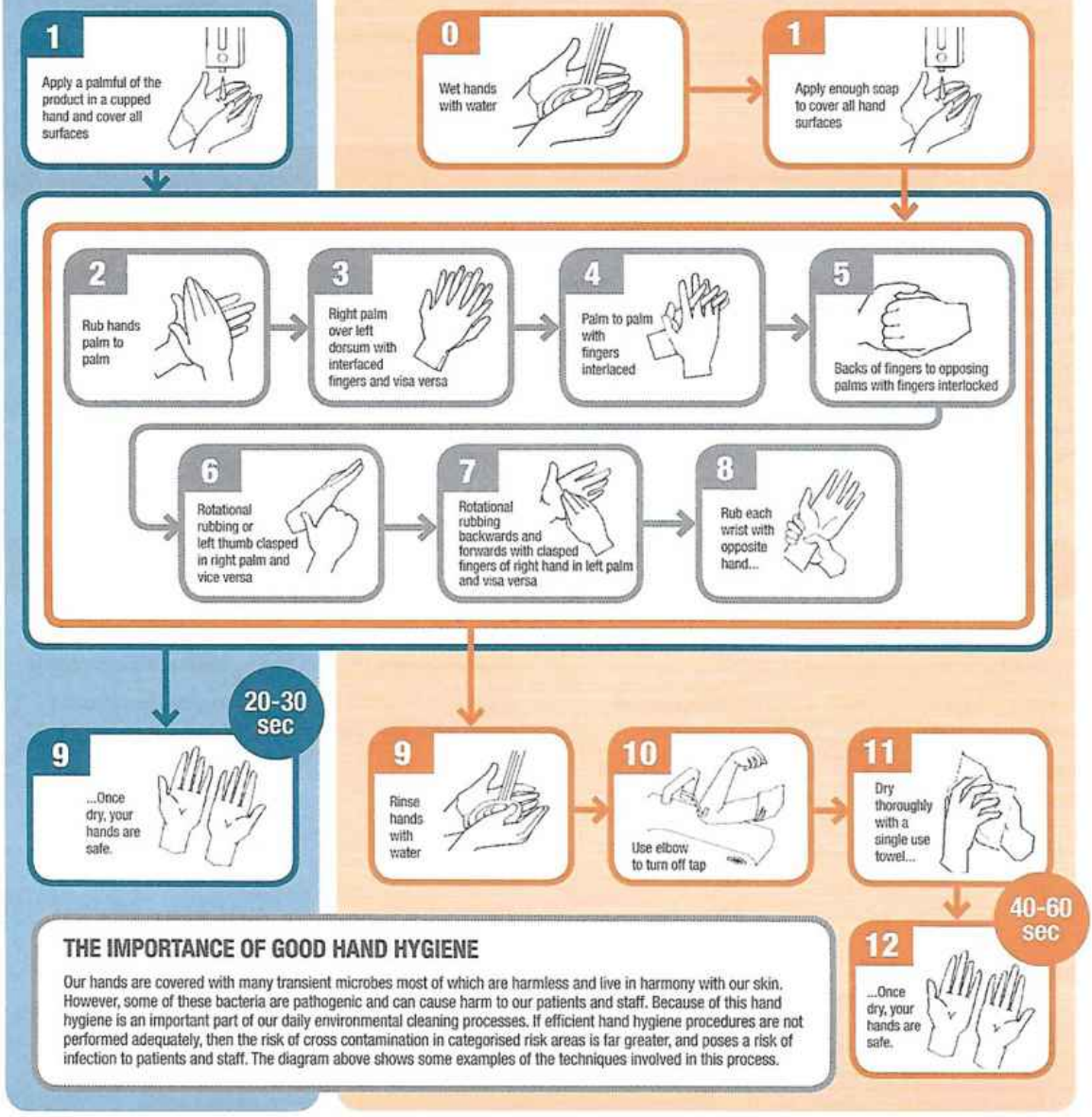
Guiding you to compliance

HAND CLEANING TECHNIQUES

How to handrub
with an alcohol based formulation



How to handwash
with soap and water

THE IMPORTANCE OF GOOD HAND HYGIENE

Our hands are covered with many transient microbes most of which are harmless and live in harmony with our skin. However, some of these bacteria are pathogenic and can cause harm to our patients and staff. Because of this hand hygiene is an important part of our daily environmental cleaning processes. If efficient hand hygiene procedures are not performed adequately, then the risk of cross contamination in categorised risk areas is far greater, and poses a risk of infection to patients and staff. The diagram above shows some examples of the techniques involved in this process.

Figure 8.3 Hand-wash and hand-rub poster.

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Dedicated hand-washing sinks must be available in the dental workplace, and marked as such. They should have taps that can be operated either by the elbow or by foot, to avoid contamination from dirty hands. In line with the WHO's 'five moments of hand hygiene', correct hand washing or hand rubbing should be carried out in each of the following instances:

- Before touching a patient.
- Before undertaking a clinical procedure.
- After exposure to a bodily fluid.
- After touching a patient.
- After touching a patient's surroundings.

The correct procedure for hand washing or hand rubbing should be displayed in poster form at each dedicated sink, and the instructions are as follows (see Figure 8.3).

Hand wash with soap and water

- Turn on the tap using the foot or elbow control, to prevent contaminating the tap.
- Wet both hands under running water of a suitable temperature.
- Apply a suitable mild antibacterial liquid soap from the specially operated dispenser (Figure 8.4), and wash all areas of both hands and wrists thoroughly. This should take up to 30 seconds to carry out correctly.
- Nailbrushes are not advised unless they are autoclavable, as they can become contaminated with repeated use.
- Rinse both hands under running water, holding them up so that the water does not flow back over the fingers.
- Dry the hands thoroughly, using single-use disposable paper towels.

- Damp hands allow micro-organisms to transfer more easily, as well as allowing the skin to be more easily damaged.
- The whole hand-wash process should take 40–60 seconds to complete.
- Once dry, gloves can be donned as necessary.
- Heavy-duty gloves must be worn when the cleaning of dirty instruments is being carried out.
- Clinical gloves must be worn whenever patients are being treated, and discarded between patients. These should be non-powdered and of a non-latex material, such as nitrile or vinyl, to avoid the development of skin sensitisation conditions.


GOJO
Automatic

Figure 8.4 'No-touch' style soap dispenser.

Hand rub with gel

- Gel is applied directly to dry hands from the dispenser.
- The same cleaning actions are carried out as for the hand-wash technique (see Figure 8.3).
- The hands are not rinsed.
- The gel is allowed to evaporate from the hands naturally, rather than being physically dried with a paper towel.
- The whole process should take 20–30 seconds.

Hand hygiene should be carried out regularly throughout a normal working day to avoid cross-infection (see the 'five moments of hand hygiene' previously), but especially at the following times:

- Before and after each treatment session.
- Before and after the removal of PPE, which will include the following circumstances.
    - After manually washing or inspecting dental instruments, before their transfer for sterilisation.
    - Before handling sterilised instruments (wrapped or unwrapped).
    - After carrying out cleaning or maintenance activities of decontamination devices.
    - After completing decontamination activities within the workplace.

The use of hand gels is not an alternative to hand washing with soap and water; gels should only be used on visibly clean hands between patients during surgery sessions. If the hands are not visibly clean, or an invasive dental procedure is, or has been, carried out, then hand washing with soap and water is required. Repeated use of hand gels throughout the day allows a build-up of the product on the skin and

the hands will feel sticky. At this point a hand wash should be carried out, even if the hands appear visibly clean.

Repeated washing and use of gels can result in the skin becoming sensitised to the products, or the hands becoming dry and cracked. Hand cream can be used at the end of a clinical session to counteract any skin dryness, but it should not be used under gloves as it can encourage the growth of any micro-organisms present on the skin. Staff who develop sensitivity or dermatitis problems due to repeated hand hygiene techniques should seek advice from the occupational health team. In extreme cases, the problem may affect their ability to work clinically in the future.

Use of personal protective equipment

PPE is worn to prevent staff from coming into contact with blood and other bodily fluids, and its correct use should be stipulated in the infection control policy.

It is a legal requirement for dental employers to provide the following protective clothing for their staff (Figure 8.5):

- **Gloves** of varying quality (clinical or household), as discussed above.
- **Uniform** (top and trousers or a dress), to be worn in the work area only.
- Uniforms must be washed at the highest temperature suitable for the fabric to reduce any potential microbial contamination.
- **Plastic apron** to be worn over the uniform when soiling may occur during surgical procedures or while cleaning the surgery.
- **Safety glasses** or goggles, to prevent contaminated material entering the eyes.
- Prescription glasses should be further protected by wearing a **visor** or face shield.
- Visors or face shields alone do not provide adequate protection to the eyes, nor prevent the inhalation of aerosol contaminants without the use of a facemask beneath the visor.

- **Facemasks** of surgical quality should be worn whenever dental handpieces or ultrasonic equipment is in use, to prevent the inhalation of aerosol contamination and pieces of flying debris.

Figure 8.5 Examples of PPE.

Alcohol-based hand gels should not be used with clinical gloves, as they can damage the nitrile or vinyl material, allowing leakage to occur. Household gloves can be safely washed with detergent and hot water, then left to dry naturally.

There has been no change in the recommended use of PPE following the publication and update of HTM 01-05, other than to no longer stipulate that uniforms are washed at 60 °C as this temperature is not suitable for some fabrics.

Cleaning of the clinical area

The whole of the dental practice should be cleaned to a socially acceptable standard on a daily basis, and this is usually carried out by a domestic cleaner. In clinical areas, however, a far higher standard of

cleaning is necessary because these are the areas where contamination of the environment by body fluids is greatest, and where the highest chance of cross-infection is likely to occur.

The dental workplace should have a protocol in place to ensure that general surface and floor cleaning activities are carried out in a set schedule, to ensure that cleaning is effective and that micro-organisms are not inadvertently transferred from one area to another during the cleaning process. Cleaning equipment should be colour-coded to assist this process (Figure 8.6), in line with guidance from the National Patient Safety Agency (NPSA).

- **Red**: cleaning items used in toilet and washroom areas only (mops, buckets, brushes, and so on).
- **Yellow**: cleaning items used in clinical and decontamination areas only.
- **Green**: cleaning items used in kitchen areas only.
- **Blue**: cleaning items used in office and reception areas only.

Figure 8.6 Colour-coded cleaning items.

The standard to be achieved in the clinical environment is that of *disinfection*. This involves the use of various chemicals to inhibit the growth of, or ideally kill, bacteria and fungi (Figure 8.7). However, most are not effective against bacterial spores or some viruses. Those in common use in the dental workplace include the following:

- **Bleach-based cleaners**: contain sodium hypochlorite and used to disinfect all non-metallic and non-textile surfaces, and to soak

laboratory items.

- **Aldehyde-based cleaners**: can be used on metallic surfaces and to soak laboratory items.
- **Isopropyl alcohol wipes**: to disinfect items such as exposed X-ray film packets for safe handling during processing.
- **Chlorhexidine gluconate**: used as an irrigating disinfectant during root canal treatments, and as a skin cleanser.


Protect+
Alcohol-Free Disinfectant
for use on all clinical surfaces
200 Wipes (200 x 220mm)
PP002/0085
Alcohol free for use on soft surfaces
Active biocide effective against bacterial organisms. Effective against MRSA.
Perfection Plus
www.perfectionplus.com
Perfection Plus Ltd. Hants. SO40 3WX. UK

Figure 8.7 Disinfectant surface cleaning product.

More recent additions to the cleaning and disinfectant products available for use in the clinical area include the following:

- **Alcohol/detergent combinations**: as wipes for use on hard surfaces (see later).
- **Hypochlorous acid products**: as surface sprays and for use in DUWLs (see later and Chapter 4).

Hypochlorous acid solution is also recommended for use by the manufacturer in the following situations:

- impression disinfectant
- instrument holding solution
- ultrasonic bath (although an alternative to foil tests must be used to test efficacy)
- mouthrinse
- root canal irrigant.

The practice as a whole should be kept clean, dry and well ventilated. Some workplaces have air conditioning installed, but care should be taken that the system does not recirculate the contaminated surgery air. In addition, special precautions are required to ensure that the air conditioning unit does not become contaminated with the waterborne micro-organism *Legionella*.

A written protocol for surgery cleaning should be available in all dental workplaces. This should describe the correct procedure in a logical manner and detail how each item should be dealt with. In general, it should include the following:

- All work surfaces should have the minimum items of equipment necessary for each procedure. When these items are not in use they should be stored in drawers or cupboards to prevent aerosol contamination.
- Areas should be designated as ‘clean’ and ‘dirty’ so that dirty used instruments are not placed where clean items should be; this is

called *zoning*.

- Equipment likely to be contaminated, such as chair and light controls, and headrests, should be covered with impervious plastic sheets (such as cling film) and changed between patients; this is called using *protective barriers*.
- Dental aspirators which exhaust outside the surgery area will reduce the risk of aerosol contamination; they should be used routinely and flushed through daily with a recommended non-foaming disinfectant (Figure 8.8).
- Clinical records and computer keyboards should not be handled while gloves are being worn.
- All non-metallic equipment can be wiped down with a bleach-based preparation, which is particularly effective against viruses, at the end of each day.
- Bleach-based disinfectants cannot be used on metallic items as they will corrode the metal.
- All intraoral radiographs should be wiped with an isopropyl alcohol wipe before being handled with clean gloves and taken for processing.
- Reusable digital devices should have single-use disposable covers available, or they must be decontaminated in accordance with manufacturers' instructions.


magnolia
Chemical Professionals
New
PULI-JET PLUS
con antiadesivo
with anti-scale agent
DISINFETTANTE
PER ASPIRATORI DENTALI
DISINFECTANT
FOR DENTAL VACUUM SYSTEMS
CATTANI GROUP
1000 ml e
CE 0434

Figure 8.8 Example of aspirator cleaning product.

Most of these disinfectant products are sold as convenient sprays or presoaked wipes, but bleach products have to be made up on a daily basis as a fresh solution. This is because the chlorine content is lost over the day so that the resulting solution becomes weaker, and cannot then be assumed to be strong enough to act as a viricide. Bleach also has to be used with caution on any fabrics as it will remove the colour, and it has an unpleasant smell and taste.

The uses of bleach-based disinfectants are as follows:

- 1% fresh solution to disinfect all non-metallic, non-fabric surfaces within the surgery.
- 1% fresh solution to disinfect impressions and removable prostheses before transferring between the patient and the laboratory.
- Up to 10% fresh solution to clean blood spillages within the surgery.

As all disinfectants are poisonous if ingested, their manufacture and usage are strictly controlled by the COSHH legislation, which is discussed in detail in Chapter 4.

HTM 01-05 implications: clinical area decontamination update

The key issue of reducing the risk of cross-infection has brought about the following updates:

- The protocol in use for cleaning of the clinical areas should be written down and should clearly outline the steps to be taken by staff for the decontamination procedure; where applicable, this protocol must also be followed by domestic cleaners.
- All surfaces and equipment should be impervious (resistant to fluids) and easily cleanable.
- Work surfaces and floor coverings should be continuous so no joints should occur between sections of the surface and with the walls of the room (Figure 8.9).
- The clinical area should be cleaned after each session using:

    - disposable cloths (reusable microfibre cloths are no longer recommended for use)
    - water to wet the cloths
    - detergent.
- Commercially available bactericidal/viricidal cleaning wipes and sprays can also be used to reduce any viral contamination of work surfaces, between patients (Figure 8.10).
- Spray bottles (whether supplied prefilled or empty) should be considered as single-use items, since bacteria have been shown to contaminate the bottles and grow in the spray mechanisms.
- Alcohol wipes are believed to 'fix' protein to surfaces over time, but recent research suggests that the timescales involved for fixing to occur make it unlikely in the dental workplace, and that alcohol-based disinfectants are effective in the dental setting.
- Alcohol alone is not a suitable cleaning agent for use on stainless steel surfaces, but alcohol-based products which also contain a detergent may be suitable for work surface cleaning (but not instrument cleaning) in this situation.
- Wherever possible, covers should be used on as many chairside items as possible, as an effective barrier against contamination. In particular, computer keyboards *must* be covered during clinical sessions.
- When a blood or other body fluid spillage occurs, the blood spillage kit (see Figure 4.13) should be used to clean the area initially. This should contain sodium hypochlorite-generating tablets to enable a fresh hypochlorite solution to be made up at the time of requirement.
- Hypochlorite solutions made up previously can be used for up to 1 week and then must be disposed of, and a new solution made using a hypochlorite-generating tablet. The solution weakens in strength over time and is unlikely to clear spillages effectively if kept any longer.
- Cleaning of all the following should occur at the end of each patient treatment, or have barrier covers changed after single

use:

- work surfaces in close proximity to the dental chair
- dental chair and control panel, if not foot-operated
- bracket table/trolley/delivery unit
- aspirator unit and spittoon
- inspection light and handles
- X-ray unit if in close proximity to the dental chair.

Figure 8.9 Continuous work surface detail.


No Harsh Chemical Residue*
Dettol
KILLS 99.9% OF BACTERIA
POWER &pure
ADVANCE
KITCHEN
WITH ACTIVE OXYGEN
Oxygen Splash

Figure 8.10 Example of surface cleaning spray.

Wherever possible, items not in use should be stored inside cupboards and drawers, and only placed on work surfaces when their use is likely on the patient about to be treated.

To ensure that the clinical area is decontaminated each day to a consistent standard, and especially where variable members of staff are involved, a written cleaning schedule should be available for reference during the decontamination procedure. It should be set out in a logical manner, with the most contaminated items to be tackled first, such as used instruments being removed to the decontamination room for reprocessing, before tasks such as floor cleaning or bin emptying are carried out. Having the schedule written out ensures that no points are missed, and that the clinical area is safe for reuse at the following clinical session.

HTM 01-05 implications: cleaning of DUWLs

DUWLs are the hoses running from the bracket table to the dental handpieces, the three-in-one syringe, and sometimes the scaler unit – they carry water to these devices so that they can be used during the delivery of dental treatment. Research has shown that DUWLs can become contaminated with micro-organisms, including *Legionella* bacteria, and therefore pose a significant infection risk to both patients and dental staff. The water from the dental unit may be swallowed by the patient during treatment, or inhaled by either the patient or the staff as an aerosol, especially when the high-speed handpiece is in use.

Micro-organism contamination of DUWLs can come from any of the following sources:

- Incoming water supply, from the mains system.
- Proliferation within the water system if temperature parameters are not maintained to prevent *Legionella* growth.
- Bacteria from the mouth of a patient, due to a 'suck-back' effect through a handpiece with a failed anti-retraction valve.
- Biofilm contamination of the reservoir bottle or the water lines themselves, due to ineffective disinfection techniques.

Of the possible micro-organisms that may contaminate DUWLs, *Legionella* bacteria are the most serious as infection with the organism can be fatal (Legionnaire's disease). All businesses, including dental workplaces, are required to undergo a *Legionella* risk assessment under health and safety legislation (laid out in the HSE publication referred to as L8). HTM 01-05 states that this risk assessment, and the written scheme produced and to be acted upon to control the risk following the assessment, are part of the essential quality requirements for all dental workplaces. The risk assessment and written scheme must be undertaken by a competent person – a water engineering specialist such as a member of the Legionella Control Association.

To reduce the risk of *Legionella* contamination in the DUWLs, the dental workplace should carry out the following actions:

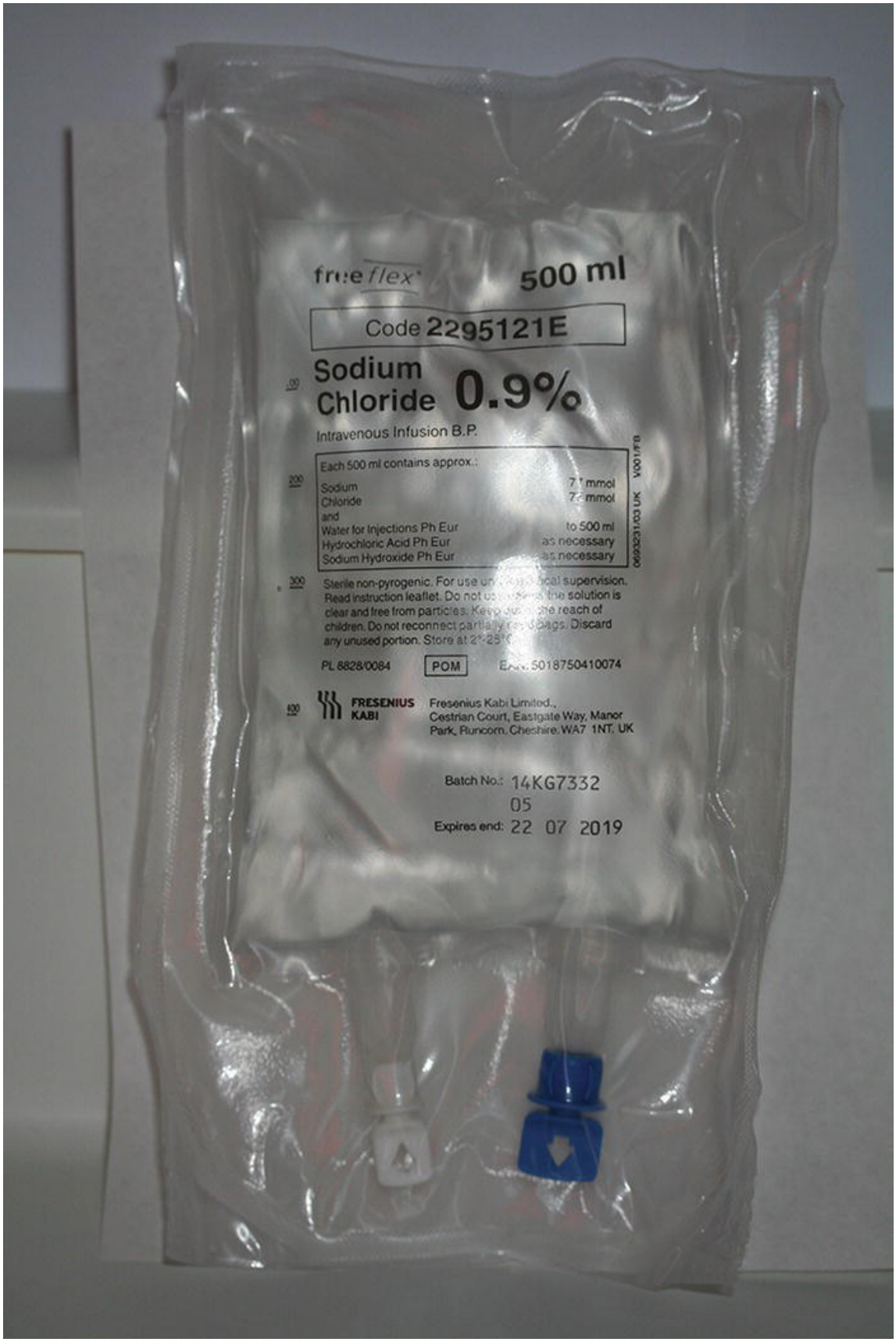
- Wherever possible, do not run mains water through the DUWLs; a reservoir bottle system attached to the bracket table should be used instead (Figure 8.11).
- If mains water has to be used, an air gap (type A) should separate the DUWLs from the mains water supply. The micro-organisms cannot 'jump across' the air gap and contaminate the DUWLs, or 'jump' in the opposite direction and contaminate the mains supply from the dental surgery by backflow.
- Washer-disinfectors do have to be connected to the mains water supply to function correctly, but their fitting and plumbing must now comply with the requirements of the Water Supply (Water Fittings) Regulations 1999, to prevent backflow.
- The preferred reservoir bottle system should contain freshly distilled or reverse osmosis generated water (see later), not mains water from the tap.
- Various types of specialist biocide chemicals (disinfectants) are available for use within the reservoir bottles while carrying out dental treatment (Figure 8.12). They pass through the DUWLs during use and help to reduce the build-up of biofilm within the system (although it cannot be eliminated completely).

- Alternatively, a hypochlorous acid solution can be used in the water bottles continuously (see Chapter 4).
- To reduce the risk of contamination further, the following is advised:
  - Remove the reservoir bottle at the end of the day, flush with distilled or reverse osmosis water (not mains water), stand upside down and leave to dry overnight.
  - Use a biocide within the reservoir bottle whenever the unit is in use, not just weekly or intermittently.
  - At the start of a session, all the DUWLs should be flushed through for 2 minutes before connecting handpieces, etc. to reduce stagnation and backflow of micro-organisms into the water lines.
  - Flushing should also be carried out between patients for 20–30 seconds, for the same reasons.
  - A separate source of single-use sterile water or saline should be used for surgical procedures, such as implant placement (Figure 8.13).

Figure 8.11 Reservoir bottle system.


Alpron
for the decontamination of water lines
in dental treatment units
Alpron is a concentrate for the continuous decontamination of water lines (including instruments and tumbler filler) in all medical and dental treatment units. Water hardness = 2-19 °e.
Spectrum of activity:
• bactericidal/ fungicidal
• removes and prevents lime and algae formation
Alpron effectively protects against algae formation and lime deposits and prevents limescale forming when warming water or after it has been left standing.
Application with internal dosage device:
Fill container with undiluted Alpron and ask your service engineer to adjust the disinfection device according to the manufacturer's dilution instruction.
Application with external dosage device:
Mix Alpron with external water (e. g. the Clean-water-System) to 1 % (Proportion: 10 ml Alpron for 990 ml water) and connect it to the dental treatment unit. In case of dosage devices standing aside ask your service engineer to carry out the adjustment.
Application is only to be effected by dental specialists.
Clinical data:
Institute Fresenius, Stockach, 1995-10/1996-08
Prof. Dr. H.P. Werner, Schwerin, cytotoxicity DIN EN ISO 10993-5, 2012-11
Active ingredients:
Tosylchloramide sodium, PHMB
Notes:
Contains Polyhexamethylene biguanidehydrochloride. The concentrate may product an allergic reaction. Safety data sheet available on request.
Contains a source of phenylalanine.
The ready-to-use solution is physiologically and ecologically harmless. In units with copper-heaters - especially after a longer period of stagnation and a low water hardness - the water might become slightly blue. In this case the tumbler filler should be operated shortly (fill 1 tumbler and empty it into the spittoon bowl) before the treatment.
REF 3177-N Alpron StarterSet
REF 3184 4 x 1 l bottle
REF 3200 5 l cubtainer
see additional label
LOT
CE 0123
Contents:
e 1 l
ALPRO MEDICAL GMBH
ALPRO MEDICAL GMBH • Mooswiesenstr. 9
78112 St. Georgen • Germany
T +49 7725 9392-0 • www.alpro-medical.com
Citrisil
Formulation
Part #
White 3L
C20-W
White 2L
C20-2W
Blue 1L
C20-B
Blue 2L
C20-2B
Shock
EC5-10
Citrisil
by Sterisil
All-In-One
Dental Waterline Microbial Contaminant Control Tablet
• Maintains Dental Waterline Effluent ≤≤10 CFU/ml
• Maintains Silver Ion Antimicrobial Tubing & Bottle
NET CONTENTS: 1 Shock Tablet & 20 Maintenance Tablets
Except Part # EC510 = 10 Shock Tablets
CAUTION:
Keep out of reach of children.

Figure 8.12 Example of DUWL biocide.


freeflex
500 ml
Code 2295121E
Sodium Chloride 0.9%
Intravenous Infusion B.P.
Each 500 ml contains approx.:
Sodium
Chloride
and
Water for Injections Ph Eur
Hydrochloric Acid Ph Eur
Sodium Hydroxide Ph Eur
to 500 ml
as necessary
as necessary
Sterile non-pyrogenic. For use under medical supervision.
Read instruction leaflet. Do not use unless the solution is
clear and free from particles. Keep out of the reach of
children. Do not reconnect partially used bags. Discard
any unused portion. Store at 2°-25°C
PL 8828/0084
POM
5018750410074
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Fresenius Kabi Limited.,
Cestrian Court, Eastgate Way, Manor
Park, Runcorn, Cheshire. WA7 1NT. UK
Batch No.: 14KG7332
05
Expires end: 22 07 2019

Figure 8.13 Sterile fluid bag for use during implant treatment.

As well as the DUWLs, the hot and cold-water supply to the dental premises should be monitored to reduce the risk of *Legionella*, in accordance with the 2016 HSE publication *HTM 04-01: Safe Water in Healthcare Premises Parts A, B, C*. *Legionella* can survive over a wide temperature range, and a colony of micro-organisms will actively grow between 20 and 45 °C so it is recommended that the workplace plumbing and DUWLs contain water outside this potential growth range. The cold-water side should be below 20 °C after running the water for 2 minutes, and the hot-water side should be stored at 60 °C and be no lower than 55 °C when run from the taps after 1 minute. These temperature performance checks are easily carried out using a suitable thermometer and stopwatch system (Figure 8.14), and the results recorded on a monthly basis. Taps that are used infrequently throughout the workplace should be flushed on a weekly basis to reduce the risk of water stagnation. If the water quality of the premises changes at any point, such as tasting foul or smelling badly, a microbiological investigation should be carried out by a competent person to determine the cause, as the growth of *Legionella* in the system is one possibility. Infection with *Legionella* in any person due to the workplace water supply system is reportable under RIDDOR (see Chapter 4).

Figure 8.14 Simple thermometer and stopwatch for testing water temperatures.

Cleaning of equipment, handpieces and instruments

The three main techniques currently available for cleaning reusable dental equipment, handpieces and instruments are:

- manual cleaning
- manual cleaning with ultrasonic decontamination
- decontamination and cleaning with washer-disinfector.

Wherever possible, items should then be subjected to sterilisation in an autoclave.

Equipment

Various items of dental equipment become contaminated during use, often because of their close position to the dental chair itself as well as by use in the patient's mouth. They are not likely to be sterilisable, and their cost prohibits them from being single-use items.

- **Curing light**: should be wiped down with a suitable cleaning agent after each use. The fibre-optic tip should be protected with a single-use barrier cover (follow manufacturer's instructions).
- **Aspirator tubing**: should be wiped down externally with a suitable cleaning agent after use, or protected with a single-use barrier cover (see later for inner tube cleaning).
- **X-ray unit tube**: should only come into contact with the outside of a positioning device, rather than the patient's skin or oral tissues, so should be wiped down with a suitable cleaning agent after use.

Handpieces

Various types of air turbine and slow handpiece are available nowadays, and the manufacturer's instructions should always be followed in relation to their cleaning, lubrication and sterilisation, to prolong the life of the item. Currently, it is accepted that full sterility of the handpiece is unlikely with any type of autoclave available, so the emphasis is more on reducing the risk of cross-infection rather than completely eliminating it.

However, all handpieces should be able to undergo the following processes:

- External cleaning using a suitable cleaning agent.
- Lubrication of bearings before and/or after cleaning and sterilisation, according to the manufacturer's instructions.
- Sterilisation in an autoclave (type B, S or N; see later).

Handpieces should never be immersed in an ultrasonic bath (the bearings which drive the bur rotation will be irreparably damaged), but some are suitable for decontamination in washer-disinfectors where indicated by the manufacturer. The point at which bur removal

should occur may also vary between makes, and again the manufacturer's instructions should be consulted for the correct procedure.

Dental instruments

These are all those instruments that are used directly in the patient's mouth, including items such as triple syringe tips and aspirating tips (high and low speed). These two items in particular should be single-use disposable wherever possible, as successful sterilisation of their inner hollow surfaces (lumens) is only achieved with vacuum autoclaves (types B and S), and not with downward displacement steam autoclaves (type N).

Dental hand instruments which are used to assess patients and provide dental treatment tend to be made of high-quality metals, especially stainless steel. Some are also available with ceramic coatings, for use with composite restorative materials. Their metallic content reduces the likelihood of surface corrosion, so wire brushes should not be used to remove hardened debris as these scratch the surface and allow corrosion to occur. Microscopically, the scratches and corroded areas will harbour micro-organisms very easily. Instead, soft-bristled brushes should be used to scrub the items while held under the cleaning solution. Ideally the brushes should be single use, but it is possible to acquire reusable brushes which can be cleaned and stored dry, according to the manufacturer's instructions. They should be replaced at the manufacturer's recommended interval or before if necessary, especially if the bristles become splayed.

Of the three techniques available for cleaning reusable instruments before sterilisation, manual cleaning alone is only suitable under the following circumstances, as there is no method of validating its effectiveness.

- For items which cannot be cleaned using an automated method (washer-disinfector or ultrasonic bath) according to manufacturer's instructions.
- To remove visible dental material that has hardened and set onto instruments, before they are fully cleaned using an automated method.

- When automated cleaning facilities are unavailable (including during breakdown and repair periods).

HTM 01-05 implications: equipment, handpieces and instrument cleaning update

Essential quality requirements allow the use of manual cleaning alone before sterilisation of items that cannot be processed using an ultrasonic bath or washer-disinfector first. The use of automated processes (ultrasonic bath or washer-disinfector) is not compulsory under the essential quality requirements, but the use of either and especially a washer-disinfector is necessary under best practice guidelines.

The procedure to be followed in each dental workplace for cleaning of all items should be written down and included in the infection control policy document, and evidence of staff training in the various techniques should also be recorded. This should include manual cleaning techniques in all workplaces, including those that routinely use automated cleaning techniques only. If these devices break down, staff must know the correct procedure to follow to effectively clean items manually before sterilisation, otherwise there is a risk of cross-infection as dirty instruments will be reused.

Dedicated sinks must be available (and marked as such) for manual cleaning procedures where immersion is required. Likewise, separate dedicated sinks or bowls must be available for rinsing items after both manual cleaning and ultrasonic bath usage, and contain either distilled water or reverse osmosis water; tap water is not acceptable.

Both types of special water can be bought from dental suppliers, or they can be produced from tap water on the dental premises, which is by far the cheaper option. As the name suggests, distilled water is made from the distillation of tap water in a special kettle-like machine (Figure 8.15).

Figure 8.15 Water distillation unit.

The reverse osmosis technique takes tap water through a series of finer and finer filters, so that any impurities are removed by osmosis and just pure water remains. The equipment can be plumbed directly into a source of tap water on the premises so that a supply of pure water is always available (Figure 8.16).

Figure 8.16 Reverse osmosis water unit.

Cleaning techniques for reusable items: HTM 01-05 implications and updates

Manual cleaning

This is the simplest method of cleaning reusable items before sterilisation, but is the most difficult to validate –prove that it has been effective – as it depends entirely on the thoroughness of cleaning by the staff member at the time. Because of its hands-on nature, it is also the technique most likely to result in an inoculation injury to the staff member.

Under essential quality requirements, manual cleaning is an acceptable method to use (as long as plans are clearly in place to introduce automated cleaning at some point in the future), but under best-practice guidance it should only need to be used on items where the manufacturer states that automated cleaning is unsuitable.

The basic procedure to manually clean items safely and effectively is as follows:

- Wear suitable PPE to avoid inoculation injury: thick household gloves should be worn whenever any sharp items are cleaned manually, as well as face and eye protection.
- Always clean the items as soon as possible after use, to avoid contamination drying onto their surfaces, which is far more difficult to remove than wet contamination.
- Use cold water and a suitable detergent in a dedicated instrument cleaning sink/bowl; hot water 'fixes' contaminants such as blood onto the item surface and makes it far more difficult to remove.
- Use nylon-bristled, single-use, reusable or autoclavable scrubbing brushes to remove difficult contaminants, as wire bristles will scratch the metal surfaces and allow corrosion and rusting to occur.
- The items should be scrubbed while under the water surface to avoid spraying contaminants into the immediate vicinity.
- A separate sink/bowl of distilled or reverse osmosis water should be used to rinse the items after cleaning, to remove any detergent and loose contamination.
- The items should be visibly inspected, ideally using an illuminated magnifier (Figure 8.17), to ensure that all contamination has been removed; if any is found the item should be recleaned and rinsed again.
- The items should then be autoclaved as soon as possible before they can dry in the air; this can result in corrosion or recontamination.
- Those that are to be bagged before vacuum sterilising should be dried thoroughly first.

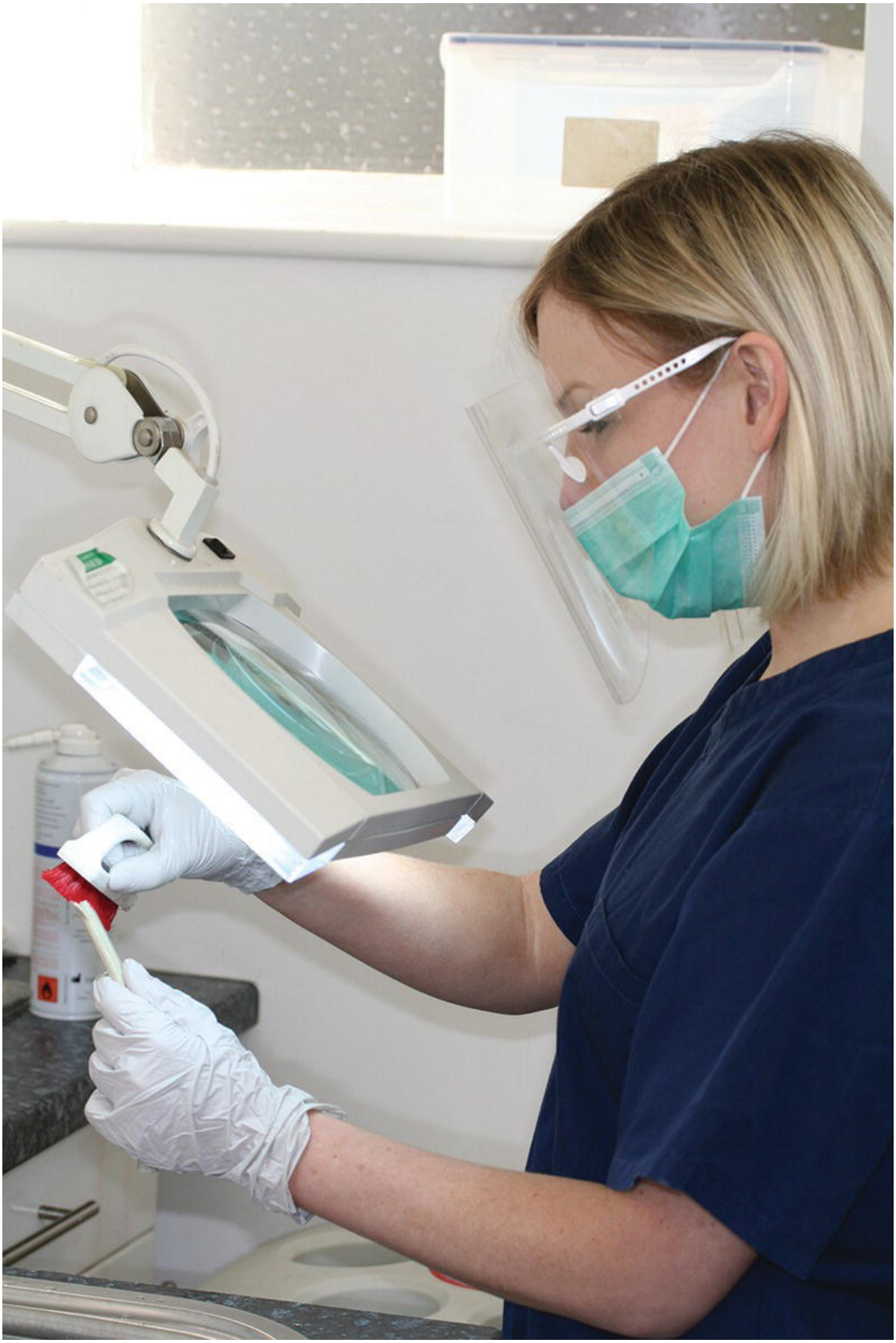


Figure 8.17 Magnifier in use.

Ultrasonic bath

These devices remove debris from items by vibrating at an ultrasonic frequency and transmitting that vibration onto the instruments loaded into the bath on the tray (Figure 8.18). They require the use of special detergents diluted in distilled/reverse osmosis water within the bath to be effective, and the solution should be replaced at the end of each clinical session or when it is obviously heavily contaminated with particles of debris.

Figure 8.18 Ultrasonic bath.

Ultrasonic baths should not be used to debride handpieces, as the bearings will become damaged. Manufacturers' instructions should be consulted for any particular operating advice relevant to each machine used in the dental workplace.

The basic procedure to decontaminate items using the ultrasonic bath is as follows:

- Heavy soiling with blood and other visible contaminants should be reduced by briefly soaking the items in cold detergent solution beforehand, and then rinsing.
- Dental material that has hardened and set onto instruments may also require prior removal by manual cleaning.
- Hinged items (such as extraction forceps) should be opened and assembled items (such as amalgam carriers) should be disassembled.
- All items should be placed on the bath tray and fully immersed beneath the solution, to allow debridement to occur effectively.
- The bath should not be overloaded with items, as debridement will not be effective.
- The timer should be set according to the manufacturer's instructions, the lid closed on the machine and the programme started; the lid must remain closed to prevent aerosol contamination of the vicinity.
- When the timer ends, the basket and its contents should be lifted and allowed to drain, then the items should be rinsed in a dedicated sink/bowl of distilled or reverse osmosis water.
- The items should be visibly inspected to ensure debridement has occurred, and put through the process again if debris remains.
- If a vacuum autoclave is in use, the items must be dried before being bagged and made ready for sterilisation.
- Items should be sterilised as soon as possible after being decontaminated, as for manually cleaned items.

Maintenance and testing of ultrasonic bath

As with all electrical items that are used to perform certain tasks in the dental workplace, the ultrasonic bath should be maintained by a service engineer or a delegated person competent in decontamination, on a regular basis. For many units, manufacturers recommend that this is carried out annually, as a minimum.

The working efficiency of the bath will be maintained if regular in-house testing is also carried out, and these daily and weekly duties are

often delegated to the dental nurse.

Daily duties are as follows:

- **Strainer/filter cleaning**: remove these items from the bath and clean using a suitable detergent solution and brush, to remove the contamination produced during normal operation.
- **Tank draining**: the bath solution should be fully drained at the end of the day, or at the end of a busy clinical session, so that contaminants are disposed of rather than transferred onto other instruments.
- **Cleaning check**: all instruments placed in the bath should be visibly checked at the end of the cycle, to ensure that all visible debris has been removed. An illuminated magnifier should be available for use during this procedure (see Figure 8.17).

Additional weekly duties are as follows:

- **Safety check**: ensure that the lid of the bath fits adequately and continues to prevent aerosol contamination of the surroundings during use; check for signs of any solution splatter around the unit.
- **Protein residue test**: use of a special test device to ensure that protein residues are being removed effectively during the ultrasonic cycle, so that items are indeed decontaminated before sterilisation (proteins are present in blood, pulp, tooth and soft tissues, and micro-organisms).

One final test that can be carried out in-house to test the efficiency of the debridement action of the ultrasonic bath is an *activity test using aluminium foil*. The test should be carried out once every 3 months. Details of the test can be found in the HTM 01-05 document but basically it involves immersing several strips of aluminium foil into the bath solution and running a normal cycle. On inspection, the aluminium should be eroded off the strips at similar points along their length, indicating that the debridement action occurs similarly throughout the whole tank. Any variation in the position and extent of the aluminium erosion indicates that the tank is not vibrating

uniformly, and instrument debridement will therefore be on a hit-and-miss basis.

HTM 01-05 guidance is to follow the manufacturer's instructions in relation to validation testing of individual units, but written records of the tests performed and retention of the devices used are held as proof (validation) of the bath's efficiency.

Washer-disinfector

These devices (Figure 8.19) are the preferred method of item decontamination under the best-practice guidelines of HTM 01-05, although they are under further review with regard to the possibility of protein fixing during the cycle. Their use is a requirement in all dental workplaces in Scotland and Northern Ireland.

Figure 8.19 Washer-disinfector unit.

The washer-disinfector operates in a similar fashion to a specialist dishwasher machine, and some makes are suitable for the safe disinfection of dental handpieces, as well as other dental items and instruments.

Each typical machine cycle goes through five stages during the cleaning and disinfection process.

- **Flush**: an initial pressure rinse to remove gross solid and liquid debris from items. Previously this was using water at high temperatures but now a temperature below 45 °C is recommended to prevent the possibility of protein fixing and the consequent complete failure of the disinfection cycle.
- **Wash**: use of a recommended detergent and/or disinfectant with water to complete the removal of liquid and solid debris by both chemical and mechanical actions during the wash process (the detergent/disinfectant breaks down the debris chemically, and the mechanical action of the solution swishing around in the machine mechanically dislodges the debris from the items).
- **Rinse**: using suitable quality mains water in accordance with the requirements of the Water Supply (Water Fittings) Regulations 1999, or reverse osmosis water, to remove all traces of the detergent/disinfectant solution. Any evidence of marking, smearing or spotting on the cleaned items indicates that the water quality is inadequate for use in the machine.
- **Thermal disinfection**: the temperature is preset at the start of the cycle, and can be varied depending on the contents of the load to be disinfected; the chosen temperature is then achieved and held for the required time within the machine.
- **Drying**: heated air is pumped into the disinfection chamber so that any residual moisture is removed from all items before the end of the cycle, as wet items will allow micro-organisms to recolonise their surfaces more readily.

Full training of staff in the correct use of the washer-disinfector is vital in ensuring that every cycle produces clean and disinfected items, ready for sterilisation. Written records of any training received should be kept by the dental workplace, and the full procedure for

machine use should be included within the infection control policy documentation. In particular, the following points should be included in the training to ensure effective cleaning.

- Instrument carriers must not be overloaded.
- Instruments should not overlap each other on the carriers.
- Instruments requiring irrigation during the cleaning cycle (such as handpieces) are attached to the irrigation system correctly, with the use of filters where necessary.

Maintenance and testing of washer-disinfector

As with the ultrasonic bath and other electrical devices, maintenance and testing of the washer-disinfector must be carried out on a regular basis by a service engineer. Intermediate in-house tests are also advised. Again, HTM 01-05 guidance is to follow the manufacturer's instructions in relation to validation testing of individual units.

Some washer-disinfectors have automatic data-logging devices incorporated into their design that produce printouts of their operational parameters for each cycle (in a similar way to those produced by some autoclaves). This ensures that a validated record is available to prove that each cycle ran efficiently and had produced clean and disinfected items at its endpoint.

However, daily and weekly in-house efficiency tests should still be carried out, as for the ultrasonic bath. One such validation test is the use of pre-made 'contaminated' sheets and accompanying holders which are put through a cycle in the washer-disinfector. Figure 8.20 shows examples of the 'before' and 'after' sheets and indicates that the artificial contamination has been sufficiently removed during the cycle, indicating that the equipment is working effectively. In addition, the following in-house tests should also be carried out on the washer-disinfector once every 6 months.

- **Automatic control test**: to ensure that the cycle parameters set are actually achieved, with regard to temperature, time, drying, etc.

- **Chemical dosing**: test to ensure that the detergent and/or disinfectant is released into the machine correctly during the cycle, and that low levels of either are indicated as necessary.
- **Thermometric disinfection test**: using a heavily soiled load, the temperatures achieved during the cycle are tested to ensure that those reached are suitable to ensure that disinfection has occurred.

Figure 8.20 Example of 'before' and 'after' test sheets to validate washer-disinfector efficacy.

Autoclave

Once reusable items have been decontaminated by either manual or automated means, they are ready to be rendered safe for reuse on another patient by undergoing sterilisation. The machines used in the dental workplace to achieve sterilisation are called autoclaves, and there are two basic types: N type and B type. A third type (S type), which is similar to the B type seen in the dental workplace, is more frequently encountered in the hospital environment and is used for specific instrument loads determined by the manufacturer. The details of the more usual types are shown below.

N-type downward displacement autoclave (Figure 8.21)

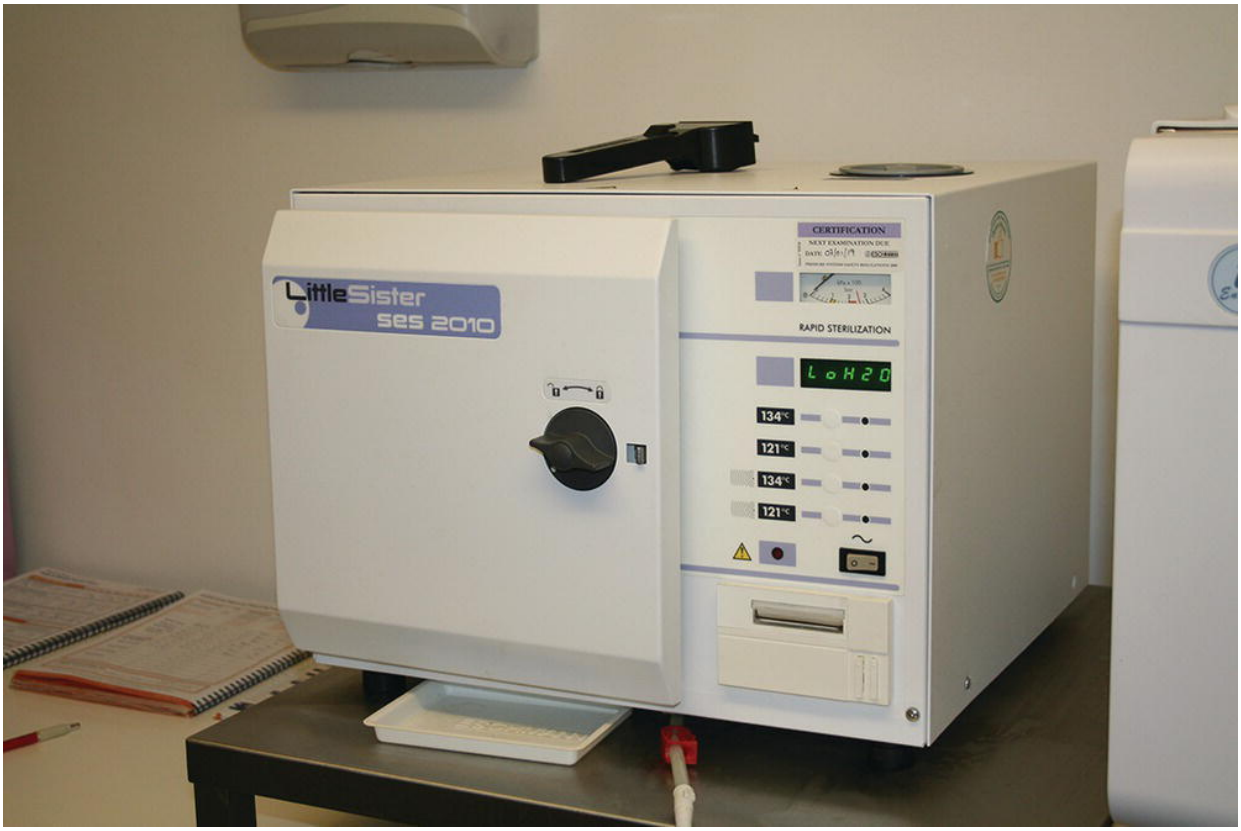


Figure 8.21 Downward displacement autoclave.

- Heats to 134 °C and holds for 3 minutes at 2.25 bar pressure (225 kPa).
- Steam displaces air downwards in the chamber so that it contacts all items.
- Cycle lasts for 15–20 minutes, depending on its make and how often it has been in use previously, as it warms up and retains the heat after each use.
- Suitable for unwrapped solid items laid in a single layer on perforated trays.
- Machine can hold several trays at a time, cutting the number of cycles required.
- Cycle can be set to dry instruments before they are removed from the autoclave, if required.

- Door cannot be opened during operation until the cycle is completed.
- Machine should have an incorporated data logging device so that printouts of each cycle are produced to prove that the sterilisation parameters were achieved, and the instruments are safe for reuse (see Figure 8.23).

B-type vacuum autoclave (Figure 8.22)

Figure 8.22 Vacuum autoclave.

- Heats to 134 °C and holds for 3 minutes at 2.25 bar pressure.
- Air is sucked out of the chamber to create a vacuum so that steam contacts all the items present as it is also sucked through, including the insides of hollow items.
- Various cycles to choose from, depending on the requirements of the loaded items for each cycle.

- Cycle can last for up to 45 minutes if a vacuum programme is required.
- Vacuum cycle is suitable for wrapped items and those with a hollow lumen, such as some surgical items and triple syringe tips.
- Machine has a data-logging device so that the operating parameters for each cycle are recorded on a printout and can be checked (Figure 8.23).
- Machine can hold several trays at a time, cutting the number of cycles required.
- Cycle can be set to dry instruments before they are removed from the autoclave.
- Door cannot be opened during operation until the cycle has been completed.
- More expensive than the N-type autoclave, but can be used for items which cannot be sterilised in N types.

ESCHMANN EQUIPMENT

SES LITTLE SISTER 3

S/N LCH4I4325

134C NO DRYING STARTED
AT 11:41:03 ON 23-05-17

COUNTER - 00787

MIN	SEC	TEMP (C)	1 1 1 1 1 1 3 3 3 3 3 3 2 3 4 5 6 7
52	06	135.0	I +
52	29	135.5	I +
52	52	135.1	I +
53	15	135.0	I +
53	39	135.0	I +
54	02	135.0	I +
54	25	135.0	I +
54	48	135.0	I +
55	11	135.0	I +
55	22	135.0	I +
55	24	135.0	I +

CYCLE ENDED
AT 11:58:17 ON 23-05-17

Figure 8.23 Cycle sterility printout.

However, neither type of autoclave will sterilise items thoroughly unless they have been suitably processed beforehand, and this is one of the most important duties for the dental nurse to complete on a daily basis, as detailed previously.

Handling and storage of sterilised items

The correct handling and storage of items once they leave the autoclave are imperative in ensuring that their sterility is maintained until they are required for use again. The obvious ways of achieving this are as follows:

- Removed from the autoclave and handled while wearing clean PPE.
- Dried using single-use cloth or towel, unless a drying cycle was used or the items were prepackaged before sterilisation (vacuum autoclave only).
- Placed within a device to act as a barrier between the items and the general atmosphere to avoid aerosol and micro-organism recontamination, such as:
    - sealed view pouch
    - lidded tray
    - sterilisation bag (for use with vacuum autoclave only).

With all autoclaves, the sterilised items must be dry before any further packaging occurs, before storage. Residual moisture makes recontamination of the items with micro-organisms a more likely scenario, so it must be removed by using the drying cycle of the autoclave or by manually drying the items as soon as they are removed from the autoclave.

Similarly, a damp cloth or towel that is repeatedly used to dry the items is also more likely to become contaminated with time, so single-use towels must be available.

For N-type autoclaves, all items must be sterilised unwrapped and then dried and stored in the following ways:

- Stored unwrapped in the clinical area for reuse within the day.
- Stored unwrapped in a lidded box in a non-clinical area (ideally the separate decontamination room) for reuse within 1 week.
- Placed in a sealed window pouch and reused within 1 year (Figure 8.24).
- The date stamp should indicate the 'use by' date, not the date of sterilisation of the item.

Figure 8.24 Date-stamped pouch.

With vacuum autoclaves, items can complete the sterilisation cycle while enclosed in pouches and lidded trays, and then dried and further packaged at the end of the cycle. These items can also be stored for reuse for up to a maximum of 1 year, in line with requirements for other healthcare settings.

Once all items have been dried and packaged, they should be stored in their designated place within the dental workplace. While it is

acceptable under essential quality requirements to store packaged items within the clinical area for ease of access, they must be kept within drawers or cupboards until immediately before use, and as far away from the chairside as possible. However, in the clinical area the potential for recontamination is greater than for other areas of the workplace due to the aerosol scatter created during dental treatment, as well as due to the throughput of the patients.

The least contaminated area of the workplace should be the 'clean zone' of the actual decontamination area itself, where the sterilised items are produced (see later), and where the public have no access. For this reason, best-practice guidelines recommend that all sterilised items are stored within the clean zone of the decontamination room, and collected from there by staff when their use is imminent, and taken to the clinical area as required.

Maintenance and testing of autoclave

Autoclaves use pressure to ensure sterilisation of the contained items, and this means that they have to comply with various health and safety legalities because of the potential danger they pose to staff and patients if they malfunction. The health and safety policy in all dental surgeries must contain written requirements for the correct use of autoclaves, as they are considered to be *pressure vessels*. The requirements are as follows:

- A daily test should be carried out on each autoclave, recording the temperature, pressure and time interval for a full cycle. These details must be kept as a written record in a dated log book.
- This is only necessary on older-style autoclaves, as all modern models have data-logs incorporated into their design or can be connected to an external printing device so that every cycle produces a printout of the parameters achieved (see Figure 8.23).
- An automatic control test should be carried out daily for all types of autoclave, and the test strip retained within the workplace records. The usual technique is to use a 'TST' strip or something similar, as provided by the manufacturer (Figure 8.25).
- Manufacturer's advice should be followed as to whether the daily tests can be conducted whilst instruments are being processed,

rather than as a separate cycle.

- A steam penetration test should also be carried out for vacuum autoclaves, to ensure that steam does indeed penetrate to the inside of any packaging used during the sterilisation cycle; this is usually a Helix or Bowie Dick test (Figure 8.26).
- Only purified or reverse osmosis water should be used within the autoclave, never tap water.
- Water should be drained from the reservoir and replaced daily.
- Door seal and safety devices used to prevent door opening during the cycle must be visually checked on a weekly basis by designated staff.
- An authorised engineer must carry out an annual inspection to ensure each autoclave operates correctly, and issue a certificate to that effect.
- Each autoclave must also be checked for its conformation with the pressure systems safety regulations on a regular basis.
- Practice insurance policy must include third-party liability cover for the use of autoclaves, in case of their explosion and resultant injury to any staff or patients.
- Any serious accident involving an autoclave, including its explosion, must be reported to the HSE under the RIDDOR.

Figure 8.25 Examples of TST and other control test strips (unused).

Figure 8.26 Helix steam penetration test device.

The first eight points are often delegated to a dental nurse, following suitable training.

Some single-use products are provided by manufacturers as prepackaged sterile items, such as syringes and needles, local anaesthetic cartridges, scalpel blades, swabs and other cotton products, gutta percha and paper points used in endodontic treatments. These are industrially sterilised within sealed packages after production, by exposure to *gamma rays*, a type of radiation similar to X-rays. As gamma radiation is highly dangerous, it must be used under strict regulation and in specialised control zones, so it is not suitable for use in dental practice. Endodontic files and reamers are either treated as single-use and disposed of as sharps after one use, or are designated as single patient use, so they can be reused but only on the same patient. Root treatment may sometimes be carried out in several sessions, so the original instruments used at the first session can be treated as follows:

- Manually cleaned separately from other instruments, then sterilised, bagged (if not already) and marked with the patient's name for reuse.
- Cleaned in the ultrasonic bath separately from other instruments, then sterilised, bagged (if not already) and marked with the patient's name for reuse.
- Cleaned in the washer-disinfector with other instruments, then sterilised, bagged (if not already) and marked with the patient's name for reuse.

Decontamination room layout

Although the provision of a decontamination room is a requirement only under best-practice guidelines in England and Wales, the need for a separate area in which to process reusable items away from the clinical area is an obvious one, and many dental workplaces have operated with separate facilities for some time. Dental workplaces in Scotland and Northern Ireland must have a separate decontamination room away from the clinical area.

However, in England and Wales, some older dental workplaces may still have a system of cleaning reusable items within the clinical area, and if so the following points must be incorporated into the procedure.

- Reprocessing should be carried out between patients, and not while patients are present in the clinical area.
- The reprocessing area should be as far away from the dental chairside as physically possible within the clinical area.
- Ultrasonic baths and autoclaves must not be in use while the patient is present in the clinical area.
- Manual washing of items should not be carried out while the patient is present in the clinical area.
- Strict zoning of clean and dirty areas within the clinical area must be followed at all times, to avoid cross-contamination.
- Thorough surface decontamination should be carried out between patients, and after each reprocessing activity.

Ideally, all reprocessing activities should be carried out in a designated decontamination room, physically separated from the clinical area, and all dental workplaces should be planning towards this as a matter of priority, and in line with best-practice guidelines

HTM 01-05 implications: decontamination room update

Under best-practice guidelines, the crucial points of the decontamination room layout and operating procedures are as follows:

- The decontamination room (or rooms) must be separated physically from all clinical areas (so a separate room is required).
- Ideally, the dirty zone where items are received for reprocessing and the clean zone where the sterilised items are produced should be separate rooms. This allows for the maximum possible separation of dirty and clean items, and therefore the minimum possibility of recontamination.
- Where only one room is available, there should be one or two sealed, smooth surfaced and easily cleaned worktops, such as ones constructed in stainless steel (Figure 8.27).
- Where other surfaces are used, such as Formica (as used in home kitchens), the surface must not be indented but completely smooth, so that there are no areas for micro-organisms to adhere.
- There should be a clean to dirty airflow within the decontamination room(s). This may be an active airflow system provided by an extractor fan sucking air out of the dirty zone to the exterior of the premises, thereby causing clean air to be passively pulled into the clean zone and across to the dirty zone in a one-way flow system (Figure 8.28).
- The areas should then be set out in the following order:
    - Set-down area for dirty items ↓
    - Hand-washing sink ↓
    - Instrument washing and rinsing sinks (or one sink with a removable bowl for rinsing) ↓

    - Ultrasonic bath (if required) ↓
    - Washer-disinfector (where available) ↓
    - Illuminated magnifier for inspection (this area can also be used for wrapping instruments before sterilisation if a vacuum autoclave is to be used) ↓
    - Autoclave (vacuum or downward displacement) ↓
    - Area for setting down sterilised instruments for packaging and storage
- The dirty and clean zones should be clearly labelled as such, to avoid cross-contamination of the two areas; ideally they can be two separate worktops (see Figure 8.27).

Figure 8.27 Decontamination room with steel surfaces.

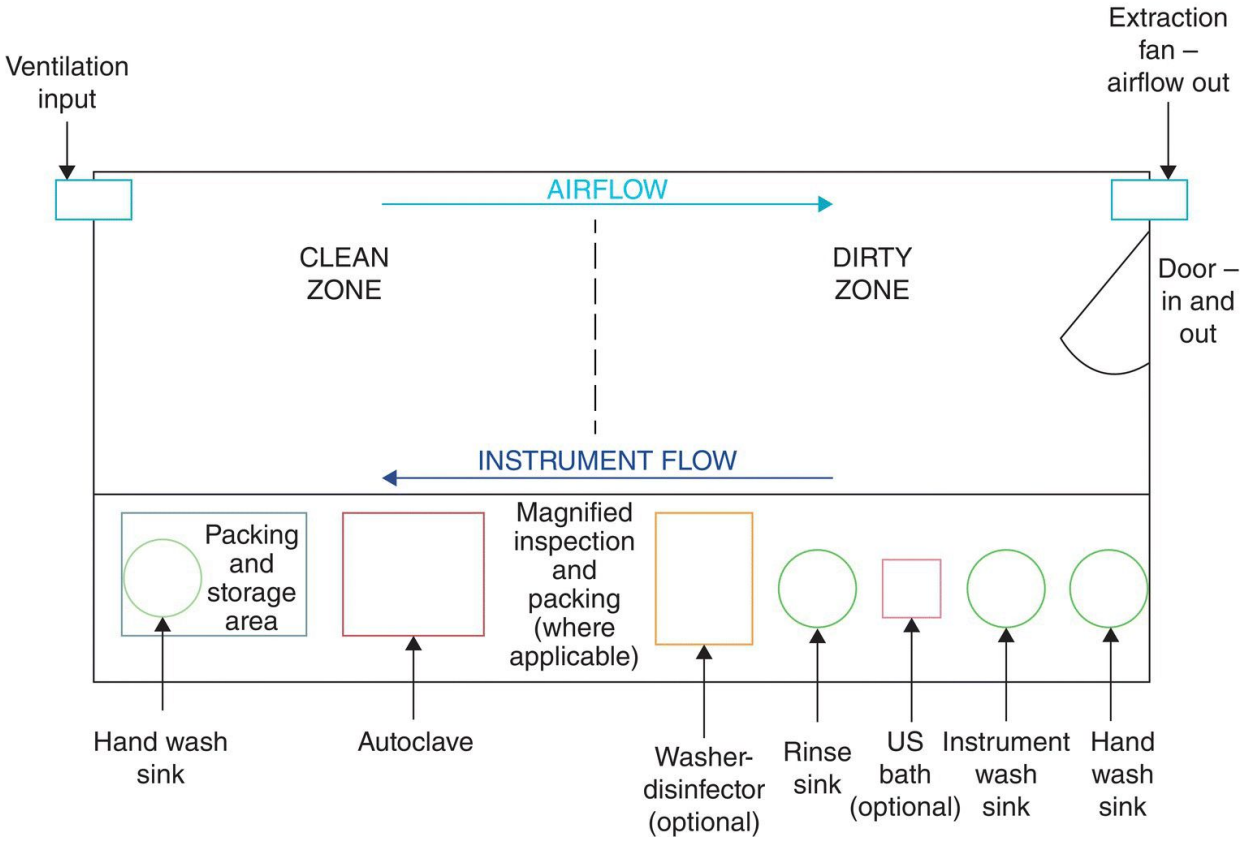


Figure 8.28 Example of decontamination room layout.

It is accepted in England and Wales that some older dental premises may not be able to achieve a full best-practice decontamination room layout without major building alterations or even a rebuild, in which case essential quality requirements must be achieved as a minimum.

Single-use (disposable) items

The best method of avoiding indirect cross-infection – the transfer of micro-organisms from one person onto an instrument, and then onto a second person when the instrument is reused – is to use single-use items. These are used on one patient only and then safely discarded in the appropriate hazardous waste receptacle, never to be used again. However, this is not feasible with many dental instruments due to their cost, and they have been designed to enable their adequate decontamination and sterilisation for reuse, during the reprocessing cycle.

Other dental items are being designed by manufacturers so that they can be single-use, such as plastic aspirator tips, saliva ejectors, three-in-one tips, surgical scalpels, and so on (Figure 8.29). These have replaced the more expensive, usually metal, previous design versions but are just as effective during use.

Figure 8.29 Examples of some single-use items.

All items categorised as single-use will bear the international symbol on the packaging (Figure 8.30) and they must never be reused, even on the same patient. They tend to be hard-to-clean items, such as metal matrix strips, barbed broaches used for pulp removal during root treatments, and steel burs. The one area of exception is the recent change in the HTM 01-05 guidance in relation to endodontic files and reamers, which can now be reused after suitable reprocessing, but only on the same patient. Unless a washer-disinfector is used to decontaminate them before sterilisation, these items must be cleaned separately from other instruments and then effectively identified for reuse on the correct patient once they have been reprocessed.

Figure 8.30 International symbol indicating single-use item.

One suggested method to achieve this is as follows:

- Decontaminate the files and reamers immediately after use while the patient's name is remembered, rather than at the end of a session.
- Do not put more than one set of files and reamers through the reprocessing cycle at a time, so that there is no possibility of them becoming mixed with another patient's instruments.
- Decontaminate them separately from all other instruments if cleaning manually or using an ultrasonic bath (change solutions after).
- Once sterilised, place the dry files and reamers in a window pouch identified with the patient's name, and the 'use by 1 year hence' storage date stamped on.
- Store the pouches in a safe place to avoid inoculation injuries (so not in the patient's record card), and with the patient's name

clearly visible to enable their easy retrieval from storage for reuse (a small 'toast-rack' style device is ideal; Figure 8.31).

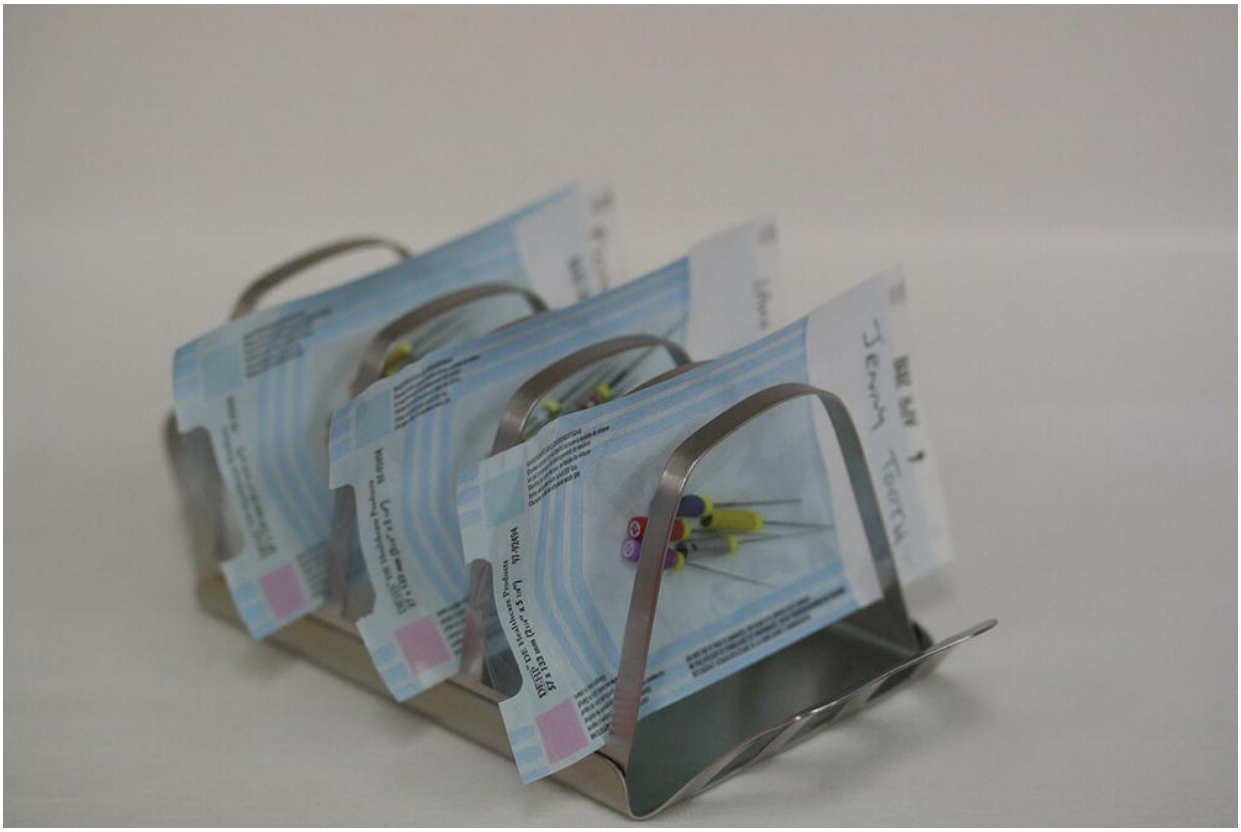


Figure 8.31 Storage device for reprocessed files.

Safe disposal of hazardous waste

This topic is covered in detail in Chapter 4, and the current classification of waste is shown in Figure 4.15.

The hazardous waste produced in the dental workplace is divided into three broad categories: non-hazardous waste, hazardous infectious waste, and hazardous chemical waste. The second category is the most important when aiming to avoid cross-infection, as the items segregated here are those which have the potential to harm members of the dental team, patients or waste contractors if not handled and stored correctly while on the premises. The hazardous waste categories require specific handling skills and colour-coded storage vessels to be used for the items included. The flowchart in Figure 4.15 shows examples of the typical types of waste produced in the dental

workplace, with the colour-coding applicable. So for example, non-cytotoxic medicines are stored in blue-lidded yellow containers, and soft infectious waste is stored in orange sacks.

Offensive waste is defined as ‘wastes which are non-infectious, do not require specialist treatment or disposal but may cause offence to those coming into contact with it’. In the dental workplace this will include any PPE, cleaning towels, X-ray films and other similar items that have *not* been contaminated with body fluids, medicines, chemicals or amalgam, as well as toilet hygiene waste. The addition of the offensive waste category has occurred in all workplaces.

Trade waste is the term used to describe items such as dental equipment (dental chairs, curing lights, portable suction units, etc.), as well as commercial electronic waste like computer screens, televisions, fluorescent lighting tubes and batteries. Specialised dental items can often be removed safely by dental engineers, while commercial waste disposal should follow the guidance of the local waste management site.

Occupational hazards: cross-infection and inoculation injury

There are three major occupational hazards in dentistry: mercury poisoning, radiation and cross-infection. All three concern dental nurses, and they must be trained to be aware of the dangers and know how to avoid them. The former two are described in Chapters 4 and 12 respectively, but cross-infection is covered here as its prevention is the purpose of good infection control.

The close nature of dental treatment exposes all surgery staff to a variety of micro-organisms on a daily basis, as dental treatment always involves exposure to saliva and often involves the shedding of blood. Even the most minute blood-stained droplets may contain viruses, and such blood-borne viruses can be sprayed over a wide area of the surgery as an aerosol when using high-speed handpieces and ultrasonic scalers, and as spatter by three-in-one syringes. So not only instruments but work surfaces, surgery equipment and surgery staff are exposed to potential contamination in this way.

Those pathogenic micro-organisms of particular concern to the dental team are any which are transmitted by contact (direct or not) with bodily fluids and secretions, and include the following:

- **HIV**: a viral infection that destroys the body's leucocytes, weakening the patient's immune system and leaving them unable to fight off diseases naturally. They eventually go on to develop AIDS, a fatal condition for which there is no vaccine currently available.
- **Hepatitis B**: a viral infection causing liver inflammation, which is often fatal. All dental staff must be immunised against the virus before working in the clinical environment.
- **Hepatitis C**: a similar virus to that causing hepatitis B, but much more likely to prove fatal. There is no current vaccination against the virus.
- **Herpes simplex type 1**: a viral infection affecting particularly the lips and oral cavity. It is not fatal but is highly contagious when 'cold sore' lesions are present on the lips of the sufferer.

- **CJD (and new variant CJD)**: rare but fatal diseases affecting the brain and nerve tissues (including tooth pulp) which are caused by newly discovered infectious agents called prions.
- **Influenza**: a viral respiratory illness characterised by a wide range of symptoms similar to the common cold, but of greater severity and including fever and a general feeling of malaise. It can be fatal in those with weakened immune systems and the elderly.
- **Tuberculosis (TB)**: a serious bacterial infection which causes respiratory and other organ damage, and is spread by droplet contamination and direct contact. Almost eliminated previously in the UK by childhood vaccination, its occurrence is now on the increase throughout the world. Following full infection control procedures in the dental workplace and vaccination should provide protection against transmission for staff, but those staff infected with TB should seek guidance from local occupational health colleagues with regard to their working procedures.
- **Ebola virus**: causes an often fatal viral haemorrhagic fever which is spread by direct contact with bodily fluids and secretions. Specific advice has been published for dental staff by the various public health departments (and equivalents) after several outbreaks occurred in recent years, and is available on their websites. It is unlikely to be seen in patients outside the hospital setting.
- **MRSA**: known as one of the 'superbugs' affecting especially hospitalised patients with sometimes fatal consequences, MRSA bacteria occur harmlessly in the nostrils of many people. Issues arise when poor infection control procedures allow spread of the organism to more vulnerable persons. Following full infection control procedures in the dental workplace should eliminate the risk, but dental staff colonised with MRSA themselves should not undertake or assist with invasive dental procedures.

By always following standard precautions to control infection within the clinical environment, the risk to staff and other patients of being cross-infected from sufferers of these diseases should be minimal.

Dental staff may come into contact with other diseases during a normal working day, or even be the source of an infection to colleagues or patients if not appropriately vaccinated themselves. It is therefore of great importance that all dental staff receive the following immunisations before working at the chairside.

- **Diphtheria**: normally received routinely during childhood.
- **Pertussis**: whooping cough, normally received routinely during infancy.
- **Poliomyelitis**: normally received routinely during childhood.
- **MMR**: measles, mumps and rubella (German measles), normally received during infancy.
- **Tetanus**: normally received routinely during childhood, and can be boosted as required.
- **Tuberculosis**: received routinely after giving a negative Heaf test, but may need boosting after 15 years.
- **Hepatitis B**: received as an occupationally required vaccine before working in any clinical area; a blood test is required to prove seroconversion and ensure immunity but boosters are currently not considered necessary.
- **Chickenpox**: if not naturally immune due to childhood exposure.
- **Meningitis**: normally received routinely as a teenager.
- **Influenza and swine influenza**: received as an adult when winter outbreaks are expected.

Special care should be taken if child patients have been in contact with viral infections such as measles, mumps or rubella (German measles). The virus is present in saliva before any signs of illness are apparent, and surgery staff may become infected in this way from an apparently fit child. If there is any evidence of contact, appropriate questioning of parents will allow the dentist to assess the risk of infection and decide whether to postpone treatment. Although such infections are usually trivial in children, they can cause serious complications in susceptible adults.

If rubella occurs in the first 3 months of pregnancy it can affect the unborn child, and this may happen before pregnancy is confirmed. Such a child is likely to have serious physical defects and in such cases there are strong medical grounds for advising termination of the pregnancy.

Adult males are most at risk from mumps as it may cause sterility. All surgical staff should therefore check their own medical history and vaccination records. They should be immune from common childhood infections previously contracted and are only at risk from any which are not included in these records.

Even such a trivial viral infection as the common cold is infectious. If surgery staff or their patients have a cold, transmission to others can be prevented by wearing protective clothing. Although the effects of a cold are not serious, they often necessitate time off work with the resultant inconvenience caused by staff shortage.

Acquired immunodeficiency syndrome

In AIDS, the body's natural defence mechanism against infection is seriously impaired. Consequently, AIDS patients succumb to infections which are not normally serious or which are not normally experienced. The outcome of AIDS is usually fatal as there is no cure, no vaccination and no resistance to infection. However, progress of the disease can be delayed, and life prolonged, by the use of antiviral and other drugs which boost the immune system. Unfortunately, the apparent success of these treatments is having the perverse effect of increasing the number of people contracting the disease. The reason for this is that many people are now ignoring the safety measures that were followed in the past, when AIDS was rapidly fatal.

AIDS is caused by infection with HIV. There are no particular symptoms of AIDS as they depend solely upon whichever chance infection affects the sufferer. Like hepatitis B virus (HBV), HIV has been found in most body fluids but is transmitted mainly by contact with blood containing the virus. HIV is present in the blood of all infected persons but it usually takes years before they suffer any effects. Furthermore, as there are no specific symptoms, many of those infected with HIV are unaware that they have AIDS. Diagnosis is by blood test.

Infectivity

Unlike HBV, HIV is not very infective and is not resistant to heat or disinfectants. Although every infected person is potentially infectious, repeated exposure to HIV in blood or body fluids is usually required for transmission. Among the general population, the usual modes of transmission are sexual promiscuity, the sharing of needles by drug addicts, childbirth and repeated transfusions with contaminated blood.

In dental practice the main hazard is an inoculation injury, but the infectivity of HIV is so low that a single such accident would only result in a 1 in 300 chance of contracting AIDS. However, no chances can be taken as AIDS is a fatal disease for which there is no cure and no vaccine.

High-risk groups

Those most at risk of being carriers are:

- the sexually promiscuous
- drug addicts
- haemophiliacs and other patients who have received long-term regular blood transfusions
- sexual partners of these groups
- infants born to infected mothers.

Prevention

Although no preventive treatment by drugs or vaccination is possible, AIDS is easily avoided. All that is required as far as the general population is concerned is to avoid any form of sexual promiscuity or the sharing of needles between drug addicts.

In dental practice, prevention is the same as for hepatitis B, by correct sterilisation and surgery hygiene procedures.

Dentists may be the first healthcare workers to see the early signs of AIDS as some very unusual mouth conditions may occur for no apparent reason. As in the case of oral cancer, early referral to a specialist may be a life-saving measure.

Treatment of known carriers

Fortunately, HIV has very low infectivity and is easily destroyed by routine sterilisation procedures. Nevertheless, no chances can be taken as AIDS is fatal and no vaccination is available, so treatment of known carriers is the same as for known hepatitis carriers.

Known carriers of HIV and hepatitis viruses are those who are aware of their condition and have informed the dentist when their medical history is taken. The requirement of confidentiality mentioned in Chapter 2 is of paramount importance in such cases. Most carriers are either unaware of their condition or unwilling to disclose it in case their affliction is revealed to unauthorised people. Some are also afraid of being denied dental treatment if they admit to being carriers. When any medical history is taken, it is ethically and legally essential to ensure that it cannot be overheard anywhere else in the practice, and takes place under conditions that give patients the confidence to provide a complete relevant history without embarrassment.

As only a minority of carriers are known to be such, most are treated without the dentist being aware of their condition. This emphasises the importance of strict adherence to correct procedures for the prevention of cross-infection by all staff within the dental workplace.

The basic principle of preventing infection with HIV is to avoid contact with the patient's blood. In addition to the sterilisation and surgery hygiene procedures already detailed, the following extra precautions have been recommended for general practice.

- For operations involving extensive loss of blood, such as multiple extractions and minor oral surgery, or if the disease is in an active state, refer the patient to hospital where full sterile surgical facilities are available.
- Reserve the last appointment of the day for treatment of known carriers. This allows more time for infection control procedures before any more patients are seen but does not excuse non-compliance with the full infection control procedures at other times.
- Move all unnecessary equipment and materials away from the chairside. Protect essential working surfaces and equipment

controls, such as switches, operating light handle and three-in-one syringe, with plastic bags or cling film.

- Take great care to avoid inoculation injuries.
- After treatment, flush the aspirator with hypochlorite and leave the solution in a collection jar overnight.
- Items which cannot be sterilised by heat or hypochlorite should be immersed in a suitable disinfectant for the manufacturer's recommended time.
- Launder linen and towelling in a hot wash of 90 °C for 10 minutes.
- Pregnant staff should not have any contact with known carriers.

Hepatitis B

Hepatitis B is an inflammation of the liver caused by a virus. Its effect varies from a mild attack of jaundice to a severe or fatal illness. Over 50% of cases are undiagnosed as their symptoms are too mild to indicate the disease. On the other hand, 80% of primary liver cancers occur as a result of hepatitis B.

HBV is always present in the blood of people suffering from the disease. It may also be present in people who have no symptoms of the disease, and such people are called *carriers*. They may or may not have had any symptoms before, and most of them are unaware that they are carriers. About one person in every 1000 of the population is an HBV carrier, so all dentists are likely to treat carriers at some point in their career.

Hepatitis B is highly infective and is very resistant to destruction. It can survive boiling for up to half an hour, and immersion in chlorhexidine disinfectant, and can live outside the body for some weeks. Disinfectants capable of killing HBV include those based on hypochlorite.

HBV has been found in all body fluids, including blood, saliva and breast milk. It is transmitted by people suffering from the disease, and by carriers who have no symptoms at all and are unaware of their condition. Diagnosis is by blood test.

In dental practice the main source of infection is by direct contact with blood containing HBV. This is most likely to occur from an inoculation injury, such as accidentally pricking oneself with a syringe needle used on an HBV carrier. One in three of such accidents results in HBV infection.

Staff are also at risk from the use of high-speed equipment, such as an air turbine handpiece with water spray, an ultrasonic scaler or a three-in-one syringe. These release a cloud of water and saliva particles into the air which, if contaminated with a carrier's blood, may infect the dentist or dental nurse via the nose, eyes or skin abrasions. Furthermore, adjacent working surfaces become infected too, while inadequate sterilisation procedures may cause infection of other patients. Infection of staff from non-sharp causes may be prevented by protective clothing, as described previously.

Although the risks may seem alarming, all dental nurses and other chairside staff are required to be vaccinated against HBV and should therefore be immune to danger.

High-risk groups

Among the general population the main modes of transmission of HBV are childbirth, the sharing of needles by drug addicts and sexual contact. Thus certain groups of people are much more likely to be carriers, as follows:

- drug addicts
- the sexually promiscuous
- those who have received long-term regular blood transfusions, such as haemophiliacs, and dialysis and transplant patients
- special-needs patients living in institutions, and staff in close contact with them
- those working or living in institutions such as prisons or rehabilitation centres for drug addicts and alcoholics
- partners and close relatives of carriers, not necessarily with sexual contact.

Prevention of cross-infection

As the majority of HBV carriers are unaware of their condition, it has been estimated that 400 are treated daily in dental practice. However, provided the sterilisation and surgery hygiene procedures in this chapter are adopted, there need be no cause for alarm. However, the existence of high-risk groups emphasises the importance of obtaining an adequate medical history before treatment.

Fortunately, all dental staff can obtain protection against hepatitis B by vaccination. This will also protect their patients against HBV infection from dental staff. Vaccination is available under the NHS but staff may still be charged for the service. It involves a series of three injections, followed by a blood test to check its success. A booster injection may be required at a later date. As vaccination is a requirement for chairside employment, documentary evidence of successful immunisation must be kept. Although vaccination is completely safe, special arrangements are necessary for staff who are pregnant, or become pregnant, during the course of injections.

Treatment of known carriers

As with HIV, the basic principle of preventing infection with HBV is to avoid contact with the patient's blood, and the same additional precautions should be followed, as detailed above.

Hepatitis C

This disease is similar to hepatitis B in the way that it is contracted, transmitted and diagnosed. However, it is a far more dangerous disease with a much higher mortality rate, and there is no vaccine. In the past cases were caused by blood transfusion, but this has not happened since 1993, when screening of donors began.

Nowadays the main sources of infection are drug addiction, tattooing, body piercing and other modes of infected blood-to-blood contact but sexual transmission is uncommon. The pathogenic micro-organism involved is the hepatitis C virus (HCV).

The greatest risk to dental staff is from an inoculation injury but provided that the safety precautions to prevent this are followed, there is no danger of HCV infection. However, it should be

understood that if such a situation does arise, there is a 1 in 30 chance of transmission of the disease.

Herpes simplex type 1

This virus is very common and is usually associated with infections of the lips, mouth and face especially in childhood. As adults, affected individuals often present with cold sores on their lips (Figure 8.32) when the dormant virus is reactivated, for example during general illness, stress, hormonal changes and exposure to sunlight. Transmission of the highly infectious virus occurs by contact with the lesion and infected saliva, so dental treatment should ideally be delayed until the cold sore has resolved completely unless the patient has a dental emergency. However, manipulation of the lips and mouth may split the lesion and risk viral spread to other areas of the skin or even the eyes, so even in emergency situations treatment should be kept to an absolute minimum to avoid these possibilities.

Figure 8.32 Cold sore lesion of the upper lip.

CJD and new variant CJD

CJD and new variant CJD are two of a group of rare but fatal related diseases (similar to mad cow disease) caused by infection with a unique non-microbial source of disease called a *prion protein*. The infection occurs within nerve tissue, affecting both the brain and all nerve tissues throughout the body, including that found within the pulp of the teeth. Its importance is entirely due to the fact that prions cannot be destroyed by normal methods of sterilisation.

Consequently, current recommendations are to consider all endodontic instruments that come into contact with the tooth pulp as single-use items to prevent the transmission of the disease by indirect cross-infection, although the risk is considered to be only theoretical. The only exception (under HTM 01-05 guidance) is when files and reamers are to be used again on the same patient at a later date. Under these circumstances, these items may be very carefully decontaminated and reprocessed for future use, as detailed previously. Otherwise, broaches, files, reamers and handpiece-driven endodontic instruments must be safely disposed of as hazardous infectious waste (sharps) after a single use.

Influenza

Although many people suffering from a common cold believe they have influenza, the latter is a far worse disease which is quite debilitating in many sufferers. It is most infectious soon after the symptoms develop – cough, headache, sneezing, sore throat, but also aching muscles and joints, fever, and a general feeling of malaise. Many sufferers become bed-ridden for several days. Transmission is through close contact with an infected person, especially due to environmental contamination following sneezing and coughing, so a 'stay at home' approach should be taken with both patients and staff exhibiting flu-like symptoms. Normal infection control procedures should deactivate any surface contamination and prevent spread in the dental workplace otherwise, but non-attendance is the best option wherever possible. Those genuinely suffering from influenza (or indeed swine flu or pandemic flu) are likely to be too unwell to attend for dental treatment anyway. The Department of Health has issued

specific guidance on what the dental team should do in the event of an outbreak of pandemic flu, and this is available on their website.

Inoculation injury

An inoculation injury has traditionally been considered to involve the inadvertent piercing of the skin by a sharp object, such as a needle (used or not). However, it is more correctly the term used when any contaminated object or substance (chemical) breaks the skin or mucous membrane, or comes into contact with the eyes. Examples besides the typical sharps injury include eyes splashed with a contaminated substance, cuts with contaminated instruments or equipment, open wound splashes with a contaminated substance, and bites or scratches from a patient.

Nearly all dental procedures involve the use of sharp items including local anaesthetic needles, sharp instruments and scalpel blades, and inoculation injuries are the most likely route for members of the dental team to acquire a blood-borne viral infection. To help reduce the number of inoculation injuries in the healthcare sector, the HSE have published guidance on the issue, the Health and Safety (Sharp Instruments in Healthcare) Regulations 2013. The regulations require risk control measures to be put in place wherever medical sharps are in use, including the dental workplace, to reduce the number of inoculation injuries:

- Avoid the use of sharps wherever reasonably practicable; however, dental local anaesthetics can only be administered with the use of a needle.
- Needles should not be capped after use. However, since conventional dental syringes require the needle to be unscrewed from the end before the syringe can be decontaminated and reprocessed, inoculation injuries are more likely to occur if the needle is not capped.
- Disposable syringe devices (‘safer sharps’) should be used instead of a conventional syringe and needle device wherever possible. These devices have a shield mechanism which can be activated to cover the needle after use without being handled by the user (Figure 8.33).

- A risk assessment must be carried out to determine if the use of a ‘safer sharps’ system is reasonably practicable, and must consider the following points:
    - Patient care must not be compromised by its use (some devices do not allow aspiration; see Chapter 14).
    - The device must be reliable at every use to reduce the risk of inoculation injury; the safety mechanism should be unable to be reversed once activated.
    - The device must be easy to use, otherwise it will not be used.
    - History of previous inoculation injuries involving the operator: a zero history would suggest that the current technique used is safe.
- Where conventional syringe and needle equipment is still used, the risk of inoculation injury must be controlled by the use of a suitable device to enable re-sheathing of the needle to occur without it having to be handled directly (Figure 8.34).
- Only the operator should handle the device during and after use, whether a conventional syringe or a ‘safer sharps’ is used. It is the operator’s personal responsibility to place used sharps safely into the sharps bin.

Figure 8.33 Example of a ‘safer sharps’ device.

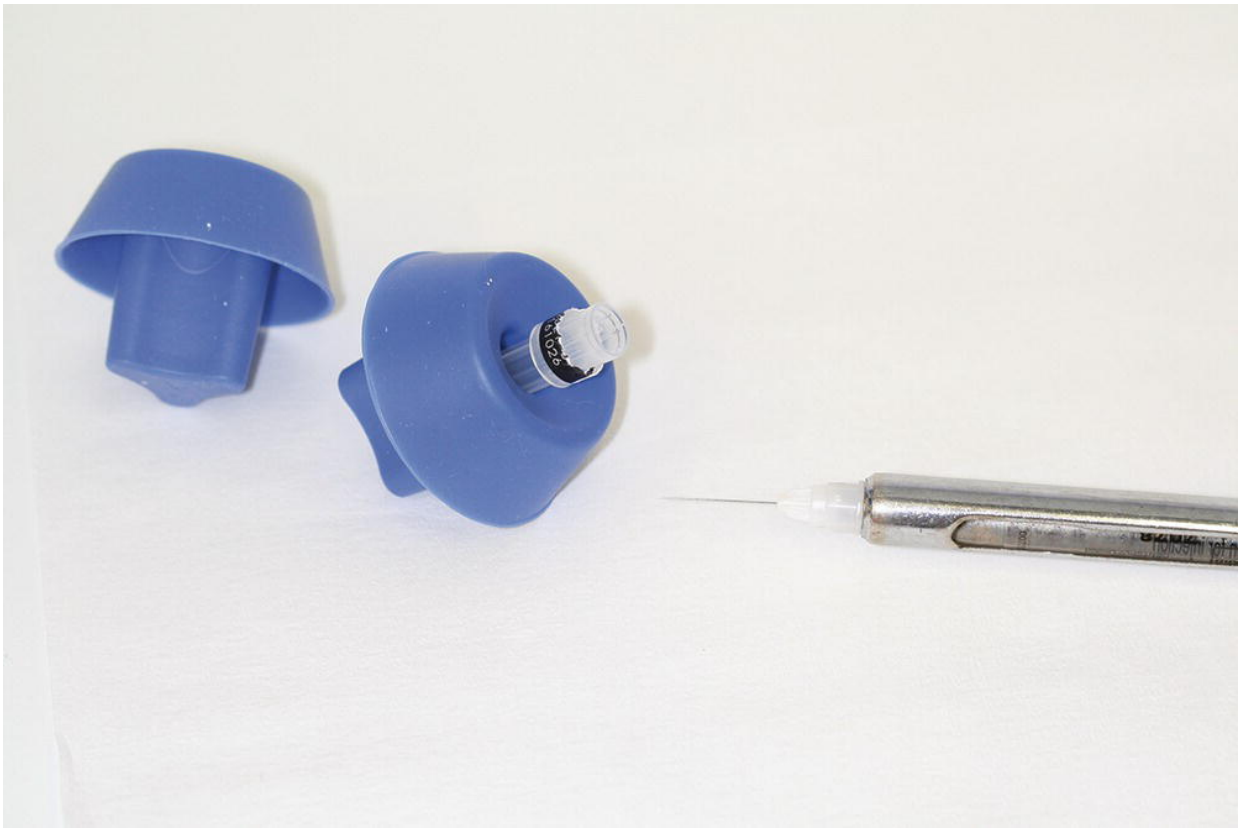


Figure 8.34 Example of needle re-sheathing device.

Every dental workplace must have an inoculation injury policy in place so that all staff members are aware of the correct protocol to follow in the event of a contaminated injury occurring. The policy should be readily visible in all clinical areas where sharps are used, so that it can be followed promptly and correctly.

- Stop all treatment immediately and attend to the wound.
- Allow the wound to bleed but do not squeeze or suck the puncture site.
- Wash the wound thoroughly with soap and running water, then dry and cover it with a waterproof dressing.
- Assess the risks associated with the patient involved.
    - Are they a known or suspected HIV or hepatitis C carrier?
    - Access the local occupational health service urgently if so, as emergency post-exposure prophylaxis treatment

(antiretroviral drugs) must commence within 1 hour of the injury.

    - If local advice is not available, the Health Protection Agency Centre for Infections should be contacted instead (infections@hpa.org.uk).

- Record the incident in full in the accident book, completing all sections of the document and then have both the injured person and the senior dentist countersign the entry.

Code of Practice on the prevention and control of infections

In England, this Code applies to all dental workplaces and sets out the criteria against which the CQC determines whether each workplace complies with the cleanliness and infection control requirements of the health and social care regulations. It is not relevant in Wales, Scotland or Northern Ireland.

However, in Wales all dental workplaces are expected to meet national minimum standards in line with Healthcare Standards for Wales, and in relation to infection control and decontamination these require the environment to:

- be well maintained and kept at acceptable levels of cleanliness
- minimise the risk of healthcare-associated infections to patients, staff and visitors to the premises
- emphasise high standards of hygiene and reflect best-practice initiatives.

Similarly, in Northern Ireland all dental workplaces are expected to meet Minimum Standards for Dental Care and Treatment and are monitored that they do so by the RIQA and the Health and Social Care Board.

By having these codes or minimum standards in place, dental workplaces are made aware of their registration requirements in relation to cleanliness and infection control, as well as enabling users of their services to know what to expect in relation to standards within the workplace.

Figure 8.35 shows the 10 compliance criteria of the CQC Code with guidance for compliance with each criterion listed. Criteria 7 and 8 are not applicable to primary care dental practices.

Compliance criterion – what must be demonstrated	Guidance for compliance
1. Systems to manage and monitor the prevention and control of infection. These systems use risk assessments and consider how susceptible service users are and any risks that their environment and other users may pose to them	• Implement existing HTM 01–05 policies and procedures • Annual statement to give review of any known infection transmission event and actions arising, audits and consequent actions, risk assessments carried out, training received, review and update policies, procedures and guidance
2. Provide and maintain a clean and appropriate environment in managed premises that facilitates the prevention and control of infections	• Implement existing HTM 01–05 policies and procedures, cleaning schedule, legionella risk assessment documentation
3. Ensure appropriate antimicrobial use to optimise patient outcomes and to reduce the risk of adverse events and antimicrobial resistance	• Systems in place to manage and monitor the use of antimicrobials to ensure inappropriate use is minimised • Systems in line with national and local guidelines (BNF, NICE, FGDP(UK)) • All prescribers to receive induction and training
4. Provide suitable accurate information on infections to service users and any person concerned with providing further care in a timely fashion	• Have available information about approach to infection prevention and control, staff roles and responsibilities, point of contact for any concerns • How and when a patient's infection status is shared with others, and in line with legislation on safe handling of information
5. Ensure that people who have or develop an infection are identified promptly and receive the appropriate treatment and care to reduce the risk of passing on the infection to other people	• Obtain medical history and risk factors for infection from all service users • Apply standard precautions to the management of all service users
6. Ensure that all staff and those employed to provide care in all settings are fully involved in the process of preventing and controlling infection	• Ensure that every person working in the dental workplace understands and complies with the need to prevent and control infections • Includes agency staff, contractors and volunteers
7. Provide or secure adequate isolation facilities	• Not applicable in primary dental care workplaces
8. Secure adequate access to laboratory support as appropriate	• Not applicable in primary dental care workplaces
9. Have, and adhere to, policies designed for the patient's care and provider organisations that will help to prevent and control infections	• Implement existing HTM 01–05 infection control policies and procedures • Antimicrobial prescribing in line with BNF, NICE, FGDP(UK)
10. Ensure as far as reasonably practicable that care workers are free of and are protected from exposure to infections that can be caught at work, and that all staff are suitably educated in the prevention and control of infection associated with the provision of health and social care	• Implement existing HTM 01–05 infection control policies and procedures • Health screening for new healthcare workers as per DoH guidance

Figure 8.35 Compliance criteria of CQC Code of Practice.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

9
Head and Neck Anatomy and Physiology

Key learning points

A **factual knowledge** of

- the gross anatomy of the skull
- the head and neck musculature
- the nerve supply to the head and neck, including the dentally relevant cranial nerves
- the blood supply to the head and neck

A **factual awareness** of

- disorders of the dentally relevant cranial nerves

The anatomy of the head and neck region of the human body is of relevance to the dental nurse in providing the underpinning knowledge required to understand their role within the dental team, as well as knowledge of the full range of topics covered in their dental nurse training programme. Dental nurses are often asked for information and advice from patients with regard to their oral health, and within the bounds of their profession they will be able to give more accurate and useful information when it is based on the head and neck area in full, rather than just on teeth. For instance, a full understanding of the subject of local anaesthesia requires knowledge of the skull and oral anatomy, as well as of the drugs used.

Anatomy of the skull

The skull is the topmost part of the bony skeleton of the body, the head, and is made up of three main areas.

- **Cranium**: the hollow cavity which surrounds the brain.
- **Face**: the front vertical part of the skull, containing the orbital cavities of the eyes and the nasal cavity of the nose.
- **Jaws**: the upper and lower jaws of the oral cavity, supporting the teeth and the tongue, and providing the openings for the respiratory tract and the digestive tract.

All the bones of the skull except the lower jaw, the *mandible*, are fixed to each other by immovable joints called *sutures*.

The base (underside) of the cranium articulates with the topmost bone of the vertebral column (the spinal column); this topmost vertebral bone is called the *atlas*, and allows nodding movements of the head. The second vertebral bone is called the *axis* and allows the head to turn to the left and right.

Like most bones in the body, the skull develops in the fetus as cartilage, which is gradually converted to bone during the growth of the body into adulthood.

The outer layer of all bone is called *compact bone*, and is perforated by many natural bony openings (*foramina*) to allow the passage of nerve and blood vessels. The inner layer is called *cancellous bone* and is quite sponge-like in appearance, because if it was a solid structure it would make the bone too heavy for the muscles attached to it to be able to lift the bone and perform movements. Nerves and blood vessels run freely within the spongy structure of the cancellous layer, and pass into and out of it through the foramina.

Cranium

At birth and during infancy, the bony plates making up the cranium are separated from each other by two natural membrane-covered spaces called *fontanelles*, which allow growth of the brain within the cranium without any bony restriction to its increase in size. During

growth, the fontanelles gradually become filled with bone as the plates close together to provide a protective helmet surrounding the brain. The bony plates join together like a jigsaw puzzle at the *coronoid sutures*. By the age of 18 months the fontanelles should have closed completely, following the natural growth together of the bony plates making up the cranium.

The cranium is composed of eight bones that are separated by the coronoid sutures, which are visible on a dry skull as the zig-zagged joints between the bony plates. The bones themselves are as follows:

- **Frontal bone**: single plate at the front of the cranium above the eyes, forming the forehead.
- **Parietal bones**: pair of plates forming the top and the greater area of the sides of the cranium.
- **Temporal bones**: pair of fan-shaped plates in the temple region of the lower sides of the cranium, in front of the ears.
- **Occipital bone**: single plate at the back and partial underside of the cranium.
- **Sphenoid bone**: single plate forming the majority of the base (underside) of the cranium.
- **Ethmoid bone**: single plate at the front base section of the cranium, immediately behind the nose.

The skull and cranial bones are illustrated in Figure 9.1.

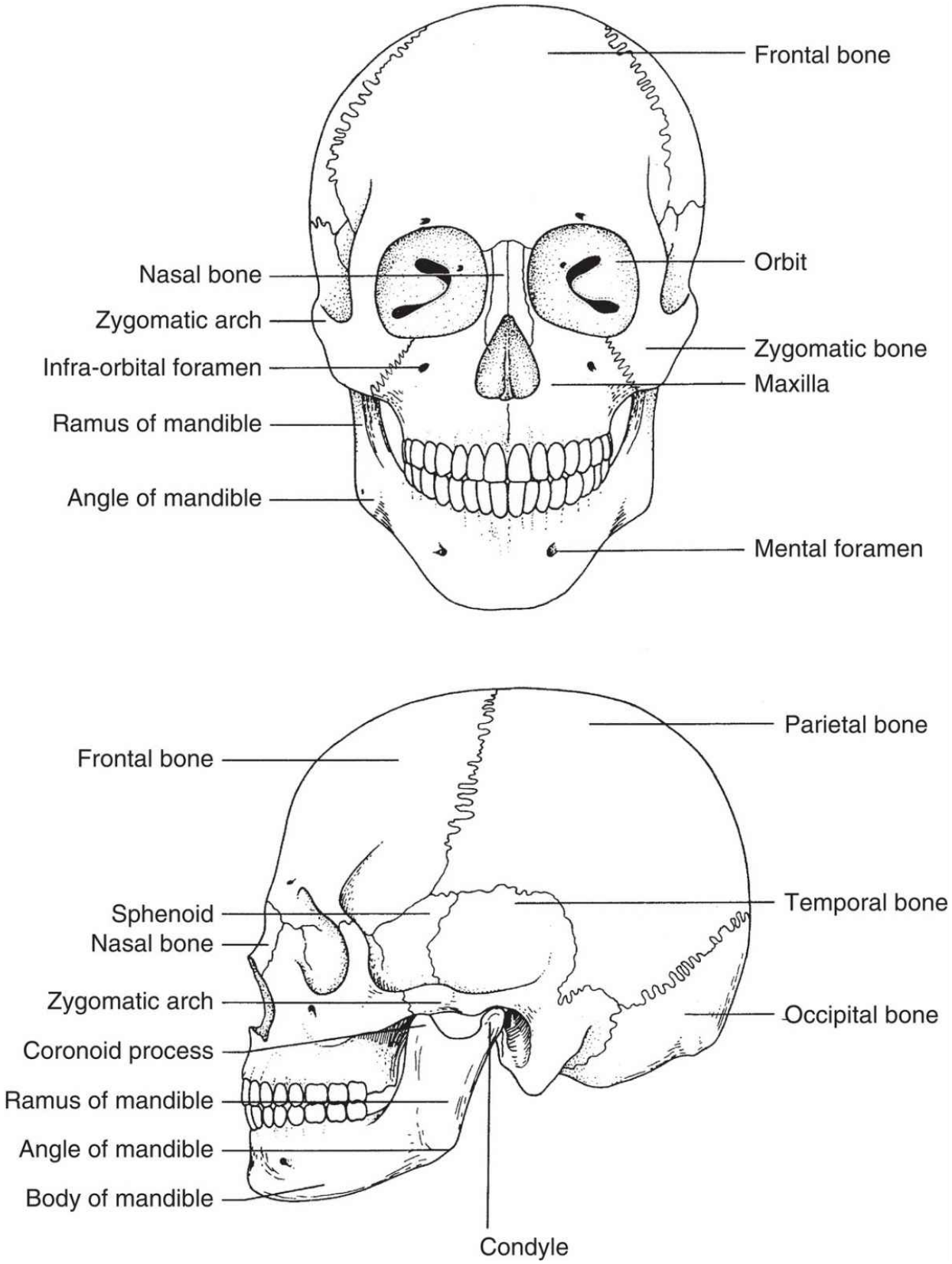


Figure 9.1 The skull, showing some cranial and facial bones.

All the sensory nerve cells running from the body to the brain and all the motor nerves running from the brain to the body have to pass in and out of this bony cavity, and they do so through the many natural foramina on the underside of the cranium. Similarly, all the blood vessels supplying the head and neck structures pass through these same foramina or between natural spaces between adjacent bones, called *fissures*.

In addition to these bony openings, some cranial bones also have various bony projections and plates on their outer surfaces, which serve as attachments for ligaments and muscles associated with head and jaw movements or which form part of various facial structures.

The largest foramen of all in the cranium is the *foramen magnum*, which opens on the underside of the cranium through the occipital bone and allows the exit of the spinal cord from the base of the brain and into the vertebral column of the spine.

The 12 pairs of nerves that branch off directly from the underside of the brain itself (rather than from the spinal cord), and which supply the head and neck region only, are called the *cranial nerves*; those relevant to the dental nurse are discussed later. The nerves that supply the rest of the body all branch off the spinal cord at various points down the vertebral column, and are referred to as the *systemic nerves*. They are not relevant to the dental nurse.

Face

The face is composed of 11 bones which are separated from each other by sutures which act as immovable joints, as in the cranium. The main bones themselves are as follows:

- **Vomer**: single bone behind the nasal cavity that connects the cranial and facial regions of the skull together.
- **Lacrimal bones**: pair of fragile bony plates forming the inner wall of the orbital cavities (eye sockets).
- **Nasal bones**: pair of bones forming the bridge of the nose.
- **Nasal turbinates**: pair of fragile curled bones projecting into the nasal cavity, which increase the contact of inspired air with the nasal mucosa. This aids debris removal before inhalation to

the lungs, and warms the air as it passes over the capillary beds covering the bones. They are separated in the midline by the nasal septum.

- **Palatine bones**: pair of bony plates forming the posterior section of the hard palate, and the side wall of the nasal cavity.
- **Zygomatic bones**: pair of facial bones that articulate with the cranium posteriorly and extend anteriorly into the zygomatic arch (cheekbone) to articulate with the maxilla.

The skull and facial bones are shown in Figure 9.1.

Jaws

Although strictly speaking the jaw bones are actually part of the facial skeleton, they are considered separately as they are of such importance to the dental team. The two jaws are each made up of a pair of bones which are fixed solidly in their midlines.

- **Maxilla**: pair of bones forming the upper jaw, the lower border of the orbital cavities, the base of the nose and the anterior portion of the hard palate.
- **Mandible**: appears as a single horseshoe-shaped bone forming the lower jaw, with its posterior vertical bony struts articulating with the cranium at the temporomandibular joint (TMJ).

Maxilla and palatine bones

The maxilla effectively forms the middle third of the face, and as with various other cranial bones it has several foramina and bony projections which are dentally relevant.

The maxilla is made up of two bones which are separated above by the nasal cavity. They join together below the nose as the front section of the *hard palate*. The back section of the hard palate is formed by the palatine bones, and the whole palate forms the floor of the nose and the roof of the oral cavity, or mouth (Figure 9.2).

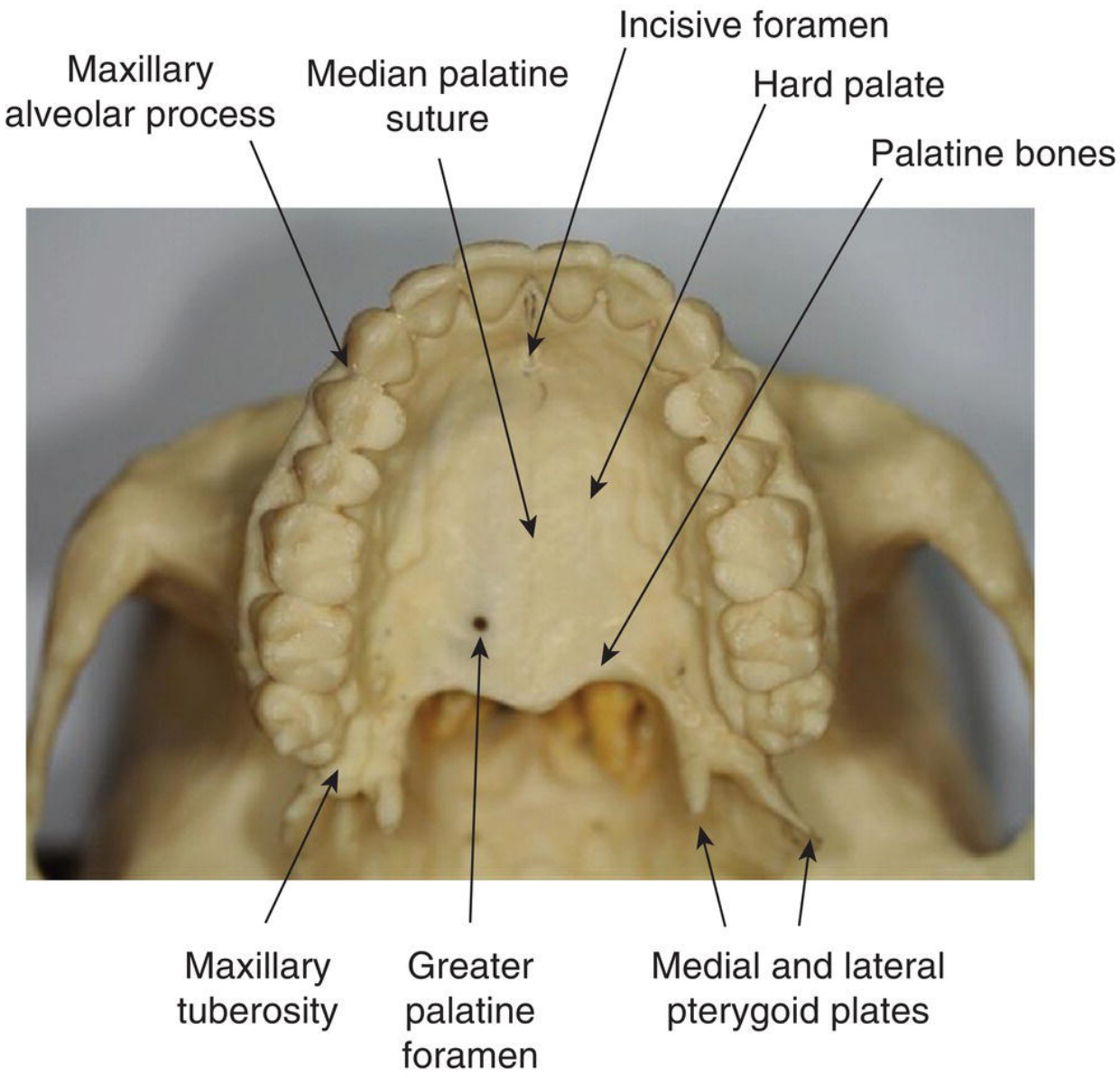


Figure 9.2 Hard palate: anatomical landmarks.

Each side of the maxilla forms part of the eye socket, the nose and the front of the cheekbone. The two maxilla bones themselves are hollow within, because if they were solid they would be too heavy to allow the head to be lifted up. Each hollow space is called the *maxillary antrum* or *sinus*, and lies just above the root apices of the upper molar and second premolar teeth (Figure 9.3). This hollow space can be easily perforated during the extraction of these teeth, causing an unwanted connection between the mouth and the antrum called an *oroantral fistula*. A natural connection between the nasal cavity and the antra

exists, to allow drainage of the sinuses to occur, and to give resonance to the voice.

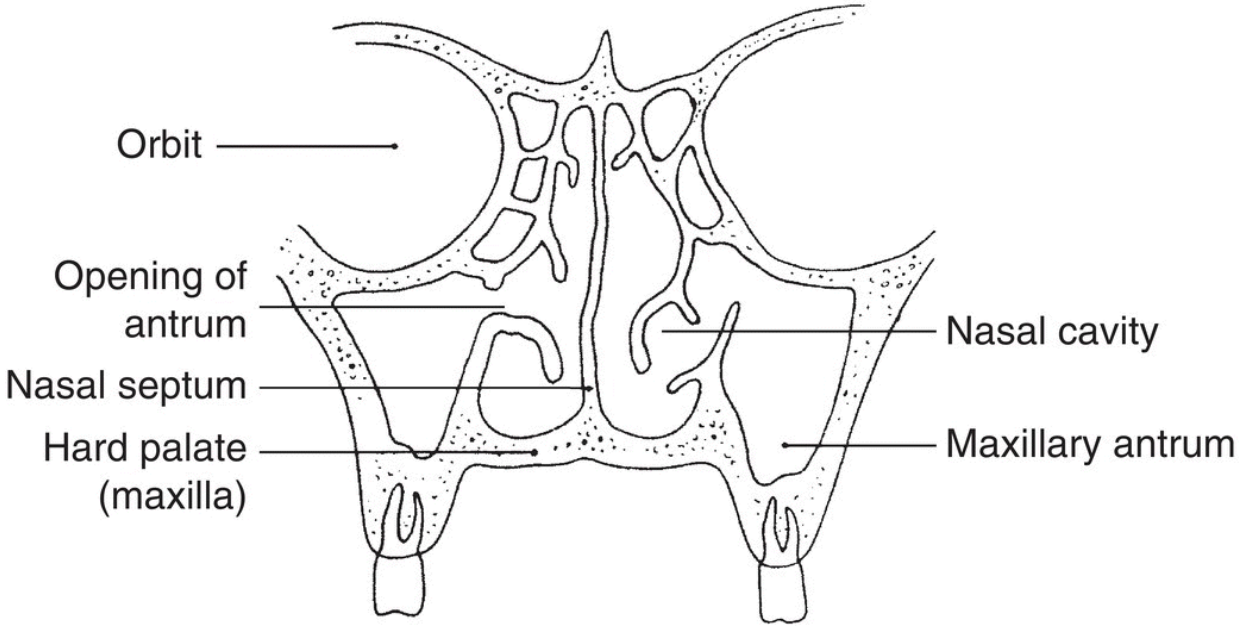


Figure 9.3 Facial bones and maxillary antrum (cross-section).

Inflammation of these air spaces (sinusitis) due to a respiratory infection often mimics dental pain in these teeth, or conversely a dental infection can be mistaken for sinusitis.

The two maxilla bones join together in the centre-line of the face at the intermaxillary suture and the lowest portions of these two sections form the alveolar process. This horseshoe-shaped structure is where both sets of upper teeth develop before birth, and later erupt into the oral cavity as the upper primary and then secondary dentition.

The back end of each side of the alveolar process is called the *maxillary tuberosity*, and this can be fractured off during difficult upper wisdom tooth extractions (Figure 9.4).

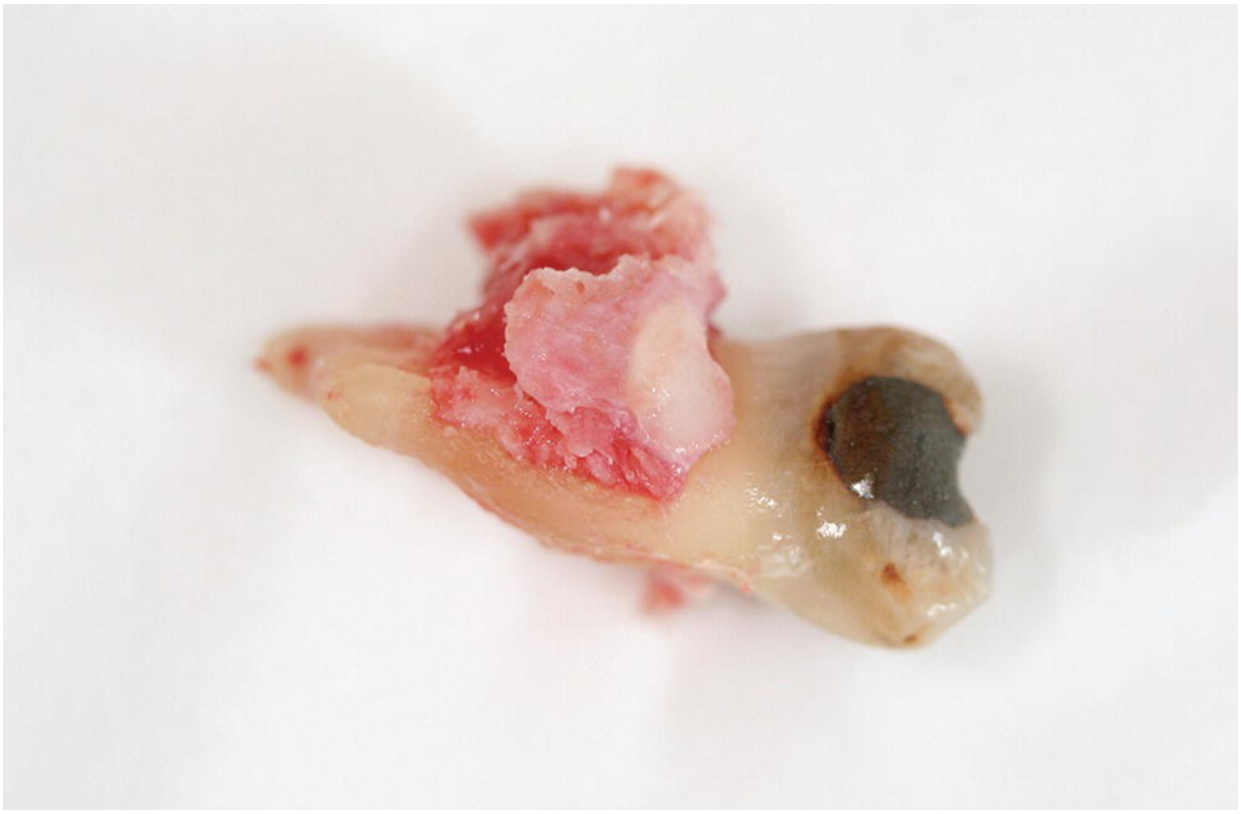


Figure 9.4 Extracted upper tooth with fractured tuberosity.

The maxilla and palatine bones (Figure 9.5) are perforated by several foramina to allow passage of the nerves and blood vessels supplying the upper teeth and their surrounding soft tissues, the four main ones being as follows:

- **Infraorbital foramen**: beneath the eye sockets, through which the nerves supplying the upper teeth and their labial soft tissues pass.
- **Greater and lesser palatine foramina**: at the back of the hard palate, through which the nerves supplying the palatal soft tissues of the upper posterior teeth pass.
- **Incisive foramen**: at the front centre of the hard palate, through which the nerves supplying the palatal soft tissues of the upper anterior teeth pass.

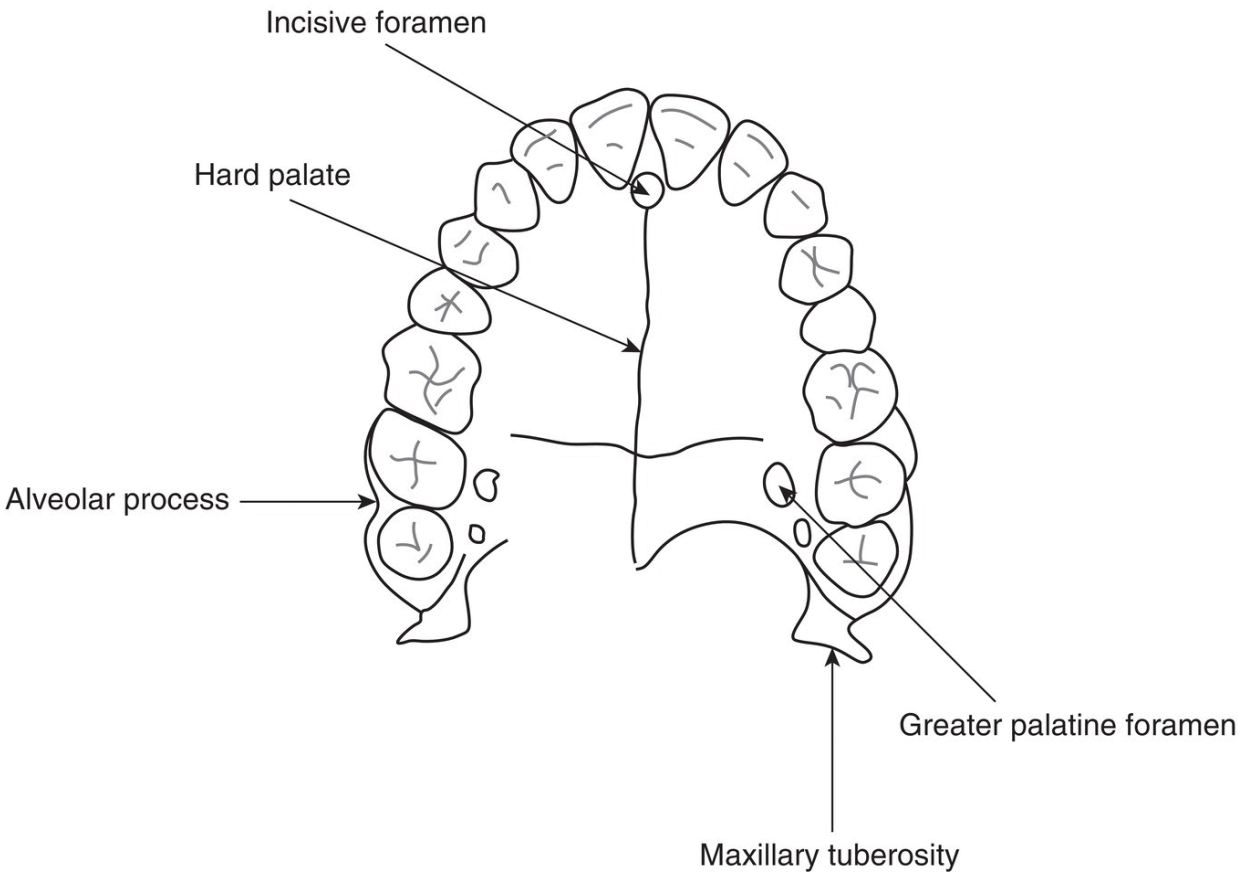


Figure 9.5 Hard palate and maxillary teeth.

Mandible

The mandible is also made up of two bones, joined together in the centre-line at the *mental symphysis* to create a single horseshoe-shaped structure, and with its two back ends bent up vertically to the horseshoe. The vertical section is called the *ramus of the mandible*, the horizontal section is called the *body of the mandible*, and the point at which they join is the *angle of the mandible* (Figure 9.6).

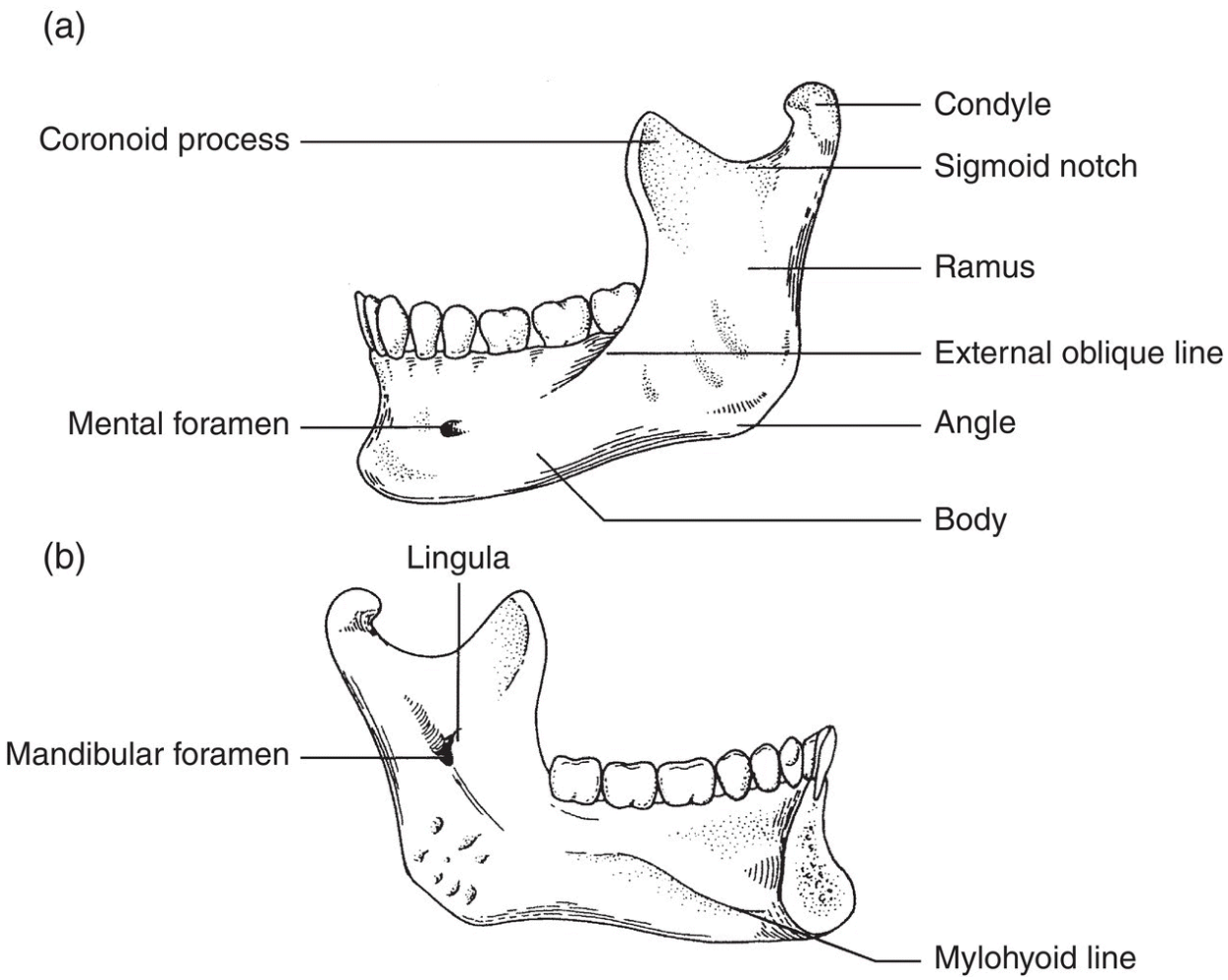


Figure 9.6 The mandible: (a) outer side; (b) inner side.

The mandible's only connection with the rest of the skull is at the two *temporomandibular joints*, where the bone moves as a hinge joint and allows the mouth to open and close. The point at which the mandible connects with the temporal bone at the TMJ is the *head of condyle* (Figure 9.7). The muscles of mastication, which allow jaw-closing and chewing movements, all connect between the cranium and various points on the mandible, as discussed later.

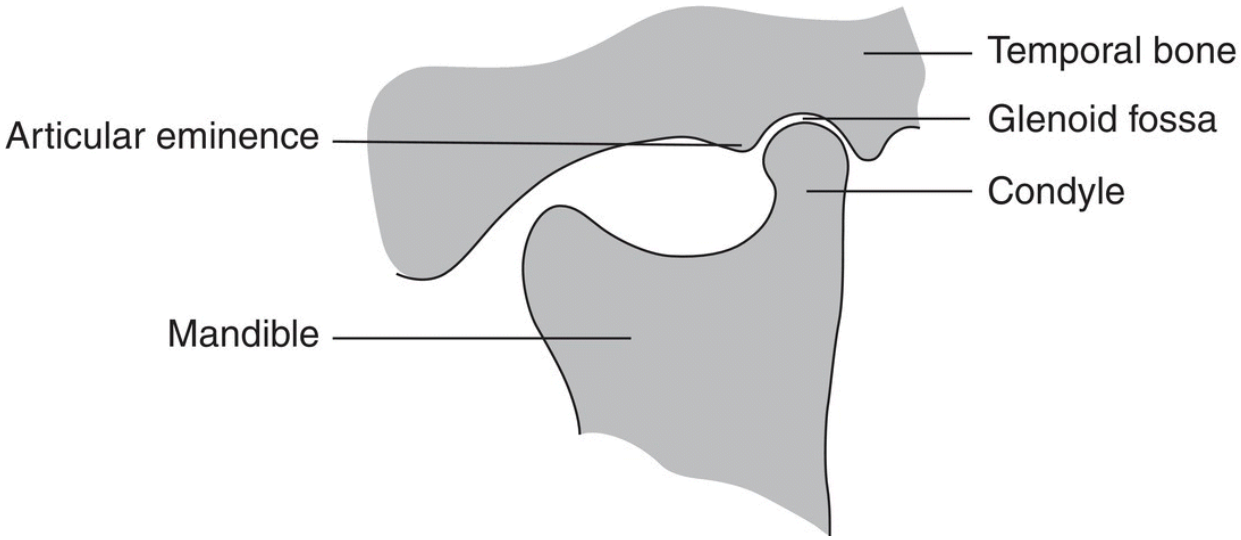


Figure 9.7 Temporomandibular joint.

The mandible also has an *alveolar process* running around it, which supports all the lower teeth. Below this process, on the inner side of the body of the mandible lies a ridge of bone called the *mylohyoid ridge*, where the mylohyoid muscle attaches to form the floor of the mouth. A bony ridge also lies on the outer surface of the ramus of the mandible, called the *external oblique ridge*, which marks the base of the alveolar process in this area.

The front edge of the ramus rises up to the *coronoid process*, and the dip between it and the head of condyle at the back of the ramus is called the *sigmoid notch*. When the mouth is closed, the coronoid process slots under the zygomatic arch of the face.

The two foramina in the mandible which are of interest to the dental nurse are as follows:

- **Mandibular foramen**: halfway up the inner surface of the ramus and protected by the bony lingula, through which the nerve supplying the lower teeth and some of their surrounding soft tissues enters the mandible.
- **Mental foramen**: on the outer surface of the body of the mandible, between the positions of the premolar teeth, through which the same nerve exits the mandible.

Temporomandibular joint and chewing action

This joint is formed between the head of condyle of the mandible and the temporal bone at the base of the skull. When the mouth is shut the condyle rests in a hollow region of the temporal bone called the *glenoid fossa*. The front edge of the glenoid fossa is formed into a ridge called the *articular eminence*. So the mandibular surface of the joint consists of the condyle, and the temporal surface consists of the glenoid fossa and articular eminence. Between these two surfaces there is a disc of fibrous tissue called the *meniscus*, which prevents the two bones from grating against each other during jaw movements. When the meniscus slips in front or behind its normal position during opening and closing of the mouth, the patient experiences the effect as 'jaw clicking'. This disarrangement of the joint is called *subluxation*.

During normal jaw movements, the joint allows three basic types of mandibular movement to occur.

- **Gliding movement**: mainly occurs when the disc and the condyle together slide up and down the articular eminence, allowing the mandible to move forwards and backwards.
- **Rotational movement**: occurs when the condyle rotates anteriorly and posteriorly over the surface of the disc itself, which remains static, allowing the mandible to move down and up.
- **Lateral movement**: this occurs when one joint glides alone, so that the other condyle rotates sideways over its disc, swinging the mandible on the side opposite from the gliding action.

As already described, the first stage of opening the mouth is a hinge-like opening of the mandible to separate the incisors. The condyle remains in the glenoid fossa during this stage. As the mouth opens further, the condyle slides downwards and forwards from the glenoid fossa along the slope of the articular eminence. When the condyle reaches the crest of the articular eminence, the mouth is open to its fullest extent and the incisors can grasp food between their cutting edges.

For the closing movement, which produces the shearing action of the incisors, the condyle returns to its rest position in the glenoid fossa, as the mandible moves backwards and closes. This produces a shearing action of the incisors which thereby cut the food into smaller

pieces ready for chewing. It is similar to the cutting action of a pair of scissors. Chewing is brought about by rotational movements of the mandible which swings from side to side, crushing food between the cusps of opposing molars and premolars.

Sometimes the condyle slips too far forward and gets stuck in front of the articular eminence. When this happens, it cannot move back on its own and the joint is said to be *dislocated*, recognised by an inability to close the mouth. It can be resolved by pressing down on the lower molars to force the condyle downwards and backwards into the glenoid fossa but sedation or a general anaesthetic may be necessary to allow the muscles of mastication to relax fully for this treatment to be carried out.

The opening movements of the mandible are due to the actions of the *suprahyoid muscles* which lie in the floor of the mouth and in the throat. The closing and chewing actions of the mandible are due to the actions of the *muscles of mastication* which run between the mandible and the cranium or facial bones. Both are discussed later.

Disorders of the temporomandibular joint

The TMJ and muscles of mastication may be subjected to excessive strain from seemingly trivial causes and these can produce a variety of effects, ranging from spasm of the muscles of mastication to degenerative changes in the joint. They result in a wide range of symptoms but the most common are pain or tenderness over the joint, clicking noises and restricted movement of the mandible.

As with any joint, the TMJ can also be affected by osteoarthritis and require the use of anti-inflammatories or steroids to relieve the painful symptoms. In extreme cases involving younger patients, the joints can even be replaced by artificial prostheses, such as with hip and knee replacements.

Abnormal or parafunctional jaw movements, which some patients perform as habits, especially habitual clenching and grinding of the teeth over long periods, are common findings by the dental team. These habits tend to exhaust the joint musculature and cause pain and discomfort, and the parafunctional action is called *bruxism*. Most patients are unaware that they perform these habitual movements,

often doing so in their sleep. Sufferers will experience any or all of the following symptoms:

- **Trismus**: involuntary painful contracture of the joint musculature, resulting in inability to open the mouth fully.
- **Face and/or neck pain**: often worse in the morning following a night of bruxing, and eased by relaxation and the use of anti-inflammatories.
- **Attrition**: enamel wear facets on the teeth, due to the constant grinding of the occlusal and incisal surfaces of each arch against the other.
- **Restorative failure**: repetitive fracture and loss of dental restorations, with or without tooth fracture, due to the excessive and prolonged occlusal forces produced.
- **Sore mouth**: especially the tongue and cheeks, where cheek ridges and tongue scalloping develop as the tongue is thrust against the teeth and the cheeks are bitten (Figure 9.8).

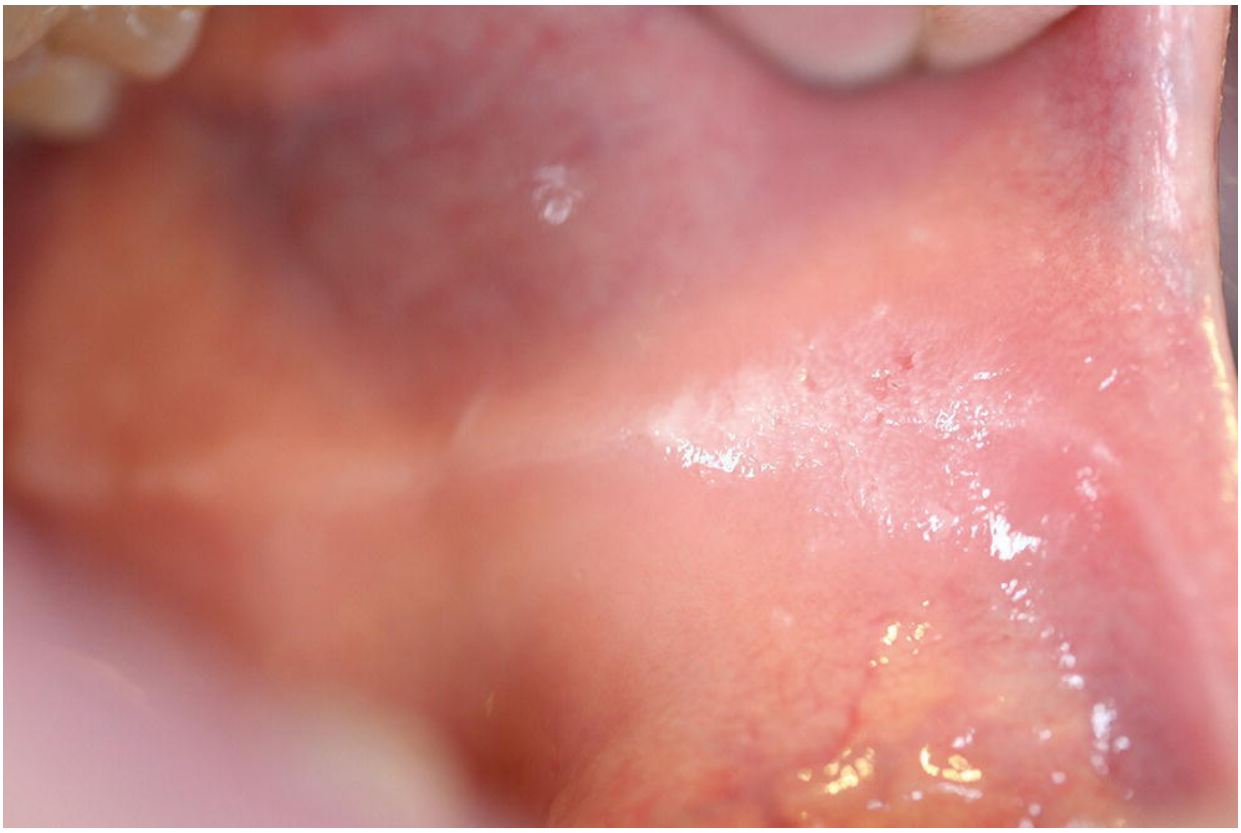


Figure 9.8 Cheek ridge due to habitual cheek biting.

Similar symptoms are often seen in patients who use chewing gum excessively.

Following diagnosis and advice on the particular cause of the bruxism, which can often be in relation to stress, treatment involves counselling, use of anti-inflammatories and muscle relaxants, muscle exercises and physiotherapy, and sometimes the provision of nightguards or splints to wear as necessary. While not preventing the bruxing action, these devices will hold the jaws open slightly and relieve the tension put on the joint musculature. In some cases involving stress as the causative factor, life changes may be necessary.

Trismus may also occur when a patient is suffering from pericoronitis (acute inflammation of the operculum of an erupting lower wisdom tooth), following the surgical extraction of these teeth, or during a bout of the viral disease mumps (acute infection of the parotid salivary glands).

Muscles of the head and neck

Muscles of mastication

These are the four sets of muscles connected between the mandible and the base of the cranium or the face, which allow chewing movements and mouth closing to occur.

- **Temporalis**
- **Masseter**
- **Lateral pterygoid** ('p' is silent, so pronounced 'terygoid')
- **Medial pterygoid**

They all receive nerve impulses from the fifth cranial nerve (trigeminal nerve) which cause them to contract so that the length of the muscle shortens. This then causes the various movements of the mandible associated with mouth closing, jaw clenching and chewing, as described previously. The muscles of mastication do not cause mouth opening – this is controlled by a different group of muscles called the suprahyoid muscles. Each set of the muscles of mastication is connected to the cranium or the face at one end, called their *point of origin*, and at their other end to the mandible, called their *point of insertion*. The contraction of individual sets of muscles, or of just one of the lateral pterygoid muscles alone, shortens their length between these two points. As the mandible is the only movable bone of the TMJ, this muscle shortening causes the movement of the mandible into various positions to allow closing and chewing actions to occur.

The muscles of mastication are summarised below.

Temporalis

Point of origin: **temporal bone** of the cranium

Point of insertion: **coronoid process** of the mandible, passing under the zygomatic arch

Action: **pulls the mandible backwards and closed**

Masseter

Point of origin: outer surface of **zygomatic arch**

Point of insertion: outer surface of **mandibular ramus and angle**

Action: **closes the mandible**

Lateral pterygoid

Point of origin: **lateral pterygoid plate** at the base of the cranium, just behind the maxillary tuberosity

Point of insertion: **head of the mandibular condyle** and into the TMJ meniscus

Action: **both contracting brings the mandible forwards** to bite the anterior teeth tip to tip, **one contracting pulls the mandible to the opposite side**

Medial pterygoid

Point of origin: **medial pterygoid plate** at the base of the cranium, just behind the tuberosity and closer to the midline than the lateral plate

Point of insertion: inner surface of **mandibular ramus and angle**

Action: **closes the mandible**

When the teeth are clenched together, the temporalis and masseter muscles can be felt by placing a hand on the side of the head and face respectively. They form the superficial layer of the muscles of mastication, while the medial and lateral pterygoid muscles form the deep layer. The superficial muscles are shown in Figure 9.9, along with some of the suprahyoid muscles and the muscles of facial expression.

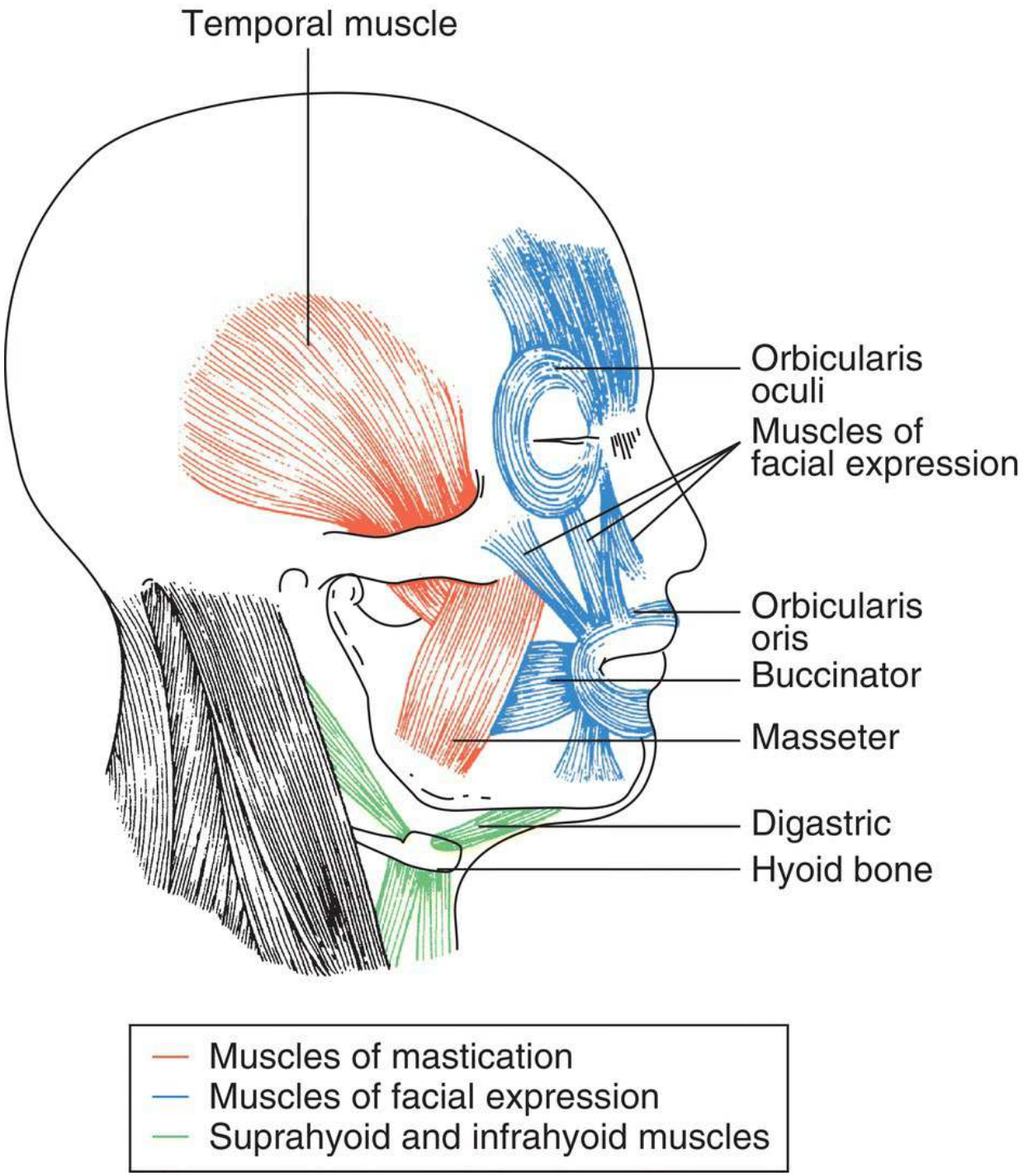


Figure 9.9 Oral musculature.

Suprahyoid muscles

As their name suggests, one end of all these muscles is attached to the horseshoe-shaped hyoid bone which lies suspended in soft tissue

beneath the mandible, in the throat. They then all lie above this bone, as opposed to a separate group of muscles lying beneath the bone called the *infrahyoid muscles*.

The suprahyoid muscles are responsible for mouth opening and swallowing actions. One group of these muscles lies in front of the hyoid bone and the others behind, producing anterior and posterior groups respectively. The anterior group is of some relevance to the dental nurse. They are listed below.

- **Anterior belly of digastric**
- **Mylohyoid**
- **Geniohyoid**

The anterior digastric and mylohyoid muscles are innervated by the motor branch of the trigeminal nerve (fifth cranial nerve), and the geniohyoid is innervated by the hypoglossal nerve (12th cranial nerve).

Anterior digastric

Point of origin: **hyoid bone**

Point of insertion: inner surface of **mental symphysis** of the mandible

Action: helps to lift the hyoid bone and larynx during swallowing, pulls the mandible down to **open the mouth**

Mylohyoid

Point of origin: mylohyoid line of the inner surface of the mandible, fusing in the midline to form the **floor of the mouth**

Point of insertion: **hyoid bone**

Action: lift hyoid bone and larynx during swallowing, and **open the mouth**

Geniohyoid

Point of origin: **genial tubercles** on inner surface of the mandible

Point of insertion: **hyoid bone**

Action: lift hyoid bone and larynx during swallowing, and **open the mouth**

Muscles of facial expression

These muscles produce the numerous facial expressions that humans are capable of showing – smiling, frowning, winking the eye, pursing the lips, and so on.

In contrast to the muscles of mastication and the suprahyoids, those of facial expression are not involved in producing skeletal movement and most are only attached at one end to the skull. Their other ends are inserted into the deep layer of the facial skin only, so that their contraction causes skin movement only.

All the muscles of facial expression are innervated by the motor branch of the facial nerve (seventh cranial nerve).

For the sake of simplicity, they can be grouped according to the facial region that their actions involve:

- the scalp
- the eyes and surrounding area
- the mouth and surrounding area.

Only the last group are of relevance to the dental nurse.

The main muscle of the eye is a ring of tissue called *orbicularis oculi* and that of the mouth is *orbicularis oris*. Thin straps of muscle run between these rings and into the surrounding tissues, to allow movement of the eyelids, lips, mouth and nostrils.

The cheek muscle is called *buccinator* and is attached above and below to the outer surface of the alveolar process of each jaw. It connects to the muscular wall of the throat behind and to orbicularis oris in front. Buccinator helps with chewing movements by helping to

keep ingested food within the confines of the teeth, while the jaw actions cause the teeth to cut and shred the food before swallowing.

The three sets of muscle relevant to the dental nurse are shown in Figure 9.9.

Nerve supply of the head and neck

The head is supplied by 12 pairs of *cranial nerves*. They all branch off from the brain, one from each pair supplying the left side, while the other supplies the right.

The nerves which make muscles and glands work are called *motor* nerves and they carry electrical impulses from the brain to effect contraction of the muscles or secretion from the glands. Those nerves which convey pain and other sensation are called *sensory* nerves and they carry electrical stimulation from the body tissues (including teeth) to the brain. Cranial nerves are either motor or sensory, or a combination of the two types, and those relevant to dental nurses are as follows:

- **Trigeminal nerve**: the fifth (V) cranial nerve, supplying the teeth and surrounding soft tissues, the muscles of mastication, and some of the suprahyoid muscles (anterior digastric and mylohyoid).
- **Facial nerve**: the seventh (VII) cranial nerve, supplying some taste sensations, some salivary glands and the muscles of facial expression.
- **Glossopharyngeal nerve**: the ninth (IX) cranial nerve, supplying some taste sensations, the parotid salivary glands and the muscles of the pharynx.
- **Hypoglossal nerve**: the 12th (XII) cranial nerve, supplying the muscles of the anterior two-thirds of the tongue and the geniohyoid muscle of the suprahyoids.

The nomenclature used to name the various nerves follows that used in other areas of anatomy, so *anterior* and *posterior* refer to front and back, respectively, and *superior* and *inferior* refer to upper and lower, respectively. The areas of supply in relation to the teeth and their surrounding soft tissues follow the dental terminology used in naming tooth surfaces, as discussed in Chapter 10.

Trigeminal nerve

The name of this nerve indicates that it splits into three divisions, each of which has several branches.

- **Ophthalmic division**: sensory supply of the soft tissues around the eye and the upper face.
- **Maxillary division**: sensory supply of the upper teeth, the maxilla and the middle area of the face.
- **Mandibular division**: sensory supply of the lower teeth, the mandible and the lower area of the face, and motor supply to the muscles of mastication and some of the suprahyoids.

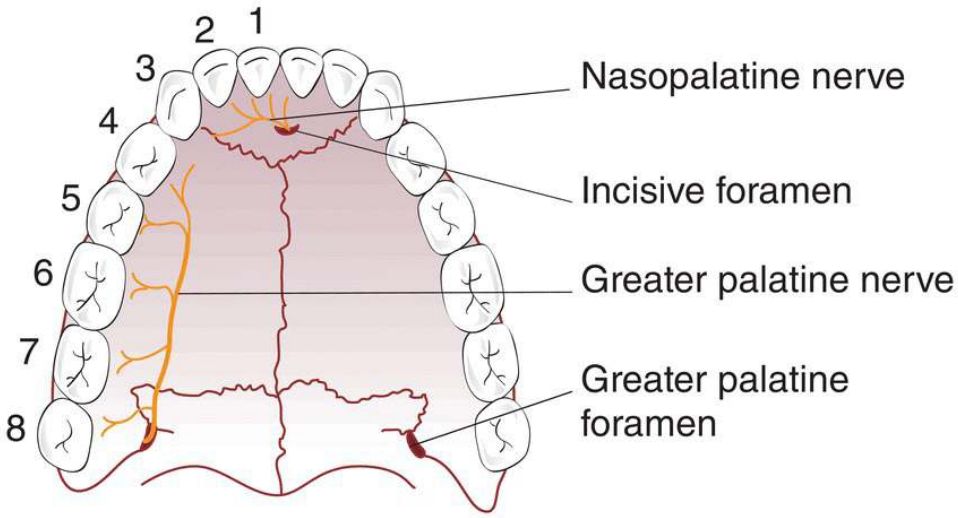
The maxillary and mandibular branches of the trigeminal nerve are of most importance to the dental nurse, as together they relay sensory information from the whole of the oral cavity to the brain, and provide the motor supply to the muscles of mastication, to effect jaw closing and chewing movements, and to some of the suprahyoid muscles to effect jaw opening.

Maxillary division

The maxillary division of the trigeminal nerve splits further into five branches, all of which are sensory (Figure 9.10). By definition, then, they transmit sensations (such as heat, cold, pressure and pain) from this area to the brain, including from the upper teeth. It is these branches that have to be anaesthetised before painless dental treatment can be carried out on the upper teeth. The five branches are as follows, and their general anatomical paths are described below.

- **Anterior superior dental (alveolar) nerve**: supplies sensation from the upper incisor and canine teeth, and their labial gingivae. In addition, it supplies sensation from the soft tissues of the upper lip and around the nostrils of the nose.
- **Middle superior dental (alveolar) nerve**: supplies sensation from the upper premolar and the anterior half of the upper first molar teeth, and their buccal gingivae.
- **Posterior superior dental (alveolar) nerve**: supplies sensation from the posterior half of the upper first molar and the second and third molar teeth, and their buccal gingivae.

- **Greater palatine nerve**: supplies sensation from the palatal gingivae of the upper molar, premolar and posterior half of the canine teeth.
- **Nasopalatine nerve**: previously called the **long sphenopalatine nerve**, this supplies sensation from the palatal gingivae of the upper incisor and anterior half of the canine teeth.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1
3
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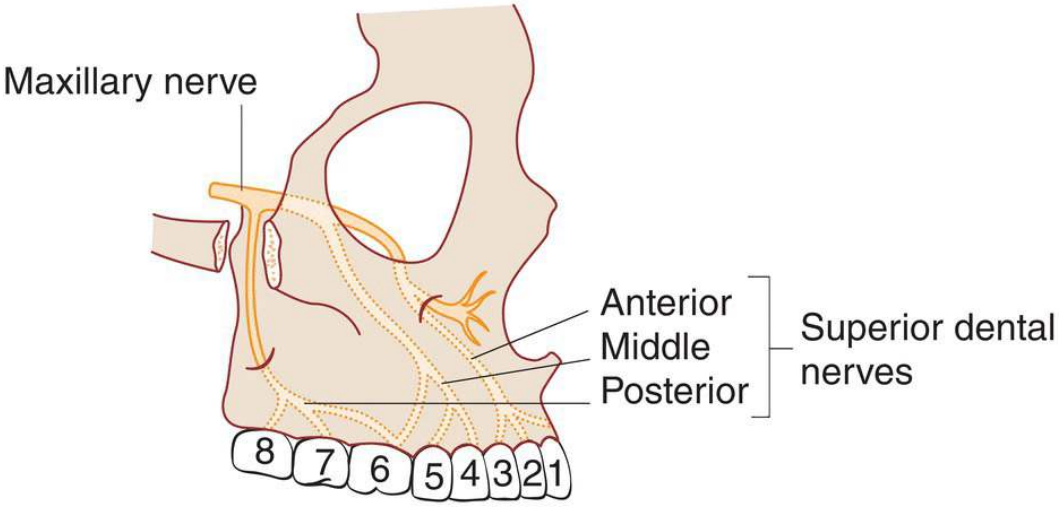
Nasopalatine nerve
Incisive foramen
Greater palatine nerve
Greater palatine foramen


Maxillary nerve
Anterior
Middle
Posterior
Superior dental nerves
8
7
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2
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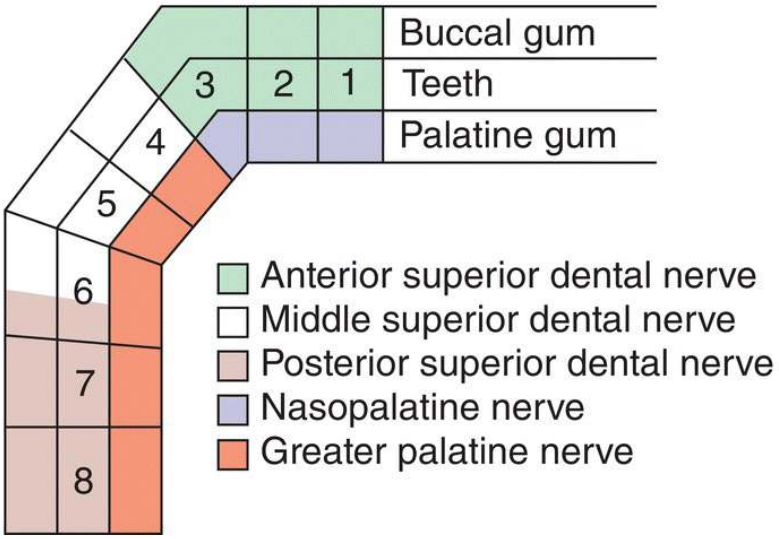
Buccal gum
Teeth
Palatine gum
3
2
1
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6
7
8
Anterior superior dental nerve
Middle superior dental nerve
Posterior superior dental nerve
Nasopalatine nerve
Greater palatine nerve

Figure 9.10 Nerve supply of the upper teeth and gingivae.

The maxillary nerve emerges from the base of the brain, leaves the skull through the *foramen rotundum* and passes forward through the floor of the eye socket (orbit). Before entering the orbit, it gives off its posterior superior dental and palatine branches. Within the orbit, it gives off the middle and anterior superior dental nerves. It emerges from the orbit through the *infraorbital foramen* on the front of the maxilla to supply the skin and mucous membrane of the lower eyelid, cheek and upper lip.

The posterior superior dental nerve enters the back of the maxilla to reach its destination, while the greater palatine nerve also passes through the back of the maxilla and reaches the surface of the hard palate through the *greater palatine foramen*, opposite the third molar tooth.

The nasopalatine nerve passes through the floor of the nasal cavity to reach the surface of the palate through the *incisive foramen* behind the central incisors, and the anterior and middle superior dental nerves branch off from the maxillary nerve in the floor of the orbit. They pass down inside the maxilla, in the walls of the maxillary sinus, to reach the teeth. The sensory nerve impulses from the upper teeth and their surrounding soft tissue structures pass from the nerve endings back along these nerve pathways to the maxillary nerve trunk, and then enter the skull and join the other two divisions (ophthalmic and mandibular) to form the trigeminal nerve trunk, which then enters the brain itself.

Mandibular division

The mandibular division of the trigeminal nerve emerges from the skull through the *foramen ovale* and splits into four branches which carry both sensory and motor components (Figure 9.11). The sensory branches of this nerve require anaesthetising before painless dental treatment can be carried out on the lower teeth. The four branches are as follows, and their general anatomical paths are described below.

- **Inferior dental (alveolar) nerve**: supplies sensation from all the lower teeth, and from the buccal or labial gingivae of all

except the molar teeth. In addition, it supplies sensation from the soft tissues of the lower lip and the chin.

- **Lingual nerve**: supplies sensation from the lingual gingivae of all the lower teeth, the floor of the mouth, and touch sensation from the anterior two-thirds of the tongue.
- **Long buccal nerve**: supplies sensation from the buccal gingivae of the lower molar teeth.
- **Motor branch**: supplies stimulation to the muscles of mastication, to effect jaw closing and chewing movements, and to the anterior digastric and mylohyoid muscles of the suprahyoids, to effect jaw opening and swallowing motions.

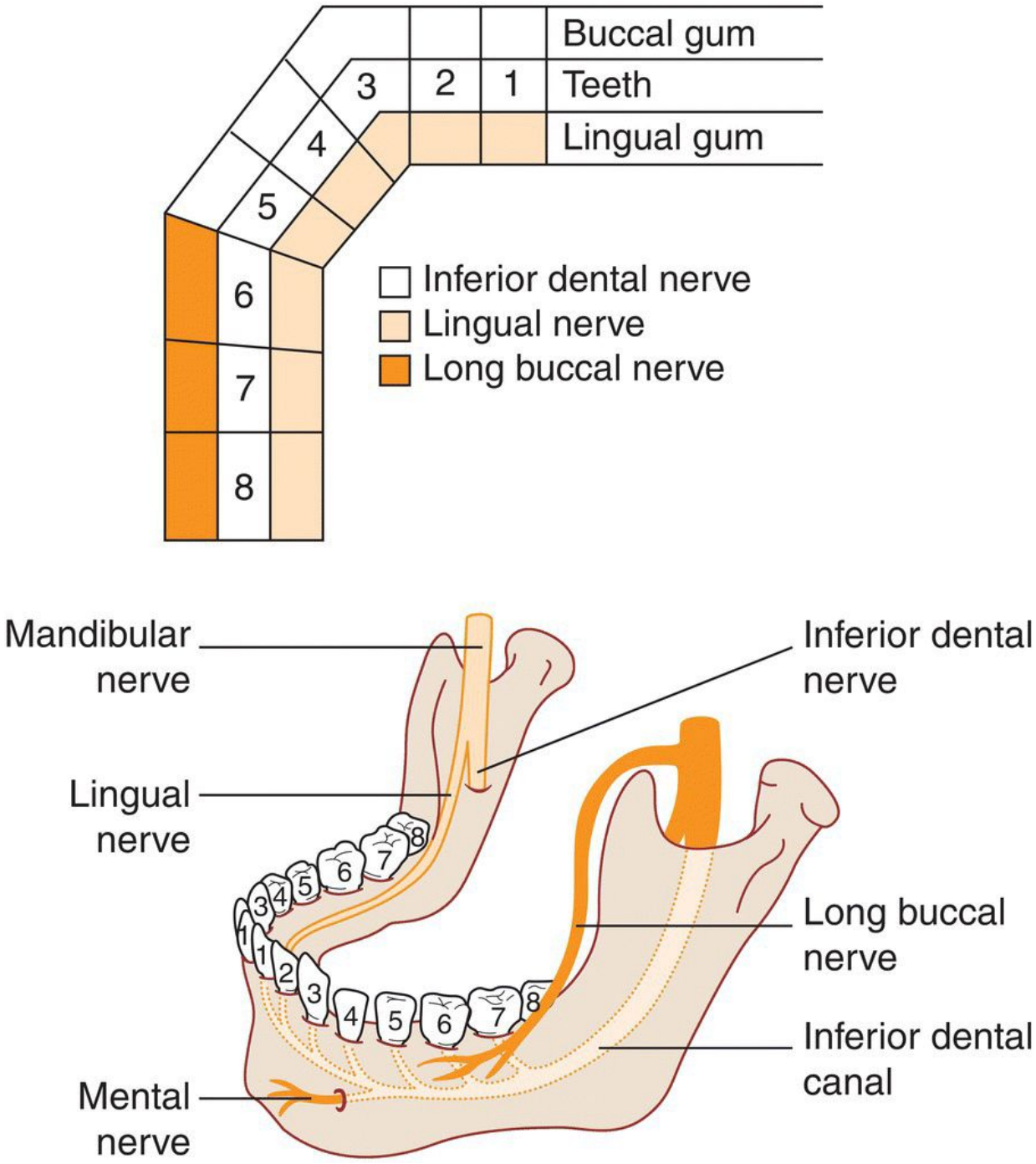


Figure 9.11 Nerve supply of the lower teeth and gingivae.

The mandibular nerve passes down from the base of the skull on the inner side of the ramus of the mandible, between the medial and lateral pterygoid muscles, and divides into the above branches.

The *inferior dental nerve* supplies all the lower teeth and enters the mandible through the *mandibular foramen*. This is situated at the

centre of the inner surface of the ramus and is guarded on its front edge by a small bony projection called the *lingula*. After entering the mandibular foramen, the nerve passes through a canal running inside the mandible, below the apices of the teeth. The end branch of the inferior dental nerve emerges on the outer surface of the mandible through the *mental foramen* which is situated below the apices of the premolars. From this point, it is called the *mental nerve* and supplies the buccal gum of the incisors, canines and premolars, plus the lower lip and chin.

The *long buccal nerve* supplies the buccal gum of the molars. It passes into the gum on the outer surface of the mandible, over the external oblique ridge.

The *lingual nerve* supplies the lingual gum of all the lower teeth. It passes along the floor of the mouth on the inner surface of the mandible, above the mylohyoid muscle, where it also supplies the anterior two-thirds of the tongue and the floor of the mouth.

The full distribution of the trigeminal nerve is shown in Figure 9.12.

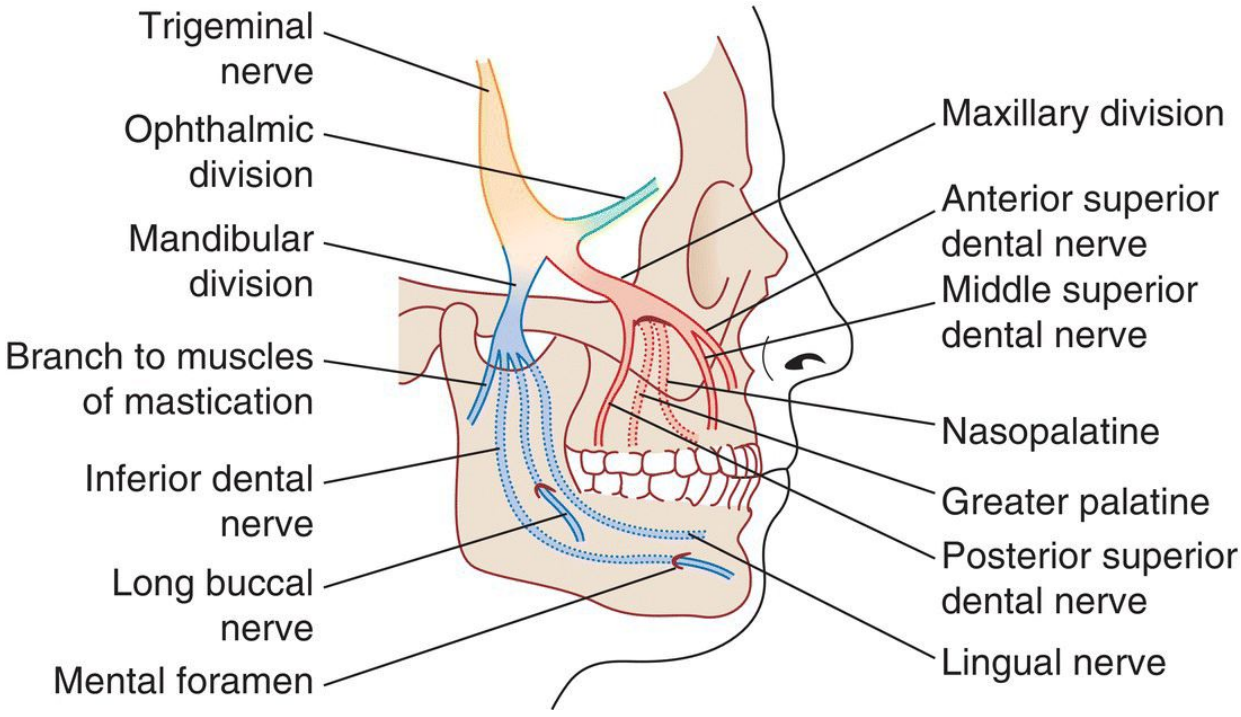


Figure 9.12 Trigeminal nerve distribution.

Trigeminal neuralgia

This is a condition affecting the sensory nerves of either the maxillary or mandibular divisions only of the trigeminal nerve, with no known cause. The sufferer experiences sudden-onset severe pain in various facial trigger zones, accompanied by muscle spasms in the area. The neuralgia can be initiated by touch, chewing movements or even speaking, and is usually of short duration.

Treatment is difficult without a known cause, and often drastic measures such as the surgical or chemical destruction of the sensory section of the nerve is undertaken, to relieve the debilitating symptoms.

Facial nerve

This is a combination nerve, carrying both sensory and motor fibres. Its sensory component carries taste sensation from the anterior two-thirds (front part) of the tongue, while its motor components supply the muscles of facial expression and the submandibular and sublingual salivary glands to effect secretion of saliva. Temporary paralysis of this nerve (left or right) gives rise to the condition of *Bell's palsy*.

Glossopharyngeal nerve

Again, this is a combination nerve. Its sensory component carries taste sensation from the posterior one-third of the tongue, while its motor component supplies the muscles of the pharynx and the parotid salivary gland to effect secretion of saliva.

Hypoglossal nerve

This nerve has a motor component only and supplies the muscles of the tongue, to effect its complicated movements during speech, mastication and swallowing.

As with all the cranial nerves, the electrical transmissions of these dentally relevant four can be affected by many disorders involving the brain, including tumours. Dental patients who complain of altered taste sensations or the sudden loss of facial sensations with no obvious cause require rapid neurological investigations to rule out any sinister causes. The dental team has a significant role to play in

detecting these aberrations, and in referring patients for more specialist investigation and diagnosis.

Blood supply to the head and neck

The blood vessels involved in supplying arterial blood to an area and removing venous blood from it tend to run alongside the nerves of the area, as *neurovascular bundles*, so each bundle consists of all three vessels. This arrangement tends to occur throughout the body and, conveniently for the medical professions, ensures that the vessels can be more easily located than if they all ran along their own courses. Similarly, they may also enter and leave the bony cavities of the skull through the same foramina and fissures as do the nerves.

The names of the various blood vessels of the oral cavity are not required knowledge for dental nurses, but they tend to follow the nerve nomenclature covered previously by being named after their area of supply, as a general rule. So the artery supplying the maxillary portion of the face is, unsurprisingly, the maxillary artery, while the vein associated with the same area is the maxillary vein, and so on.

The major arteries carrying oxygenated blood to the head and neck region are the *common carotid arteries*, which are direct branches from the arch of the aorta as it leaves the left ventricle of the heart (see Chapter 5). These travel up the left and right sides of the neck and are palpable against either side of the larynx as the carotid pulse, often taken by professional resuscitation personnel during medical emergencies. Around this position of palpation, the common carotids divide into the following two major arteries:

- **External carotid artery**: supplying all the head outside the cranium, including the face and the oral cavity.
- **Internal carotid artery**: supplying all the inner cranial structures, including the brain and the eyes.

Once the usual gaseous exchange has occurred in the capillary beds of the head and neck region, deoxygenated blood tends to flow from small venules into gradually widening veins, until they reach the main venous vessels of the area.

- **External jugular vein**: draining a small area of extracranial tissues only.

- **Internal jugular vein**: draining the brain and the majority of the head and neck tissues.

These veins run on and eventually join the superior vena cava and enter the right side of the heart, where the deoxygenated blood that they carry is pumped to the lungs for reoxygenation.

The flow of deoxygenated blood from the head and neck region is not always in one direction, as occurs in other areas of the body. This is because the veins of this area usually do not contain the one-way valve system present in the majority of venous vessels, so blood can flow forwards and backwards depending on changes affecting the local pressure.

Generally, then, it is easier for localised infections to spread in the head and neck regions than elsewhere in the body. The seriousness of this statement is compounded further by the fact that the blood travels through the most important organ of the body, the brain, and that pathogens may enter the area in a variety of ways.

- Inhaled through the nose or mouth.
- Ingested through the oral cavity.
- Carried there by the circulatory or lymph systems.
- Traumatically deposited through the soft tissues, such as during dental treatment, local anaesthetic injection or following head and neck injury.

The maintenance of high standards of infection control in the field of dentistry is therefore of paramount importance to avoid introducing pathogens into the patient's head and neck region during the delivery of dental treatment, and the topic is of great concern to the whole oral healthcare team.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

10
Oral Anatomy and Physiology

Key learning points

A **factual knowledge** of

- the gross anatomy of the tissues and structures of the oral cavity
- the microscopic anatomy of teeth and their supporting structures

A **working knowledge** of

- the functions of the tissues and structures of the oral cavity
- the morphology and functions of teeth
- the salivary glands

The oral cavity contains many anatomical structures besides the teeth, and to gain a full understanding of the topics of oral health and disease the dental nurse must have knowledge of all these structures. The bones, muscles, nerves and blood supply to this region are discussed in Chapter 9; this chapter will focus on the following specific anatomical structures and their physiology (that is, their biological activities and functions):

- Oral soft tissues and soft palate.
- Tongue.
- Teeth.
- Supporting structures of the periodontium.
- Salivary glands.

Soft tissues of the mouth

Epithelial membrane

The whole of the mouth is lined with epithelial mucosal tissue as a type of mucous membrane, which is continuous with that lining the digestive tract. Throughout the oral cavity there are three types of this membrane, each with its own particular features.

- Lining membrane.
- Masticatory membrane.
- Specialised membrane.

Their details are shown in Table 10.1. The first row identifies the area of the oral cavity where each type of epithelial membrane is normally found, while the second row describes its appearance in each case. The final row explains the function(s) of the membrane in relation to its appearance, so the ridged nature of the masticatory membrane, for example, and its firm underlying attachment are explained by its function of providing a hard-wearing surface that can withstand the regular abrasive contact it has with food.

Table 10.1 Oral mucous membranes.

Lining membrane	Masticatory membrane	Specialised membrane
Covers inner surfaces of the cheeks and lips, floor of the mouth, underside of the tongue, soft palate	Covers gingivae, topside and edges of the tongue, hard palate	Interspersed throughout the masticatory membrane covering of the topside and edges of the tongue
Appears as red, smooth and moist membrane, which can be squashed and stretched Contains minor salivary glands	Appears as red, moist membrane, often ridged or stippled, firmly attached to underlying structures; forms the **mucoperiosteum** where it lies over the alveolar processes	Appear as discrete papillary structures of the taste buds, in a visible pattern over the tongue
Provides a physical barrier between anything entering the mouth and the deep structures of the oral cavity, acts as a cushion, provides lubrication and cleansing	Provides a hard-wearing surface that prevents traumatic damage from food, chemicals, oral hygiene products, etc.	Provides taste sensation

Within the oral cavity, the space between the posterior teeth and the mucous membrane lining the cheeks is called the *buccal sulcus* whilst that between the anterior teeth and lips is the *labial sulcus*. The upper lip is attached to the centre of the gingiva above the central incisors by a band of fibrous tissue called a *frenum*, and when this attachment is thicker than usual there is often a space created between the two incisor teeth, called a *median diastema*.

Soft palate

The soft palate is a flap of soft tissue attached to the back of the hard palate. Its function is to seal off the oral cavity from the nasal cavity during swallowing, in order to prevent food passing up into the nose. The free edge of the soft palate has a central prolongation called the *uvula*. You can see this for yourself by looking in a mirror with your mouth wide open. To either side of this area at the back of the mouth, called the *oropharynx*, lie the tonsils which appear as small ball-like structures with a pitted surface (Figure 10.1). They are most noticeable when inflamed during a throat infection, such as *tonsillitis*.

Figure 10.1 Uvula with tonsils either side and oropharynx behind.

Tongue

The floor of the mouth lies within the arch of the mandible and is occupied by the tongue, which is a muscular organ situated in the oral cavity and extending behind into the throat. The posterior one-third section, called the base of the tongue, is the section which lies in the throat and attaches to the floor of the mouth. It is relatively firmly attached and is mainly concerned with swallowing movements. The correct term for swallowing is *deglutition*.

The remaining anterior two-thirds of the tongue, called the body, lie within the oral cavity and this section is relatively moveable, being able to perform numerous convoluted movements, as it is composed of many bands of muscle lying in various directions. It is attached to the floor of the mouth by a thin band of fibrous tissue called the *lingual frenum*. Where excess of this fibrous tissue occurs, the tongue is held more rigidly than normal so that its movements are restricted, and the person affected is often described as 'short-tongued' or 'tongue-tied' due to the lisp created as they speak. The body of the tongue is concerned with taste, chewing activities and speech.

All the muscles of the tongue are innervated by the hypoglossal nerve (12th cranial nerve).

The functions of the tongue are as follows:

- **Speech**: by allowing certain sounds to be created by touching the tongue to the upper anterior teeth or the palate (such as 's', 't', 'n', 'the'). Other speech sounds are made by contact between the lips or the lips and teeth (such as 'b', 'f', 'v', 'w').
- **Taste**: the tongue is covered by various different types of taste buds (including *filiform papillae*, *fungiform papillae* and *vallate papillae*; Figure 10.2) that allow recognition of the four basic tastes: sweet, sour, salt and bitter.
- **Aids mastication**: by assisting the buccinator muscles of the cheeks to package ingested food into a parcel, or *bolus*, for easier chewing before swallowing.
- **Aids swallowing**: by guiding the bolus to the back of the mouth, the oropharynx.

- **Cleansing**: by moving around the oral cavity and the smooth surfaces of the teeth to dislodge food particles.

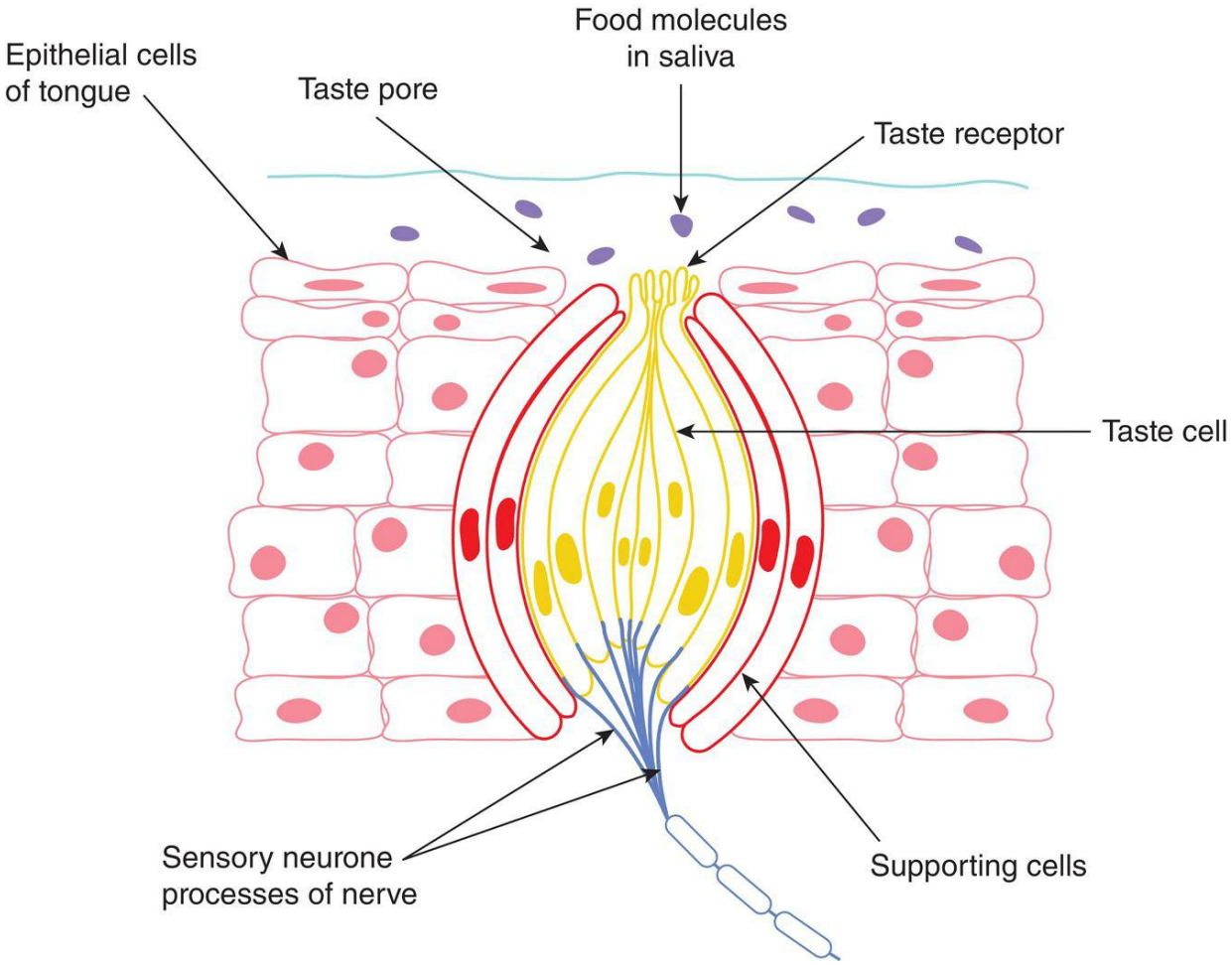


Figure 10.2 Diagrammatic representation of a taste bud.

The lining epithelium of mucous membrane covering the underside of the tongue is so thin that it allows the very rapid absorption of drugs placed here into the underlying capillaries of the tongue. Patients given GTN tablets or spray for the treatment of angina pectoris use their medications in this way. The huge numbers of blood vessels supplying the oral cavity also allow the rapid absorption and distribution of other drugs, such as midazolam gel administered buccally during a prolonged epileptic seizure.

Swallowing

Swallowing is a complex muscular action which aims to direct the food bolus into the oesophagus while also preventing it from entering the nasal cavity or the larynx. The bolus is mixed with saliva to lubricate it, and then propelled by the tongue from the mouth to the oropharynx, and then into the oesophagus. The sequence of events in the swallowing process is as follows (see Figure 5.11):

- The lubricated ball of food is propelled backwards to the oropharynx by the actions of the body of the tongue.
- The soft palate rises up and seals off the nasopharynx from the oropharynx, to prevent the bolus from passing upwards into the nose.
- At the same time, the larynx lifts up and is sealed by the epiglottis to prevent the bolus passing into the trachea and being inhaled into the lungs.
- The bolus is propelled downwards from the oropharynx by the base of the tongue, and to the oesophagus by the throat muscles.
- Oesophageal muscles then move the bolus downwards by peristalsis into the stomach.

Disorders of the tongue

Glossitis

This is soreness and inflammation of the tongue, and can occur in conditions such as anaemia, vitamin B deficiency and hormonal disturbances (including pregnancy). It is associated with a thin, smooth, glazed appearance of the normally thick layer of mucous membrane on its upper surface.

Dysphagia

This is the condition of having difficulty in swallowing, which occurs relatively frequently and has several causes.

- **Psychological**: an inability to swallow (usually) medication in tablet form, although food and drink can be swallowed normally by the patient.

- **Xerostomia**: dry mouth syndrome, where reduced salivary flow prevents adequate bolus lubrication.
- **Oesophagitis**: inflammation of the oesophagus, often due to acid reflux.
- Other conditions affecting pharyngeal or oesophageal function, including cancers.
- Central nervous system disorders preventing correct muscle innervation, such as stroke and multiple sclerosis.

Teeth

The teeth are the anatomical structures within the oral cavity that are of the greatest relevance to the dental team, as their development, health, disease and restoration are the fundamentals of dentistry. The teeth have the following functions:

- To cut up and masticate food into suitably sized portions before swallowing.
- To expose the food surfaces to enzymes and allow digestion to begin.
- To support the oral soft tissues of the cheeks and tongue, and therefore enable clear speech.

Humans have two sets of teeth: the primary (deciduous) teeth of childhood and the secondary (permanent) teeth of adulthood. The number and type of teeth in each set differ, although the shape of the common ones is the same. The detailed anatomical shape of each tooth, and its function, is called *tooth morphology*.

The four types present in the secondary dentition, from the midline of the mouth posteriorly, are as follows:

- **Central and lateral incisors**
- **Canine**
- **First and second premolars**
- **First, second and third molars**

The primary dentition has just two molars and is made up of just three different types of teeth – there are no premolars present.

Each tooth of all types, and in both sets, has three sections: the crown, the neck and the root(s). The *crown* is the section of the tooth visible in the oral cavity, following its eruption from the underlying alveolar bone. The *neck* is the section where the tooth and the gingival tissues are in contact with each other at the point where the tooth emerges through the gums, and the *root* is the (usually) non-visible section that holds the tooth in its bony socket. Roots may become exposed to

the oral cavity when gingival recession occurs – the attachment of the gingivae moves down the tooth towards its apex, so that sections of the root are visible in the mouth. This often occurs naturally during the ageing process, but can also be due to incorrect toothbrushing or periodontal disease.

All teeth are composed of the same four tissues.

- **Enamel**: a highly calcified tissue covering the whole crown of the tooth.
- **Dentine**: a less calcified tissue than enamel, which forms the inner bulk of the crown and root.
- **Cementum**: a thin calcified covering of the root dentine only.
- **Pulp**: the inner neurovascular tissue of the tooth, within the central pulp chamber.

The structure of a typical tooth is shown in Figure 10.3.

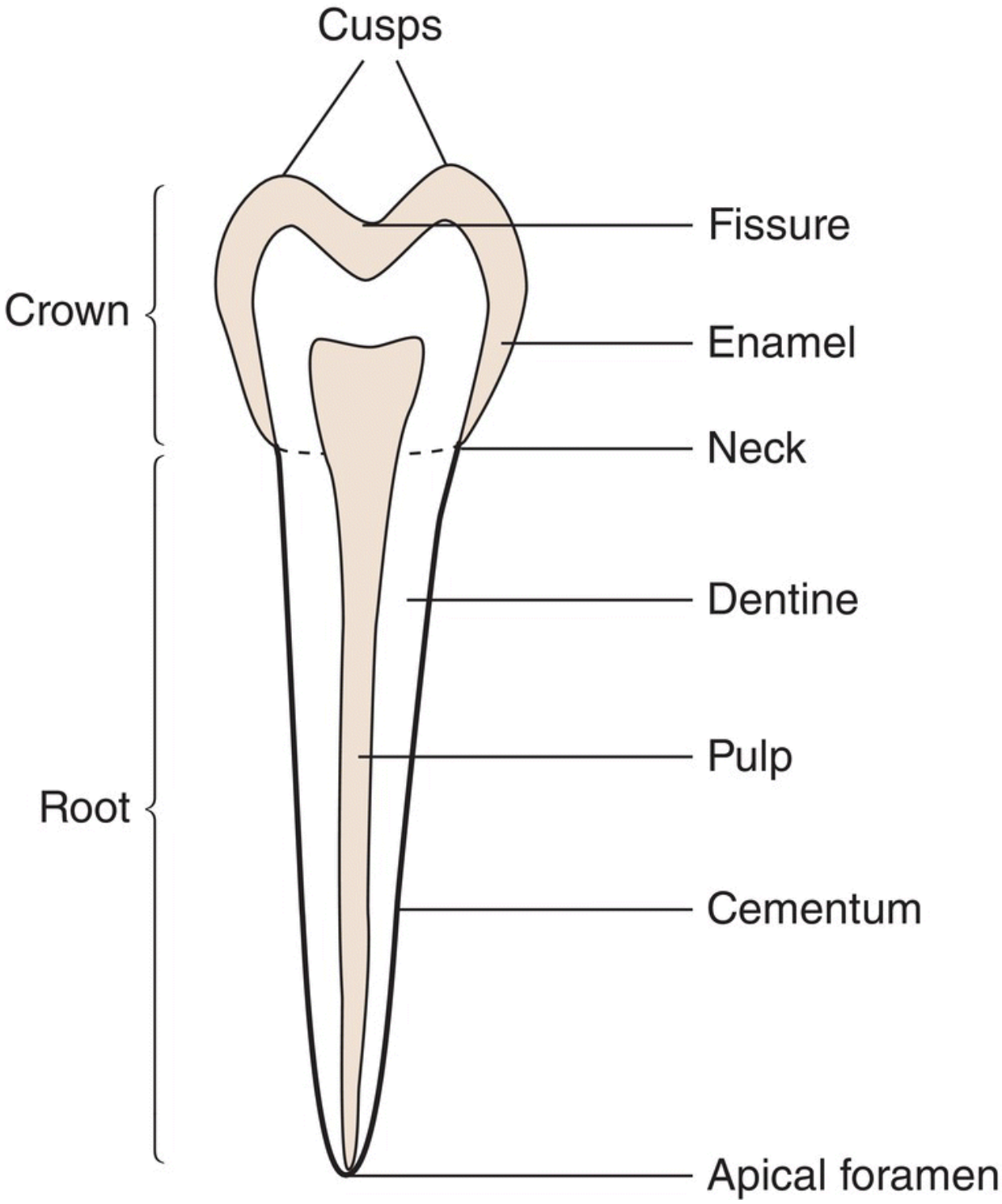


Figure 10.3 Structure of a tooth (note that incisors have an incisal edge rather than cusps).

Microscopic structure of the teeth

The differences in the microscopic structure of the four layers of the teeth are what determine how they function, how they develop disease, how they are treated for that disease, and how they are restored or extracted by the dental team.

Enamel

This is the highly calcified, protective outer covering of the crown and is the hardest substance in the body. Its properties and microscopic structure are as follows:

- It is composed of 96% mineral crystals (inorganic) arranged as **prisms** in an organic matrix called the **interprismatic substance**.
- The main mineral crystals are **calcium hydroxyapatite**.
- The prisms lie at right angles to the junction with the next tooth layer, the **dentine**.
- The junction between these two layers is called the **amelodentinal junction** (ADJ).
- Enamel is formed before tooth eruption by the **ameloblast cells**, which lie at the ADJ.
- It contains no nerves or blood vessels and therefore cannot experience any sensation.
- It is a non-living tissue which cannot grow and repair itself, so progressive damage caused by injury, erosion or tooth decay is permanent.
- It can, however, remineralise its surface after an acid attack, by taking in minerals from saliva and from oral health products such as toothpaste and mouthwash.
- The crystal structure can also be altered without undergoing acid attack, by the exchange of hydroxyl ions in the hydroxyapatite with **fluoride**, to form **fluorapatite crystals**. These make the enamel surface harder and more resistant to acid attack.
- The enamel layer is thickest over the biting surface of the tooth (the occlusal surface or the incisal edge) and thinnest at the neck of the tooth (the cervical margin).

- It is translucent, so the shade of a tooth is determined by the colour of the underlying dentine.

Dentine

This tissue forms the main bulk of a tooth and occupies the interior of the crown and root. It is also mineralised, but to a lesser extent than enamel, and is covered by enamel in the crown of the tooth and by cementum in the root of the tooth. Its properties and microscopic structure are as follows:

- It consists of up to 80% inorganic tissue, mainly **calcium hydroxyapatite** crystals.
- It is composed of **hollow tubes** which originally surrounded the cells within the dentine structure as it was first being formed.
- In a fully formed tooth, these **odontoblast** cells lie along the inner edge of the pulp chamber only, but are present throughout life and can lay down more dentine as required.
- In this way, it can repair itself by laying down secondary dentine.
- This type of dentine is also formed as part of the natural ageing process, and its formation gradually narrows the pulp chamber.
- The hollow tubes contain sensory nerve endings called **fibrils**, which run from the nerve tissue within the pulp chamber.
- Dentine is therefore a living tissue and can transmit sensations of pain, pressure and thermal changes to the brain.
- Its hollow structure allows it a degree of elasticity so that it can absorb normal chewing forces without breaking.
- However, it also allows tooth decay (**caries**) to spread more rapidly through its hollow structure than it does through solid enamel.
- Dentine is a yellowish colour, and gives teeth their individual shade.

Cementum

This is the calcified protective outer covering of the root and is similar in structure to bone. Cementum meets enamel at the neck of the tooth, and normally lies beneath the gingivae. Its properties and microscopic structure are as follows:

- Around 65% mineralised, with calcium hydroxyapatite crystals.
- The crystals lie within a matrix of fibrous tissue, with the ends of collagen fibres from the periodontal ligament inserted into the outer layer of the cementum.
- This allows the attachment of the root to the periodontal ligament, and therefore to the walls of the tooth socket.
- The cementum is formed by cells called **cementoblasts** and they can continue laying down more tissue layers when required.
- The thickness of cementum may vary at different parts of the root, and changes throughout life, depending on the forces exerted on individual teeth.
- The point where the cementum and the root dentine are in contact with each other is called the **dentinocemental junction**.
- The cementum contains no nerves or blood vessels itself, so it receives nutrients from the periodontal ligament.

Pulp

Unlike enamel, dentine and cementum, the pulp contains no mineral crystals and is composed purely of soft tissue. It lies within the very centre of every tooth, from the crown as the coronal pulp and into each root as the radicular pulp. The radicular pulp is often referred to as the ‘root canal’ of the tooth. The properties and microscopic structure of the pulp are as follows:

- The pulp contains sensory nerves and blood vessels.
- The sensory nerves are end sections of the trigeminal nerve (fifth cranial nerve), either as the inferior dental nerve for the lower teeth or one of the superior dental nerves for the upper teeth.

- They allow the tooth to feel hot, cold, touch and pain by the stimulation of its sensory nerve endings which run as fibrils in the hollow dentine tubules.
- These pulp tissues enter the tooth through the **apical foramen**, lying at the root apex of every tooth.
- The pulp chamber itself is lined by the odontoblast cells which form dentine.
- The chamber gradually narrows with age, so that it can become completely obliterated in older patients, making endodontic treatment very difficult.
- It can also become blocked by **pulp stones** which are formed by lumps of calcium-containing crystals.
- Some teeth have additional contact between the pulp and the surrounding periodontal ligament via accessory canals, whose presence can make successful endodontic treatment of the tooth very difficult to achieve.

Tooth morphology

All people have two sets of teeth: the first (primary) or *deciduous* teeth, and the second (secondary) or *permanent* teeth. All have different appearances or morphology, which depends on the set and the individual teeth themselves. Their morphology enables each tooth to be individually identified by any trained member of the dental team, this identification being based on the tooth shape and size, the number of cusps present, and the number of roots present. Curvature of the roots will also help to indicate whether a tooth is from the right or the left side of the dental arch.

Deciduous teeth

The deciduous teeth are the first set and are also known as milk, temporary or primary teeth (Figure 10.4).

- Total set of **20 teeth**, 10 in each jaw.
- They begin developing in the jaws of the early embryo, around 6 weeks after conception.

- They are referred to in dentistry by letter – **A**, **B**, **C**, **D** and **E** – starting from the midline of the jaw.
- They are **smaller** than permanent teeth, and **whiter** in colour.
- Their roots are **resorbed** by the underlying permanent teeth as they move into position to erupt, and the deciduous teeth gradually loosen and fall out. This natural loss of the deciduous teeth is called **exfoliation**.
- The roots of the deciduous molars are splayed out to accommodate the presence of the underlying permanent premolar teeth, so the roots are described as **divergent**.
- They have a **larger pulp chamber** than the permanent teeth, with **thinner enamel**, which makes them more prone to the development of dental caries.
- They begin erupting at around 6 months of age, and are usually all present by about 29 months, although individual variation does occur.

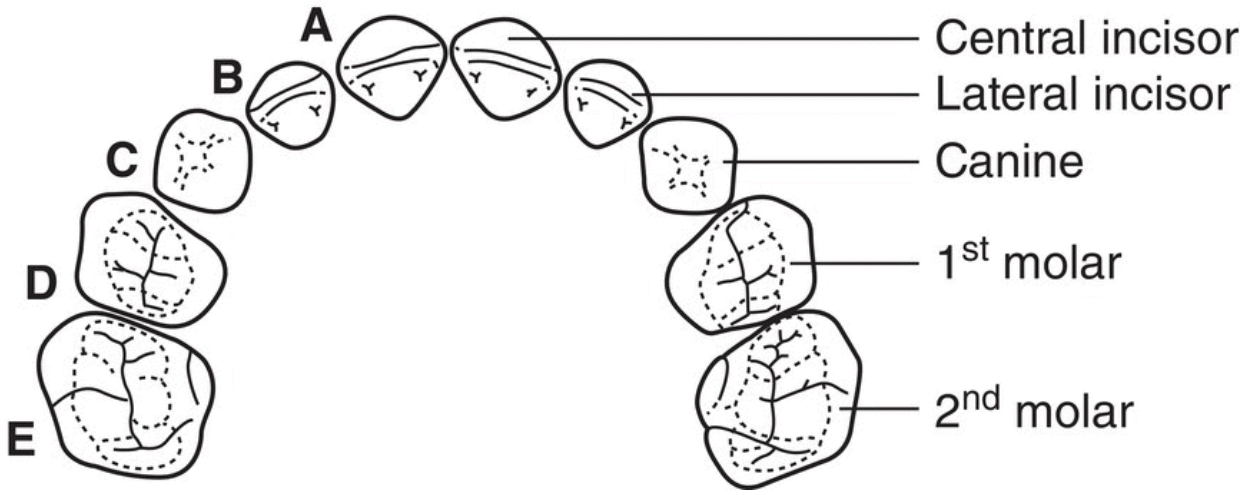


Figure 10.4 Deciduous teeth.

The five deciduous teeth present in each quadrant of the oral cavity are the *central and lateral incisors*, the *canine*, and the *first and second molars*. There are no premolar teeth in the primary dentition. Their tooth and root morphology is summarised in Table 10.2.

Table 10.2 Primary dentition: tooth and root morphology.

Tooth	Letter	Number of roots	Number of cusps (where applicable)
Uppers			
Central incisor	A	One	N/A
Lateral incisor	B	One	N/A
Canine	C	One	N/A
First molar	D	Three	Four
Second molar	E	Three	Five
Lowers			
Central incisor	A	One	N/A
Lateral incisor	B	One	N/A
Canine	C	One	N/A
First molar	D	Two	Four
Second molar	E	Two	Five

The three roots of the upper molars are arranged as a tripod, with the developing permanent premolar teeth lying within this area, while the two roots of the lower molars lie one in front of the other in the alveolar bone of the mandible. The average eruption dates of the deciduous teeth, in months, are shown in Table 10.3.

Table 10.3 Average eruption dates of the deciduous teeth.

Tooth	Letter	Uppers in months	Lowers in months
Central incisor	A	10	8
Lateral incisor	B	11	13
Canine	C	19	20
First molar	D	16	16
Second molar	E	29	27

The usual eruption pattern of the deciduous dentition is the lower central incisors first, followed by the other incisors, then the first molars followed by the canines, and finally the second molars.

The dentition begins changing again at about 6 years of age, when the permanent teeth begin to erupt by resorbing the roots of their deciduous predecessors and causing their exfoliation.

Permanent teeth

Permanent teeth are the second and final set, and are also called the adult teeth (Figure 10.5).

- Total set of **32 teeth**, 16 in each jaw.
- They begin developing in the jaws just before birth, and continue for many years afterwards.
- They are referred to in dentistry by number – **1**, **2**, **3**, **4**, **5**, **6**, **7** and **8** – starting from the midline of the jaw.
- They are of very similar morphology to the deciduous teeth, with eight extra teeth called **premolars** present, two in each quadrant.
- They are **larger** in size and **darker** in colour than deciduous teeth, with relatively **smaller pulp chambers**.
- The three permanent molar teeth in each quadrant develop behind the deciduous teeth, using the space created as the jaws grow during childhood and the teenage years.

- So the **deciduous molar teeth** are succeeded by the **permanent premolar teeth**.
- It is relatively common for some adult teeth to be **congenitally missing** from the dentition, especially the third molars.
- They begin erupting at around 6 years of age, and all except the third molars are usually present by the age of 13 years.
- The third molars may be congenitally missing, present but unerupted due to lack of jaw space, or they may erupt from the age of 18 years onwards.

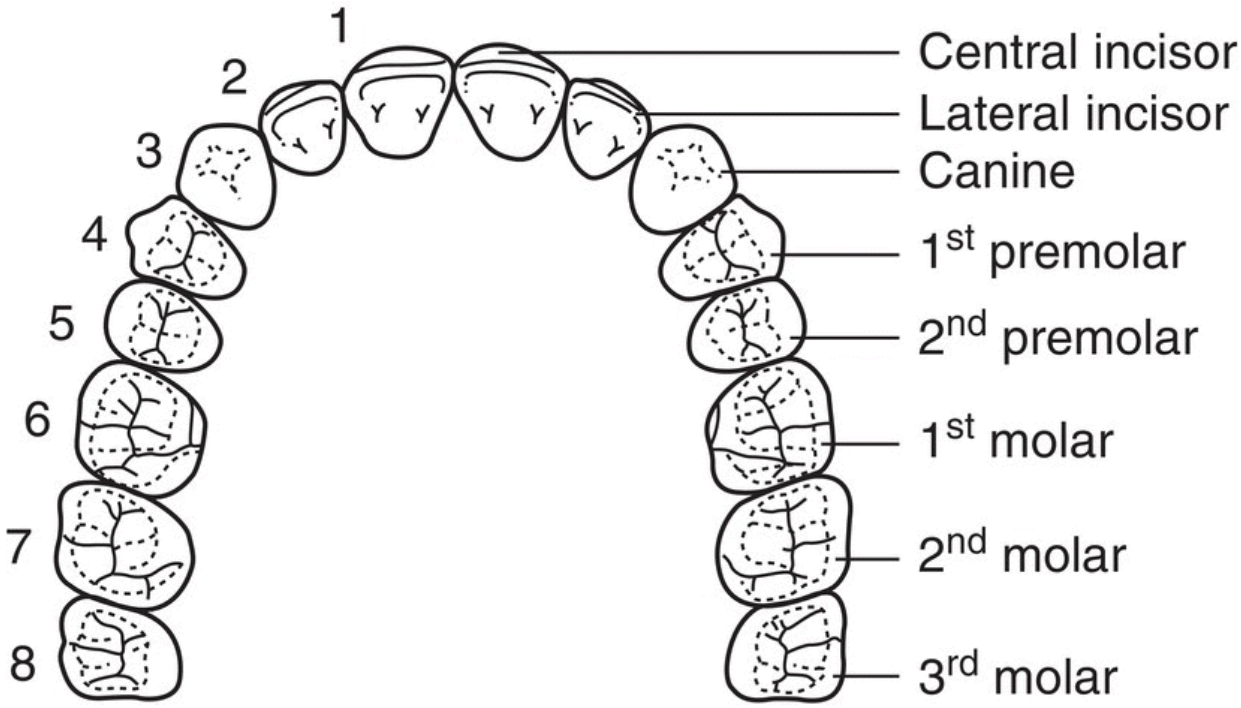


Figure 10.5 Permanent teeth.

The eight permanent teeth present in each quadrant of the oral cavity are the *central and lateral incisors*, the *canine*, the *first and second premolars*, and the *first, second and third molars*. Their tooth and root morphology is summarised in Table 10.4.

Table 10.4 Permanent teeth: tooth and root morphology.

Tooth	Number	Number of roots	Number of cusps (where applicable)
Uppers			
Central incisor	1	One	N/A
Lateral incisor	2	One	N/A
Canine	3	One	N/A
First premolar	4	Two	Two
Second premolar	5	One	Two
First molar	6	Three	Five
Second molar	7	Three	Four
Third molar	8	Three	Four
Lowers			
Central incisor	1	One	N/A
Lateral incisor	2	One	N/A
Canine	3	One	N/A
First premolar	4	One	Two
Second premolar	5	One	Two
First molar	6	Two	Five
Second molar	7	Two	Four
Third molar	8	Two	Four

Again, the three roots of the upper molars are arranged as a tripod (one palatal, one mesiobuccal and one distobuccal), and the two roots of the lower molars lie one in front of the other (one mesial and one distal) in the alveolar bone of the mandible. The two roots of the upper first premolar teeth lie across the maxillary alveolar bone (one buccal and one palatal). The average eruption dates of the permanent teeth, in years, are shown in Table 10.5.

Table 10.5 Average eruption dates of the permanent teeth.

Tooth	Number	Uppers in years	Lowers in years
Central incisor	1	7–8	6–7
Lateral incisor	2	8–9	7–8
Canine	3	10–12	9–10
First premolar	4	9–11	9–11
Second premolar	5	10–11	9–11
First molar	6	6–7	6–7
Second molar	7	12–13	11–12
Third molar	8	18–25	18–25

Permanent teeth erupt before their roots are fully grown. About two-thirds of their root length has formed by the time of their eruption and the apex is still wide open. It takes another 3 years before root growth is complete and the apex closes. The only exceptions are canines and third molars which do not erupt until root growth is complete.

Surfaces of the teeth

To enable the dental team to describe and discuss individual teeth and the treatment they may require, each surface of every tooth has its own name in relation to the midline of each jaw, and the anatomical structures that they sit against. It is this *tooth surface nomenclature* that allows the charting of every patient to be recorded accurately, a key task of the dental nurse.

Charting is discussed in detail in Chapter 12, as it forms an important part of oral health assessment techniques.

The general terminology used for describing the tooth surfaces is summarised below.

- **Labial**: surface adjacent to the lips, applies in both arches and relates to incisor and canine teeth.
- **Buccal**: surface adjacent to the buccinator muscle of the cheeks, applies in both arches and relates to premolars and molars.
- **Palatal**: surface adjacent to the palate, applies to all maxillary teeth.
- **Lingual**: surface adjacent to the tongue, applies to all mandibular teeth.
- **Mesial**: interdental surface of all teeth closest to the midline of each arch, so the front interdental surface (Figure 10.6).
- **Distal:** interdental surface of all teeth furthest from the midline of each arch.
- **Contact point**: the point where the mesial and distal surfaces of adjacent teeth are in contact with each other.
- **Incisal:** biting edge of anterior teeth, applies to both arches and relates to incisors (canines have a cusp rather than an edge).
- **Occlusal**: biting surface of posterior teeth, applies to both arches and relates to premolars and molars (Figure 10.7).
- The sharply raised points of the occlusal surfaces are called **cusps**, and the crevices between them are the **fissures**.
- **Cervical**: the neck region of any tooth, on the buccal, labial, palatal or lingual surface.

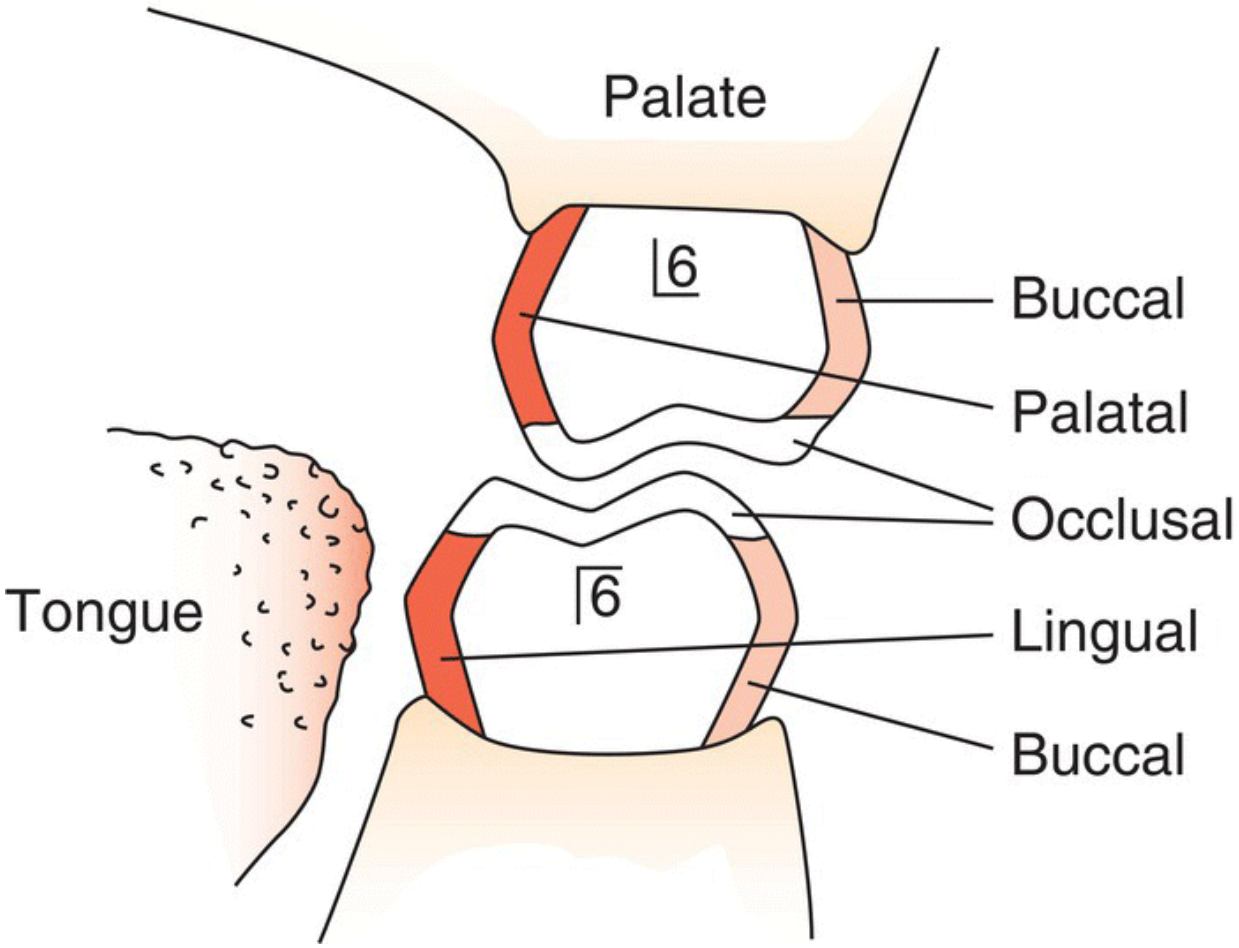


Figure 10.6 Surfaces of the teeth: mesial aspect.

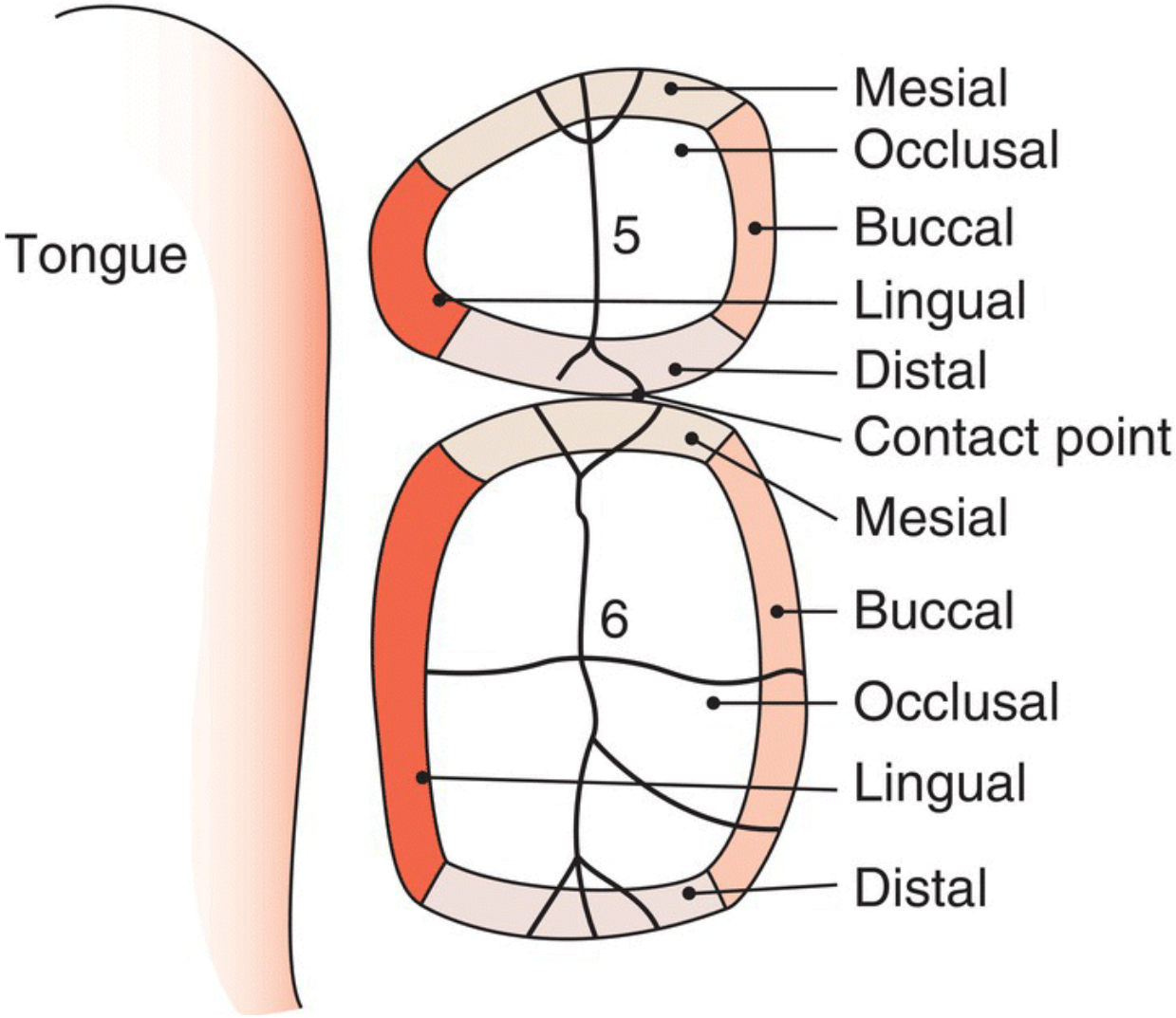


Figure 10.7 Surfaces of the teeth: occlusal aspect.

Using these named surfaces, the anatomy of individual teeth can be described in detail.

Anatomy of individual teeth

A collection of extracted teeth in good condition is a great help in learning dental anatomy and tooth morphology, but they are more difficult to acquire nowadays due to infection control issues. The secondary dentition is shown diagrammatically for clarity in Figure 10.8, and various extracted teeth are shown in Figure 10.9.

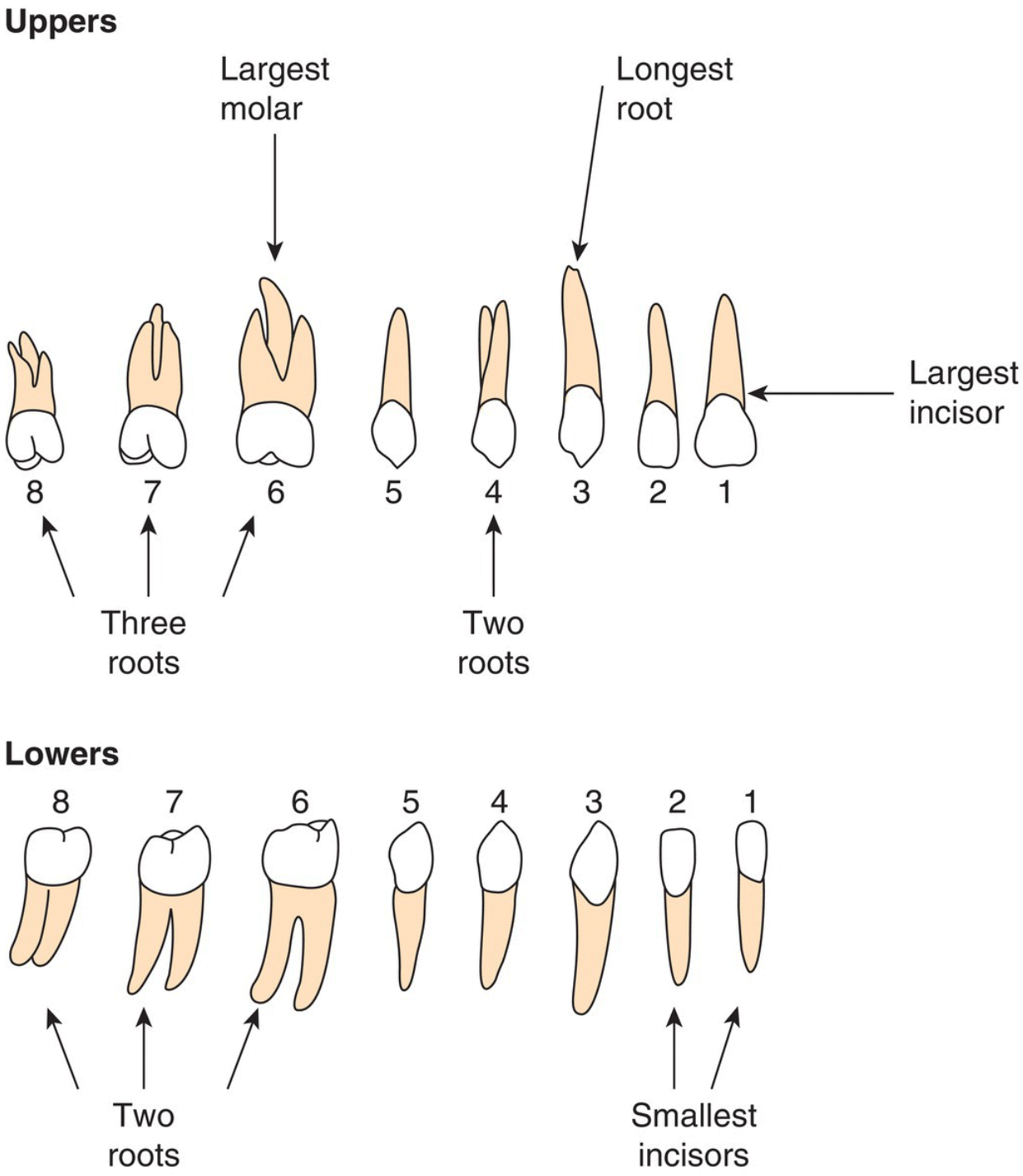


Figure 10.8 Tooth anatomy.

Figure 10.9 Features of individual teeth. (a) Upper right lateral incisor. (b) Upper right central incisor. (c) Lower left central incisor. (d) Lower left lateral incisor. (e) Upper right canine. (f) Lower left canine. (g) Upper right second premolar. (h) Upper right first premolar. (i) Lower left second premolar. (j) Lower left first premolar. (k) Upper right third molar. (l) Upper right second molar. (m) Upper right first molar. (n) Lower right first molar. (o) Lower left second molar. (p) Lower left third molar.

In the primary dentition there are five teeth in each quadrant of the mouth: central and lateral incisors, a canine, and first and second molars.

In the secondary dentition there are eight teeth in each quadrant: central and lateral incisors, a canine, first and second premolars, and first, second and third molars. The morphology and function of the similar teeth in each dentition are the same.

Central incisor

- Chisel-shaped crown with an incisal biting edge.
- Single root.
- Palatal or lingual surface has a raised area called the **cingulum**.
- Upper permanent central incisor is the **largest** of all incisors.
- Lower central incisor is the **smallest tooth**.
- Functions are to:
  - cut into food and separate bite-size chunks from the food product
  - assist tongue in making certain speech sounds ('th')
  - assist lips in making certain speech sounds ('f').

Lateral incisor

- Narrow, chisel-shaped crown with an incisal biting edge.
- Single root.
- Lower lateral incisor sometimes has a second (lingual) root canal, especially if the root has split into two.
- Palatal or lingual surface has a cingulum.
- Function is to bite in a scissor action with the upper incisors, and break off separate bite-size portions.
- Uppers can be congenitally absent or develop as abnormally small teeth, often called **peg laterals**.

Canine

- Robust tooth forming the 'corner' of each dental quadrant.

- Incisal edge is sloped to a sharp cusp tip that lies more mesially than distally.
- Single root and the **longest** of all teeth.
- Root apex sometimes curves distally slightly.
- Upper and lower canines have a cingulum, the upper is joined to the cusp tip by a palatal ridge.
- Functions are to:
    - pierce food and tear into it
    - support the oral soft tissues at the 'corners' of the oral cavity
    - provide 'guidance' for normal occlusion, especially when the mandible is moved sideways.

First premolar

- Not present in primary dentition.
- Are the permanent successors to the deciduous first molars.
- Has occlusal surface arranged as two cusps lying buccally and palatally, or buccally and lingually (upper or lower).
- Cusps are of equal height in uppers, but lingual is always smaller in lowers.
- Mesial and distal edges of all are raised into **marginal ridges**.
- Upper has two roots lying in the same orientation as the cusps.
- Root apices sometimes curve distally.
- Concavity between the roots mesially is called the **canine fossa**, and can be a harbour for micro-organisms and calculus in patients with periodontal disease.
- Lower first premolar has one root.
- Functions are to:
    - assist canine to pierce and tear food (cusps)
    - assist molars to grind food (occlusal surface)
    - help maintain the shape of the mouth.

- Usual tooth to be extracted for orthodontic reasons, as it lies midway along the dental arch and can therefore relieve either anterior or posterior crowding.

Second premolar

- Not present in primary dentition.
- Is the permanent successor to the deciduous second molar.
- Has occlusal surface arranged as two cusps lying buccally and palatally (uppers), or buccally and lingually (lowers), like the first premolars.
- Cusps are of equal height in all.
- Mesial and distal edges are raised as marginal ridges.
- Upper is usually slightly smaller than the first premolar.
- Lower is usually slightly larger than the first premolar.
- Single root, apex sometimes curves distally.
- Root apex of uppers can lie very close to the floor of the maxillary antrum.
- Functions as for first premolars.
- Lowers are sometimes congenitally absent.
- Can become impacted in either arch, following the early loss of deciduous predecessor and the eruption of the permanent first molars, so that the arch space for the second premolars is lost.

First molar

- Primary first molars are succeeded by the first premolars, and are the smaller of the deciduous molars.
- Widely divergent roots present in deciduous molars, with the crown of the developing first premolar lying contained by them (Figure 10.10).
- Permanent first molars are the **largest** of all teeth.

- Upper has occlusal surface arranged as four major cusps, two buccally and two palatally.
- Fifth minor cusp of uppers may develop palatally as the **cusp of Carabelli**.
- Lower has five cusps, three buccal and two lingual.
- Mesial and distal edges are raised as marginal ridges.
- Uppers have three roots arranged as a tripod – large palatal, shorter mesiobuccal and distobuccal – apices of latter two are sometimes curved distally.
- Lowers have two roots arranged as mesial and distal, apices are sometimes curved distally.
- Junction of the roots beneath the crown is called the **furcation area** and can be a harbour for micro-organisms when periodontal disease is present.
- Function is to grind and masticate food chunks so that they can be swallowed.
- Root apices of uppers can lie close to, or even penetrate, the floor of the maxillary antrum.

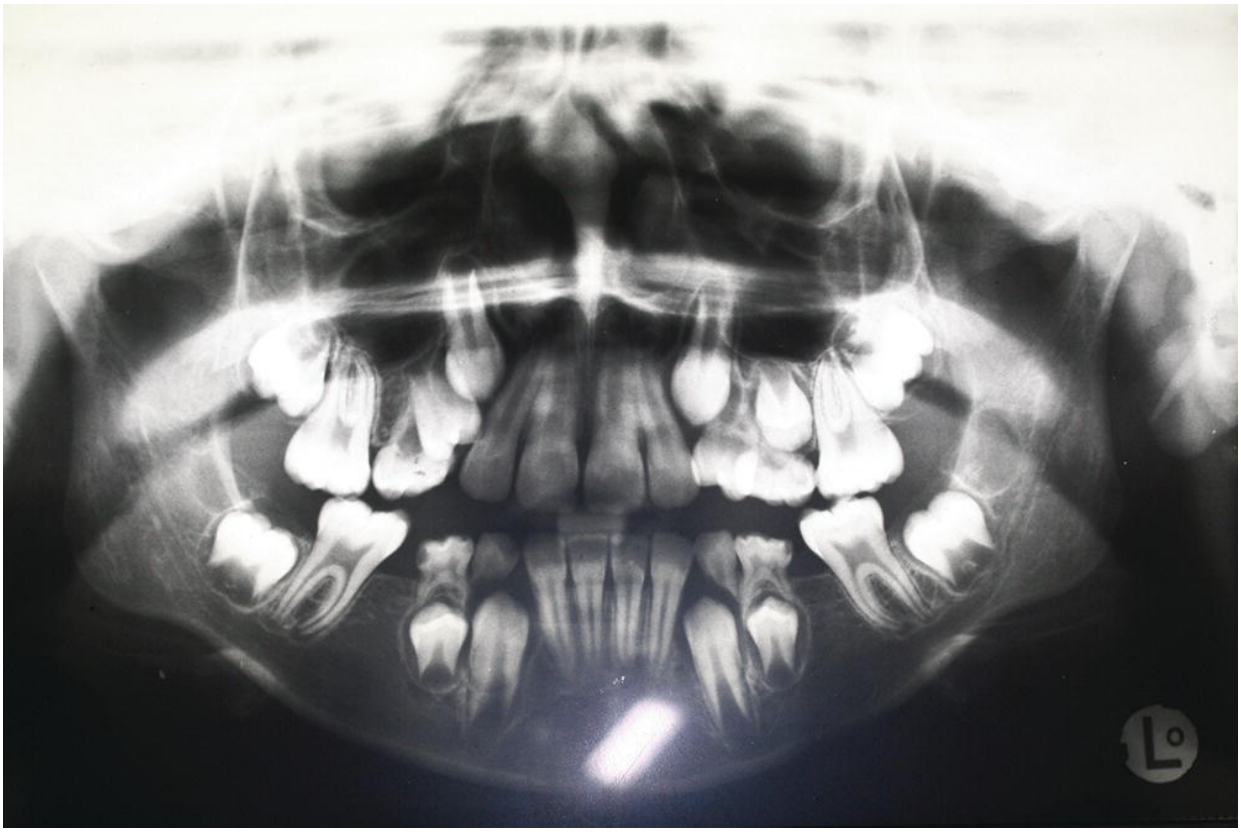


Figure 10.10 Radiograph showing unerupted premolars beneath primary molars.

Second molar

- Primary second molars are succeeded by the second premolars, and are the larger of the deciduous molars.
- Widely divergent roots present in deciduous molars, with the crown of the developing second premolar lying contained by them (see Figure 10.10).
- Crown of both upper and lower is smaller than that of the first molar.
- Has occlusal surface arranged as four cusps, two buccally and two palatally (upper) or lingually (lower).
- Mesial and distal edges are raised as marginal ridges.
- Uppers have three roots, arranged as for the first molar and sometimes curved distally.

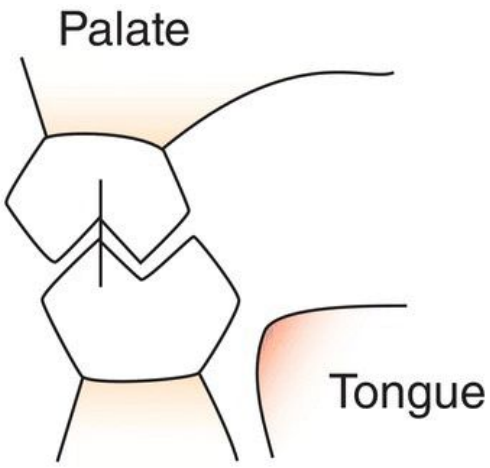
- Lower has two roots, arranged as for the first molar and sometimes curved distally.
- Furcation area present in both.
- Function as for the first molar.
- Root apices of the upper can also lie in close proximity to the floor of the maxillary antrum.

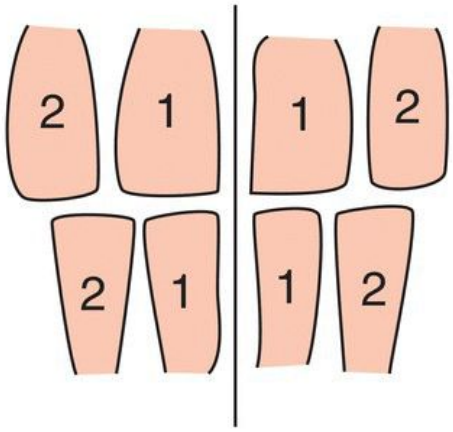
Third molar

- Not present in the primary dentition.
- Not always present in the secondary dentition.
- Referred to as **wisdom teeth**.
- Morphology varies widely.
- Smaller crown size than the second molar usually.
- Has occlusal surface arranged as three or four cusps, with marginal ridges present.
- Uppers usually have three roots, but not always, and they may be fused together to appear as one root.
- Lowers usually have two roots, but not always, and they may be fused together to appear as one root.
- Furcation area present unless the roots are fused together.
- Function as for the first and second molars.
- Often extracted if involved with recurrent bouts of disease, or if impacted and associated with pericoronitis.

Occlusion of the teeth

When the upper and lower teeth are closed together, they are said to be in *occlusion*. The arch of the upper teeth is larger than the lower so upper teeth overlap the lower on the buccal side. Lower buccal cusps accordingly bite into the fissure between upper buccal and palatal cusps (Figure 10.11).


Palate
Tongue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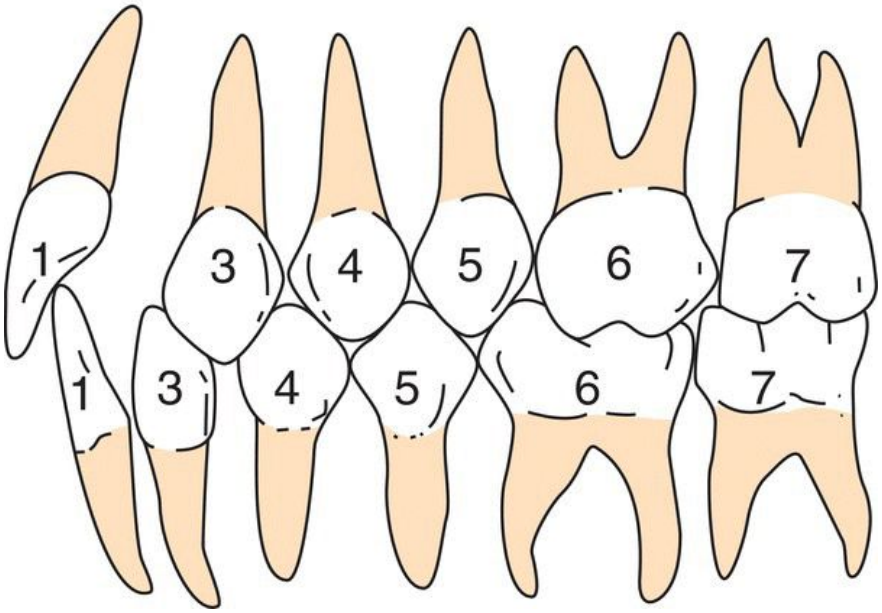
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Figure 10.11 Normal occlusion showing the interdigitation of the upper and lower teeth.

The mesial edges of upper and lower central incisors form one straight vertical line. This is called the midline. As lower central incisors are much narrower than uppers, all the remaining lower teeth occlude with two upper teeth – their corresponding upper tooth and the one in front – so the lower lateral incisor occludes with both the upper lateral incisor and the upper central incisor, and so on along the arch.

From this explanation of *normal occlusion* it is clear that the interdigitation of the upper and lower teeth when the mouth is closed results in the following:

- the mesial cusp of the upper first molar bites into the fissure between the mesial and distal cusps of the lower first molar
- the lower canine bites in front of the upper canine
- the mesial edges of the upper and lower central incisors form one straight vertical midline.

Supporting structures of the periodontium

The supporting structures are collectively referred to as the periodontium, and are those lying around the roots of the teeth which hold them in their sockets (Figure 10.12). Their hold on the teeth is not a rigid one; rather, it allows the teeth to 'bounce' in their sockets so that there is some shock absorption effect when the teeth are used for chewing. This prevents fracture of the tooth under normal occlusal forces.

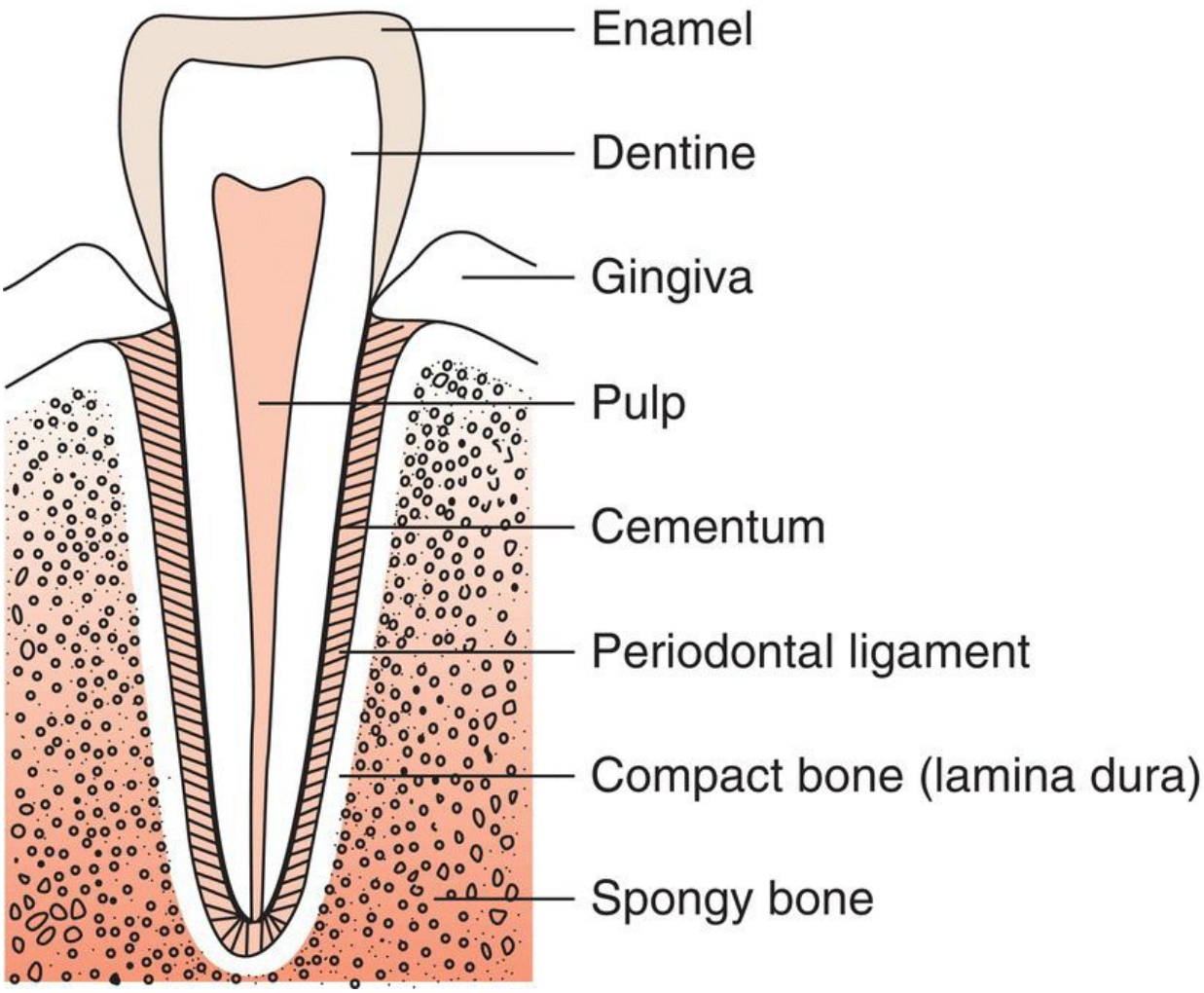


Figure 10.12 Supporting structures of a tooth.

The four supporting structures are as follows:

- **Alveolar bone**: specialised ridge of bone over the bony arch of each jaw, where the teeth sit in their sockets.

- **Gingiva**: specialised soft tissue covering of the alveolar processes, that are also in attachment with the teeth at their necks.
- **Periodontal ligament**: connective tissue attachment between the tooth and the alveolar bone.
- **Cementum**: hard tissue covering of the root that anchors the periodontal ligament to the tooth (discussed previously).

Alveolar bone

The maxilla and the mandible both contain a horseshoe-shaped ridge of bone called the alveolar process. It is here that the teeth form during the growth of the fetus and then the child, and from where they erupt into the mouth at various ages. The properties of the alveolar bone are as follows:

- It is a specialised bone found only in the jaws, and nowhere else in the body.
- Its outer layer is made of hard **compact bone**, the outer surface of which is called the **lamina dura**.
- The inner layer is called **cancellous bone** and is sponge-like in appearance, to allow the passage of the various nerves and blood vessels that supply the jaws, teeth and surrounding oral soft tissues.
- The sole purpose of the alveolar bone is to support the teeth, and it is gradually lost when a tooth is extracted as the bone slowly resorbs away.
- Patients who have had all their teeth extracted will have gradually reducing alveolar ridges, until eventually their jaws consist of just the base bone of the maxilla and the mandible.
- The teeth lie within individual **sockets** in the alveolar bone, each one being lined by lamina dura which shows on dental radiographs as a continuous white line – its absence indicates the presence of dental disease.
- The outer surface of the alveolar bone is covered in specialised **alveolar mucosa**, which forms the **gingivae** (gums) around

the necks of the teeth.

- Destruction of the alveolar bone occurs in **periodontal disease**.

Gingiva

This is the correct anatomical term for the gums (plural, gingivae). It is a continuous layer of specialised epithelium found only in the oral cavity, and which is firmly attached to the underlying alveolar bone as a **mucoperiosteal layer** of tissue. This layer is raised as a flap during oral surgical procedures, to expose the bone below.

There are three distinct areas of gingival coverage (Figure 10.13).

- **Attached gingiva**: that covering the majority of the alveolar process, which is firmly attached to the underlying bone as the **mucoperiosteum**.
- **Marginal gingiva**: that forming the gingival margin of the teeth, which is free from the underlying bone and follows the shape of each tooth in the arch, as well as extending between the teeth in the contact areas. The level at which these two areas meet is called the **free gingival groove**.
- **Junctional tissues**: the specialised gingival tissue lying within the gingival crevice and forming the anatomical junction between the teeth and the oral epithelium. This point is called the **junctional attachment**, and the tissues are called the junctional epithelium.

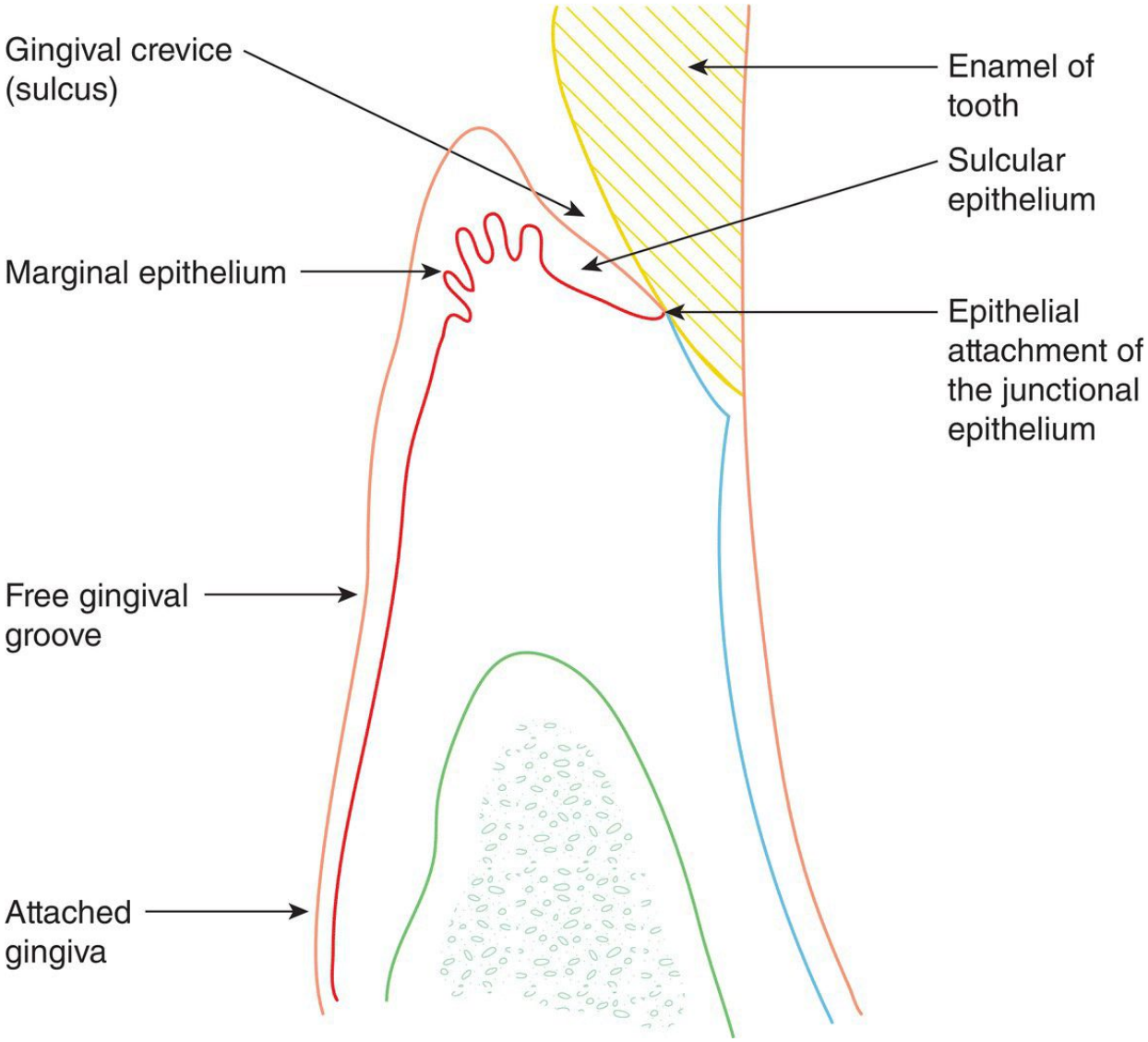


Figure 10.13 The three gingival areas.

The junctional attachment is the point where the integrity of the periodontium has to be maintained in order to avoid the devastation of periodontal disease and the resultant tooth loss that can occur. It provides a mechanical barrier between the oral cavity and the deeper periodontal tissues, preventing micro-organisms from gaining entry and causing disease. The main method of maintaining the health and functionality of the whole gingival area is to carry out good levels of oral hygiene on a daily basis.

During a periodontal examination, the gingival crevice should be less than 3 mm deep when probed, with the periodontal probe contacting the junctional attachment at its deepest point.

The properties of the gingivae are as follows:

- The gingivae fit around the neck of every tooth like a tight cuff, when healthy.
- The **gingival crevice** exists as a shallow space of less than 3 mm between the tooth surface and the gingival margin, and contains the junctional epithelium.
- A natural mound of gingival tissue occurs between each tooth and is called the **interdental papilla**.
- In health, the gingivae are pink in colour with a stippled surface, like orange peel.
- Inflammation of the gingivae is called **gingivitis**; it affects the marginal gingivae and occurs in the presence of **dental plaque** due to poor oral hygiene control.
- Gingivitis appears as red and shiny gingivae that are swollen due to their inflammation, and they bleed easily on touching, either during toothbrushing or during dental examination.
- The swollen appearance of the inflamed gingivae presents as '**false pockets**' when probed, giving the impression that the gingival crevice is deeper than 3 mm. In fact, the junctional attachment is still present and the underlying periodontal tissues are unaffected by the inflamed condition of the gingivae.
- The gingivae can also be stimulated to overgrow and become **hyperplastic** as a side-effect of various drugs being taken by the patient, including some antihypertensives (such as nifedipine, taken to reduce raised blood pressure) and some drugs used to control epilepsy (such as phenytoin).

Oral diseases, including gingivitis and periodontitis, are discussed in detail in Chapter 11.

Periodontal ligament

The periodontal ligament is a specialised fibrous tissue which attaches the teeth to the alveolar bone and the surrounding gingivae. It acts as a shock absorber to the teeth during chewing, and its main

fibres run between the alveolar bone and the cementum covering the root of the tooth. Other fibres run between the necks of the teeth, and from the cementum into the surrounding gingivae. During tooth extraction, it is these fibres which must be severed to allow the successful removal of the tooth from its socket. After orthodontic treatment, it is these fibres and their particular orientations that often result in relapse of the treatment if retainers are not worn, as they pull the teeth back into their original positions – so derotated teeth twist back again, or spaces that had been closed open up again.

The various periodontal ligament fibre groups and their functions are summarised below, and illustrated in Figure 10.14.

- **Alveolar crest fibres**: run from the alveolar bone crest to the cementum at the neck of the tooth; prevent tooth movements in (intrusion) and out (extrusion) of the socket, as well as resisting tilting and rotation.
- **Horizontal fibres**: run horizontally from the alveolar bone to the cementum, just below the crest fibres; resist tilting and rotation of the tooth.
- **Oblique fibres**: run at an angle from the alveolar bone down to the cementum; prevent intrusion and rotation of the tooth.
- **Apical fibres**: occur at the root apex and run between the bone and cementum; prevent extrusion and rotation of the tooth.
- **Transseptal fibres**: run between the cementum of adjacent teeth through the interdental region; maintain the gingival attachments between the teeth and therefore their positions in the dental arch.
- **Free gingival fibres**: run from the cervical cementum into the gingival papillae; maintain the gingival cuff around each tooth.

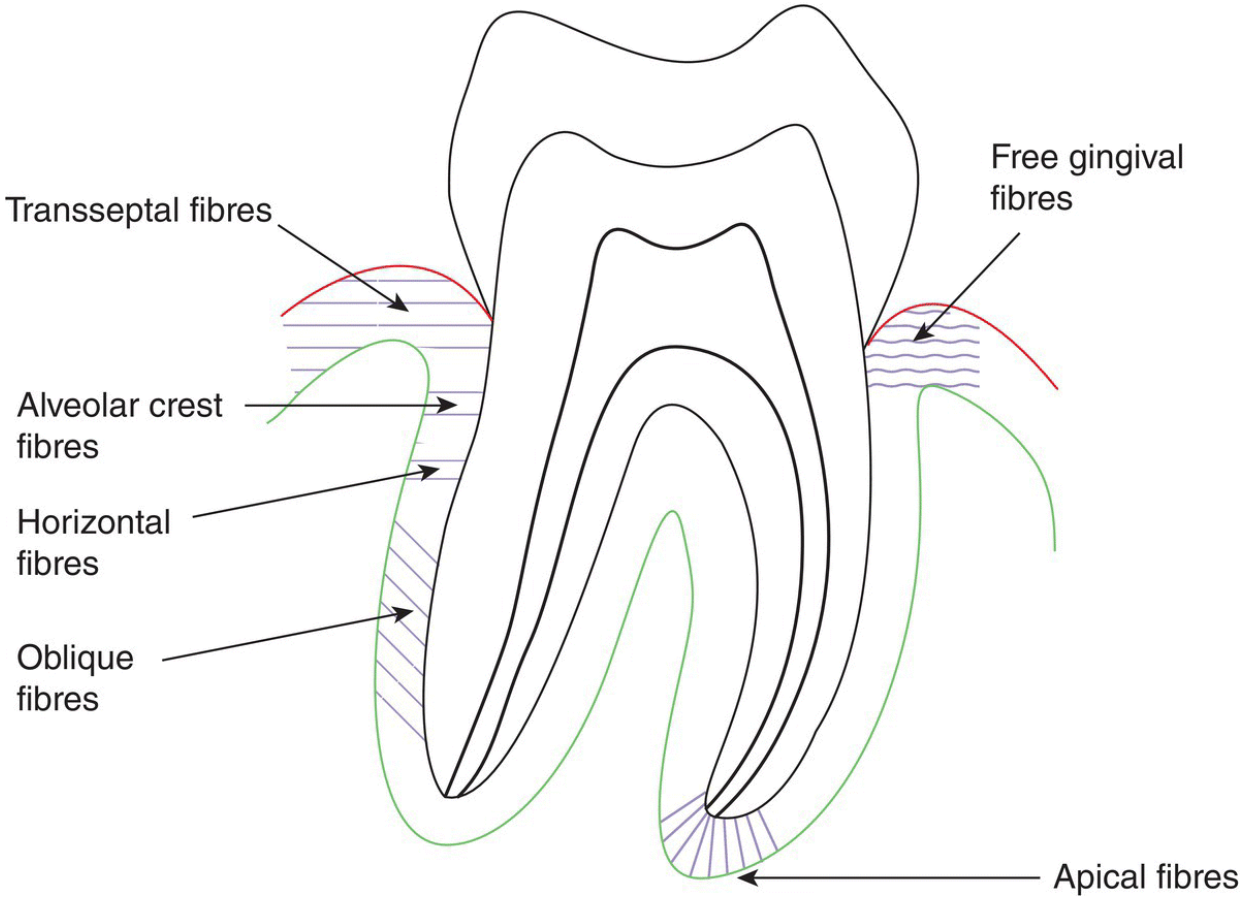


Figure 10.14 Fibre groups of the periodontal ligament.

The properties of the periodontal ligament are as follows:

- Its fibres are made up of a protein called **collagen**.
- They run in various directions, the end result being that the teeth are held in their sockets but can 'bounce' under normal chewing forces.
- This prevents tooth fracture and pain during normal occlusal loading and chewing actions.
- When excessive occlusal forces are applied, the resultant pain experienced by the patient tends to stop further overuse from occurring.
- The ligament has a sensory nerve supply which transmits pressure, pain, touch and temperature changes; the ability of the tooth to detect and transmit these sensations is called **proprioception**.

- Inflammation of the ligament is called **periodontitis** and occurs during periodontal disease.

Salivary glands

The salivary glands are present in the oral cavity as either numerous minor glands dotted throughout the lining membrane of the oral mucosa, or as one of the three pairs of major salivary glands (Figure 10.15).

- **Parotid salivary glands**: located between the ramus of the mandible and the ear, and deep to the muscles in that area.
- **Submandibular salivary glands**: located in the posterior area of the floor of the mouth, beneath the mylohyoid muscle.
- **Sublingual salivary glands**: located in the anterior area of the floor of the mouth, above the mylohyoid muscle.

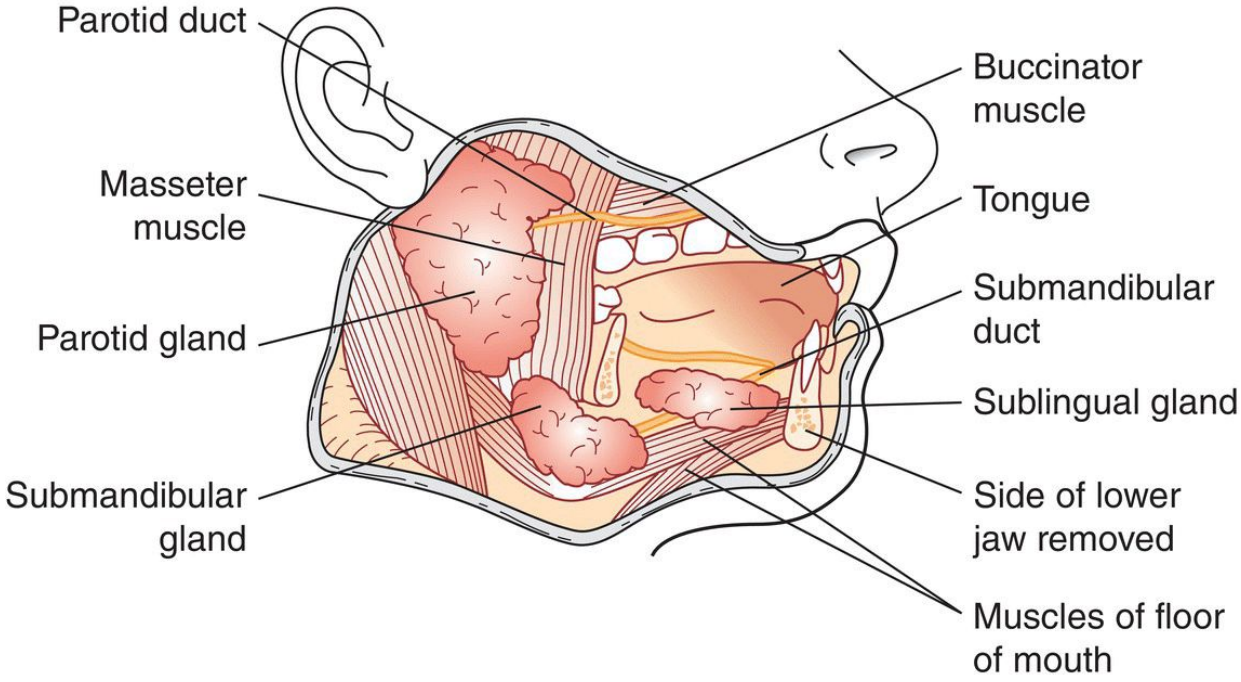


Figure 10.15 Floor of the mouth (cross-section) showing the positions of the major salivary glands.

The function of all the salivary glands is to produce the secretion *saliva*, which is deposited from the glands into the oral cavity only – it occurs nowhere else in the body. The saliva is transported to the oral cavity through tube-like structures called ducts, so the salivary glands are classed as *exocrine glands*. Other structures elsewhere in the body are classed as *endocrine glands*, whose secretions pass

directly into the adjacent blood vessels (without travelling through ducts) and are transported by the circulatory system to their area of action. Examples are certain glands within the pancreas, the stomach, the liver and the adrenal glands that lie over the kidneys.

Both types of glands have their secretions controlled by the effects of motor nerve transmission, via the autonomic nervous system.

Parotid gland

The parotid gland lies partly over the outside and partly behind the ramus of the mandible, in front of the ear. It is the largest of the three major salivary glands, and the only one to be affected by the viral infection *mumps*, which is caused by a paramyxovirus.

The tube connecting the gland to the oral cavity, the *Stenson duct*, passes forwards across the surface of the masseter muscle and then inwards through the cheek to open into the buccal sulcus opposite the upper second molar. The parotid gland is innervated by the glossopharyngeal nerve (ninth cranial nerve) and is the salivary gland most commonly associated with both benign and malignant tumours.

Submandibular gland

The submandibular gland lies in the posterior region of the floor of the mouth below the mylohyoid line, against the inner and lower surface of the body of the mandible and near the angle. The submandibular duct (*Wharton duct*) passes forward in the floor of the mouth to open at the midline, beside the lingual frenum. It is the longest of the salivary ducts, and the most likely to become blocked by salivary stones (calculi). The submandibular gland is innervated by the facial nerve (seventh cranial nerve).

Sublingual gland

The sublingual gland also lies in the floor of the mouth, but above the mylohyoid line and much further forward than the submandibular gland. There are several sublingual ducts, and these open into the floor of the mouth just behind the orifice of the submandibular duct (Figure 10.16). The sublingual gland is also innervated by the facial nerve.

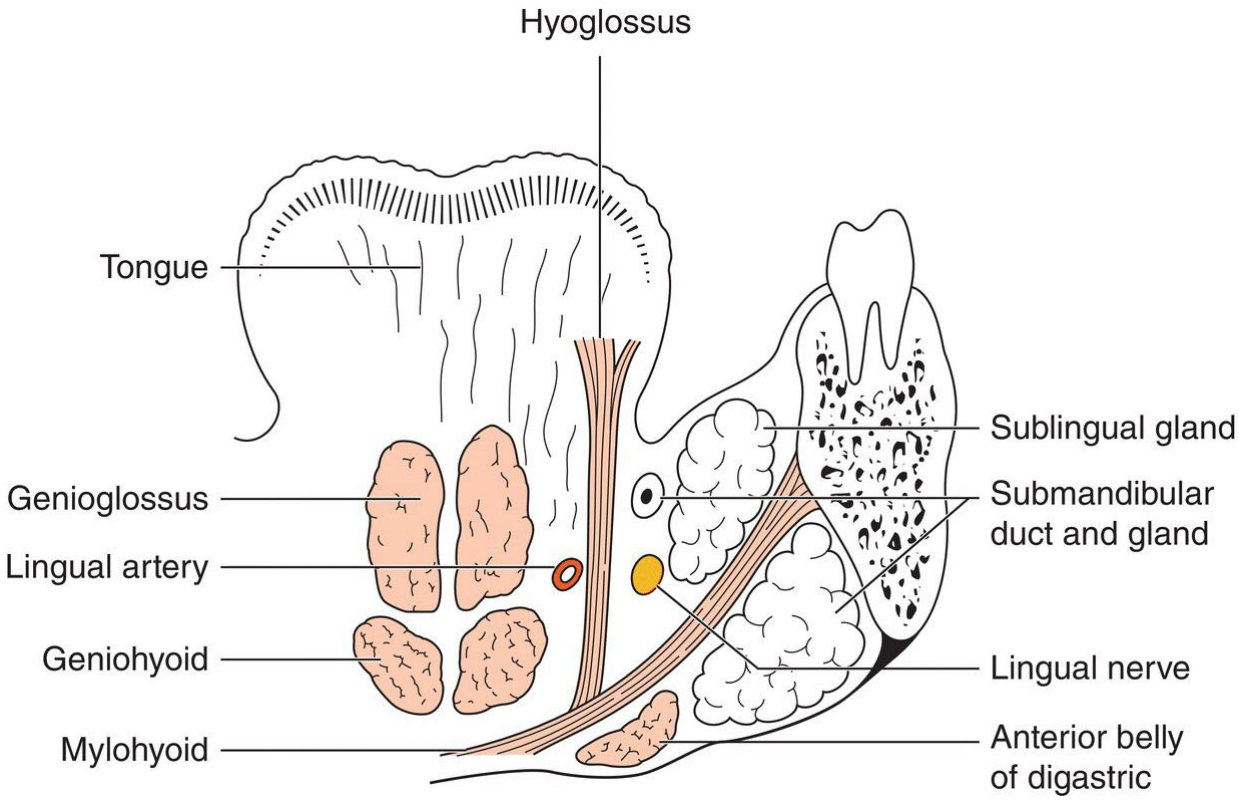


Figure 10.16 Position of salivary glands in the floor of the mouth.

Functions of saliva

Although saliva appears as a watery fluid in the mouth, it contains many different components which differ between each salivary gland, depending on the main type of secretory cell present. The two types of cell found in the glands are as follows:

- **Mucous secretory cells**: produce a thick, mucus-like secretion which aids lubrication in the oral cavity, and contains minerals and enzymes.
- **Serous secretory cells**: produce a thin, serum-like secretion containing antibodies and electrolytes.

The different components present in the secretion are related to the various functions and roles of saliva, as shown in Table 10.6. The seven components of saliva are individually identified in the left-hand column, while their function(s) are explained in the right-hand column. So, for example, the enzyme salivary amylase is present to

allow carbohydrate digestion to begin in the oral cavity, and acts on the food bolus as it is chewed and broken into smaller pieces before being swallowed.

Table 10.6 Components of saliva and their functions.

Component	Function or role
Minerals: sodium, calcium, potassium, and their electrolytes (e.g. phosphates)	Neutralise dietary acids Buffering to maintain stable pH in the oral cavity Also allow mineralisation of plaque to form supragingival calculus
Salivary amylase	Digestive enzyme that begins starch digestion before food is swallowed. Also called ptyalin
Antibodies	Immunoglobulins (especially IgA) present to fight infections, such as periodontal disease Promote wound healing IgA is the most common antibody of the immune system
Leucocytes	White blood cells, as a defence mechanism against oral infection and disease
Mucus	From the mucous secretory cells, to aid lubrication and allow speech and swallowing to occur
Other enzymes	Antibacterial enzymes, to aid in the defence of the oral cavity against disease Promote wound healing
Water	Carrying agent for other components Aids with lubrication for speech and swallowing Dissolves food particles to allow taste sensation Cleansing action by dislodging food particles from around the teeth

Patients who produce mainly watery saliva with a low mineral content tend to develop little calculus but have a higher caries incidence than patients with high mineral content saliva. Those with a high mineral content tend to have thick, stringy saliva and develop calculus more readily, in the absence of adequate oral hygiene. They also tend to have a lower incidence of caries, often despite inadequate dietary sugar control.

The position of the salivary ducts against the upper molars and the lower incisors allows dental calculus to build up easily in these areas, and it can be seen as particularly heavy deposits when patients attend for scaling treatment.

Saliva is slightly alkaline, due to its electrolyte components, but maintains the oral cavity at a neutral pH of 7 between meals. When the pH falls below 7 following the intake of food, the mineral content of saliva acts to neutralise the acidic environment produced and raise the pH again. If the pH of the oral cavity falls to the critical level of 5.5, enamel demineralisation will occur.

The role of saliva in oral health is discussed in detail in Chapter 11.

Disorders of the salivary glands

Xerostomia

This is the uncomfortable condition of having a constantly dry mouth due to the decreased production of saliva. It is relatively common, and has several causes.

- **Irradiation**: of the head and neck area, usually as radiotherapy treatment for cancer in this area.
- **Medications**: any that affect the nerve supply to the salivary glands to reduce their salivary flow, or that act as a diuretic and stimulate fluid loss, as well as certain drugs such as tricyclic antidepressants which cause dry mouth as a side-effect.
- **Sjögren's syndrome**: a syndrome that occurs in conjunction with an autoimmune disorder, such as rheumatoid arthritis, where the body's defence system attacks itself and destroys its

own glandular tissues, including the salivary glands and the lacrimal glands in the eye.

As all dental professionals know, saliva has many functions in the oral cavity and any reduction in its production will have serious oral consequences for the patient.

- Increased incidence of **dental caries**, as the self-cleansing ability is lost.
- Increased risk of **oral infections**, as the defence capability is reduced.
- Increased risk of **oral soft tissue trauma**, as the protective mechanism is reduced.
- **Problems with speech, swallowing and chewing**, as the lubrication effect is reduced.
- **Poor taste sensation** and lack of food enjoyment, as the taste buds cannot function correctly in a dry field.

Other than to change the patient's drug regimen where possible, there is little else that can be done to ease this condition. The use of salivary stimulants and artificial saliva sprays may help in some cases, and research is currently ongoing into salivary gland tissue transplant.

Dental patients suffering from xerostomia should be advised by the dental team as follows:

- Frequent recall attendance to monitor for the onset of caries and other oral problems.
- Use of artificial saliva sprays or constant sipping of plain water.
- High standard of oral hygiene, and especially the use of topical fluoride products to strengthen teeth against caries.
- Dietary advice to avoid cariogenic products.
- Avoidance of oral health products containing alcohol, as these tend to worsen the drying effect.

Ptyalism

Excessive salivation, or ptyalism, is a symptom associated with an underlying disease rather than a disorder in its own right. It can occur due to any of the following disorders:

- Periodontal disease.
- Oral soft tissue injury or trauma, including that caused by sharp-edged dental appliances.
- Oesophagitis and other conditions causing acid reflux.
- Disorders affecting the nervous system, including Parkinson's disease and mercury poisoning.

Treatment is focused on the causative disease and the relief of its symptoms, although some drugs may be used to directly reduce the salivary gland secretions. In particular, the drug *atropine* may be used during oral and maxillofacial surgery to significantly reduce saliva flow and provide a clear, dry operating field for the surgeons.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

11
Oral Disease

Key learning points

A **working knowledge** of

- the causes and risk factors involved in dental caries
- the process of cavity formation, and its progress ultimately to an alveolar abscess
- non-carious tooth surface loss
- the causes and risk factors involved in periodontal disease
- the onset of gingivitis and its progress to periodontitis
- the non-surgical treatment of periodontal disease

A **factual awareness** of

- other periodontal conditions
- the risk factors associated with oral cancer

The two main oral diseases of concern to the dental team are dental caries and chronic periodontal disease, and the prevalence of both throughout the human race provides the vast majority of the day-to-day work of dental team members. Other periodontal conditions that may be seen from time to time are also mentioned here.

Dental caries and chronic periodontal disease are discussed in detail within this chapter, while full details of oral health assessment and diagnosis techniques, and oral disease prevention are covered elsewhere.

Although oral cancer was discussed in Chapter 7, it is included again here as a worryingly increasing disease condition that may be seen from time to time in the dental workplace, and the importance of the dental team in its early diagnosis and prevention cannot be overestimated.

Dental caries

Dental caries (tooth decay) is a bacterial disease affecting the mineralised tissues of the tooth, where the strong crystal structure found in both enamel and dentine is *demineralised* (dissolved) by the action of acids. This allows the softer organic component of the tooth structure to be broken down to form cavities.

The acids involved are created as a waste product by oral bacteria, as they digest the foods we eat for their own nutrition. Although the acids are relatively weak organic ones, such as *lactic acid* or *citric acid*, they are strong enough to attack enamel and dentine. Not all the bacteria found in the oral cavity are associated with the production of these acids, but the usual ones are:

- *Streptococcus mutans* (initial stages of cavity formation)
- *Streptococcus sanguis*
- Some lactobacilli (later stages of cavity formation).

Not all the foods that we eat can be broken down into acids either, but those foods that can easily be formed into these damaging organic acids contain carbohydrates. Foods that consist of protein or fats are not relevant to the onset of dental caries. So in summary, the relevant factors in the development of dental caries are:

- the presence of certain types of **bacteria**
- **carbohydrate foods**
- the production of **weak organic acids** by these bacteria
- adequate **time or frequency** for the acids to attack the tooth.

The bacteria need to become attached to the tooth surface to be able to digest food debris and initiate dental caries, and they do this by forming themselves into a sticky layer called *bacterial plaque*, or the *plaque biofilm*.

Bacterial plaque

Millions of bacteria live in our mouths, flourishing on the remnants of food items that we eat. Some of these food remnants stick to our teeth or become trapped between the teeth or at the margins of tooth restorations (such as fillings and crowns), and attract colonies of bacteria to the tooth surfaces at these points. This combination of bacteria and food debris on a tooth surface forms a thin, transparent, protein-containing, soft and sticky film called the *plaque biofilm*. It tends to form and stick most readily in areas where it cannot be easily dislodged, such as at the *gingival margins* of the teeth, in the *fissures* of teeth, and around the edges of *dental restorations*. These are called *stagnation areas*.

The build-up of plaque at the gingival margins of the teeth is directly associated with the onset of *gingivitis* and *periodontal disease*.

The plaque that sticks to the tooth surfaces allows the bacteria living within the biofilm to turn sugar into weak acids, which in turn dissolve enamel to produce *dental caries*.

The main micro-organism which initiates the process of caries is the bacterium *Streptococcus mutans*. Large numbers of *lactobacilli* bacteria are then able to thrive in the acid environment, and the presence of these two micro-organisms is put to practical use as a chairside test for caries activity in the patient's mouth. By periodically assessing the microbiological levels of streptococci or lactobacilli in a patient's saliva, their caries risk and the effectiveness of previous preventive measures can be monitored and used to guide the dental team in offering future advice and instruction. Several dental companies now offer these chairside test products for sale to the dental team.

Sugars

As referred to in Chapter 5, all types of food are classified into three distinct groups.

- **Protein**: such as meats, fish and various dairy products and pulses.
- **Fat**: such as animal fats and vegetable oils.
- **Carbohydrate**: natural sugars, starches, and dietary fibre from fruit and vegetables, and artificial sugars from processed foods.

Of these, only carbohydrates can be turned into acid by bacteria and thereby cause caries, so they are described as *cariogenic foods* because they are capable of causing caries. The most important forms of carbohydrate in relation to dental caries are sugars – these are soluble carbohydrates in our diet which provide energy for our bodies to work. Being soluble (able to dissolve in a liquid), they are quickly and easily absorbed into our bodies and do not produce a 'full' feeling when consumed, unlike other 'stodgy' carbohydrates, such as potatoes. Sugars are also used to enhance the flavours of food and drink products by manufacturers, chefs and home cooks, and are therefore found in some unlikely food products, such as tomato soup, savoury sauces, tinned vegetables and some flavours of crisps. These are referred to as *hidden sugars*, because their presence in food products is often unexpected by consumers.

Currently, the categorisation of the types of sugars available in the diet can be quite confusing but one point is clear – those types of sugars that are relevant to the incidence of dental caries are also relevant to the development of obesity. Therefore, limiting the amount of these sugars consumed in the diet has an important twofold health benefit to patients (and dental staff!).

Sugars are described as one of the following types:

- **Intrinsic sugars**: occur naturally within the cell structure of foods (natural sugars in whole fruit and vegetables).
- **Extrinsic sugars**: usually added to foods in the manufacturing or cooking process as **free sugars**, although some can occur naturally (such as honey, and lactose in milk).

Extrinsic sugars are the important category for the dental team, and can be subdivided into 'milk sugars' (lactose) and 'free sugars' (loosely similar to those previously termed 'non-milk extrinsic sugars'). Free sugars comprise those from the following sources:

- **Added** during food and drink production by the manufacturer/caterer: refined sugars, honey, and 'hidden' sugars.
- **Added** by the patient before consumption: as refined sugars added to drinks (tea and coffee), over breakfast cereals, during home cooking, and including honey.
- **Released** during preparation due to the destruction of the natural fruit cell structure: fruit juices, fruit smoothies, fruit concentrates and fruit syrups.

The most damaging free sugars of all are the refined sugars *sucrose* and *glucose* (also called dextrose), which can be instantaneously turned into acid by the bacteria concerned in dental caries formation, and available types include table sugar, sugar used in cooking, and sugar added to anything else taken by mouth, whether liquid or solid (Figure 11.1). Medicines may also contain hidden sugar and can be a significant cause of caries in chronically sick children.

Figure 11.1 Examples of various sugar products.

Naturally occurring sugars that produce so little organic acid that they are considered harmless to teeth include the following:

- **Intrinsic sugars**: found naturally in foods, such as **fructose** in whole raw fruits.
- **Milk extrinsic sugars**: especially lactose.

Any food containing added sugar can cause caries and some obvious ones are:

- cakes, biscuits, jam and sweets
- breakfast cereals
- pastry, desserts, canned fruit, syrups and ice cream
- soft drinks
- hot beverages sweetened with sugar.

However, less obvious sources of cariogenic products include the following popular foods and drinks, some of which are considered by many to be 'healthy' options, although some are also acidic and may contribute to enamel erosion of the teeth.

- **Fruit smoothies**: producing the 'smoothie' itself in the blending machine actually destroys the cell wall structure of the natural fruit and releases its

carbohydrate content as free sugars, so while smoothies containing all the fruit pulp are considered a particularly healthy contribution to the recommended dietary '5 a day', they should only be taken at mealtimes and then followed by some form of tooth cleansing activity.

- **Fruit juice**: again, the juicing process destroys the cell wall structure and releases the natural sugars present as free sugars to enable them to cause caries; even unsweetened fruit juice products are damaging to teeth so their consumption should be restricted, and confined to mealtimes.
- **Dried fruit**: the drying process removes much of the water content of the fruit and leaves a super-concentrated amount of free sugars in the dried product, which is also sticky and able to sit in tooth stagnation areas for some time, especially if eaten between meals. So, while whole fruits are healthy their dried versions may cause caries if eaten between meals and without adequate oral hygiene afterwards (Figure 11.2).
- **Canned fruits**: many fresh fruits are canned within a liquid syrup containing a high content of free sugars, and while a healthier option is to choose fruits canned in their natural juice, these still contain some free sugars.
- **Honey**: this is a naturally occurring sugar produced by bees in a hive, but it is still a free sugar and therefore has cariogenic potential. However, it is less cariogenic than refined sugar products and has the benefit of a level of antibacterial activity too, but its consumption should be confined to mealtimes only.

Figure 11.2 Fresh grapes and dried grapes (raisins).

Sugar occurring naturally in milk, whole fruit and vegetables is *not* a significant cause of caries. Naturally starchy and fibrous vegetables such as potatoes, carrots, peas and beans are rich in carbohydrate but may be regarded as insignificant causes of caries as long as no sugar is added by producers or during home cooking. The prime cause of dental caries is refined sugar (sucrose), processed from sugar beet and sugar cane, and commercial glucose, which together constitute such a large proportion of the manufactured and sweetened food in our diet. Unfortunately, foods containing these free sugars tend to be cheap and readily available in most developed countries, along with acidic drinks such as carbonated fizzy 'pops'.

Summary of alternative sugars

There are many 'alternative' sugars currently available from supermarkets and health food shops, and it can be difficult for patients to know which are suitable for their oral and general health, and which may cause dental caries and weight gain/obesity. It can also be confusing for dental professionals to give accurate advice about some of the products in relation to oral and general health, so the more common ones are itemised in Table 11.1. The source of each alternative sugar, any oral or general health effects the products have, and therefore the advice that should be given to patients by the dental team in relation to consumption of each 'sugar' is shown.

Table 11.1 Information on alternative sugars and their effects on oral and general health.

Alternative sugar	Source	Effect on oral health	Effect on general health	Advice to patients
Lactose ('milk sugar')	Animal milk and other dairy products as a natural extrinsic sugar Also used as a powder filler Flavoured forms available as milk drinks, yoghurts, shakes, smoothies	**Non-cariogenic** in natural form Helps keep teeth strong Cariogenic in flavoured forms	Important dietary source of calcium, phosphates and protein in unsweetened form Flavoured forms contain calories Lactose-intolerant patients cannot digest milk products	Safe for teeth when unsweetened Not safe for teeth when sweetened/flavoured without adequate oral hygiene
Honey	Produced by bees from flower nectar in honeycombs, as a natural extrinsic sugar Combs collected and sold widely	**Cariogenic** as contains glucose Classed as a **free sugar** Antibacterial properties outweighed by cariogenic potential	Contains calories and can contribute to obesity, diabetes and heart disease No specific health benefits	Not safe for teeth without adequate oral hygiene
Stevia	Sweetener from the *Stevia* plant Extracted and sold as food or drink additive	**Non-cariogenic** and can be used as an artificial sweetener	No effect and can be safely used by diabetics Contains no calories	Safe for teeth when not mixed with other sugars

Alternative sugar	Source	Effect on oral health	Effect on general health	Advice to patients
Coconut sugar	Made from the sap of coconut palm tree Mixed with sucrose for use	**Cariogenic** as mixed with sucrose Classed as a **free sugar**	Contains calories and can contribute to obesity, diabetes and heart disease	Not safe for teeth without adequate oral hygiene
Yacón syrup ('nectar')	Made from the roots of the yacón plant (*Smallanthus sonchifolius*)	**Cariogenic** as contains glucose	Contains calories but significantly less than other sugars Can be used when dieting but not to excess Excess can cause abdominal pain	Not safe for teeth without adequate oral hygiene
Syrup	By-products of sugar manufacture, as treacle or golden syrup Natural sources such as maple syrup, date syrup	**Cariogenic** as they contain glucose and sucrose	All contain calories so contribute to obesity, diabetes and heart disease	Not safe for teeth without adequate oral hygiene
Agave nectar	Syrup produced from the *Agave* plant	**Cariogenic** as contains free fructose	Contains calories and can contribute to obesity, diabetes and heart disease	Not safe for teeth without adequate oral hygiene

Alternative sugar	Source	Effect on oral health	Effect on general health	Advice to patients
Dried fruit	Fruits that have been dried to remove water: dates, figs, raisins, currants, apricots, etc	**Cariogenic** as contain more concentrated fructose and other sugars	Good source of dietary fibre and iron Contain calories so eat in moderation	Safe for teeth if eating at mealtime Not safe for teeth if eaten as snacks without adequate oral hygiene
Xylitol	Natural sugar alcohol used as a sweetener Also used in sugar-free chewing gum	**Non-cariogenic** as not metabolised by oral bacteria Stimulates enamel remineralisation	Used as an artificial sweetener for dieting, but in moderation Contains reduced calories	Safe for teeth but not to excess as chewing gum, due to possible tooth wear

More detailed information about sugars and healthy diets is available at the British Dietetic Association website (www.bda.uk.com).

Acid formation

As soon as the carbohydrate source is eaten, the oral bacteria take the sugar component into the plaque biofilm structure and begin to digest it themselves. Within just a minute or two, it is turned into acid by the plaque bacteria and then attacks the enamel surface beneath the plaque. Enough acid is produced to last for about 20 minutes, and in this initial acid attack a microscopic layer of enamel is dissolved away. This phase is called *demineralisation*.

At the end of the meal or snack, when the intake of sugar is over, the acid persists for a period ranging from 20 minutes to 2 hours before it is neutralised by the buffering action of saliva.

Saliva is the fluid bathing the oral cavity that is secreted from the salivary glands (see Chapter 10). Among its many roles, it maintains the mouth at a *neutral level*, being neither acidic nor alkaline. The measure of acidity/alkalinity of a solution is called its *pH* (ranging from 1 to 14) and the neutral level maintained by saliva is *pH 7*. When the weak organic acids are produced by the oral bacteria, the pH level starts to fall and once it passes the critical pH 5.5, the environment is acidic enough to attack the enamel and dentine of teeth, and produce cavities.

Once neutralisation has occurred, no further demineralisation can take place until such time as more sugar is consumed. In this phase where no more sugar is

present in the plaque, some natural healing takes place; mineral constituents naturally present in saliva enter demineralised enamel and restore the part lost by the initial acid attack. This healing phase is called *remineralisation*.

What happens next is entirely dependent on the frequency of sugar intake. If it is confined to mealtimes only, for example at breakfast, midday and early evening, there can only be three acid attacks a day on the teeth. The amount of time available for remineralisation will greatly exceed that of demineralisation and the initial phase of caries will be arrested. But if a series of snacks is eaten between meals throughout the day, the reverse will occur. Most processed snacks contain some added sugar and the result is a rapid succession of acid attacks, with insufficient respite between them for saliva to neutralise the acid and allow the healing process of remineralisation to become dominant. Caries can then spread rapidly through affected teeth, as described later.

The longer the sugar stays on the teeth, the longer the duration of acid production. Thus sweet fluids, such as tea or coffee with sugar, which are rapidly washed off the teeth by saliva, are not normally a major cause of caries unless many drinks are taken throughout the day, whereas the much more frequent consumption of very sweet soft drinks by children is far more serious. Overall, the most dangerous sources of sugar are those which have a sticky consistency when chewed, as it is far more difficult for the natural saliva flow to wash them away. The adherent nature of such foods allows them to cling to the teeth for a very long time, throughout which they are supplying plaque bacteria with the raw materials for prolonged acid formation and demineralisation.

Foremost among these sticky forms of sugar which cause caries are:

- toffee and other sweets
- cakes, biscuits, some white bread and jam
- puddings with syrup or treacle.

With our modern diet, added sugar is consumed nearly every time something is eaten, and the teeth are attacked by acid on each of these occasions. If snacks containing such sugar are frequently taken between meals, there will be a corresponding increase in the number of acid attacks on the teeth. The delicate balance between the forces of destruction (demineralisation) and those of repair (remineralisation) will then be completely upset in favour of tooth destruction and *irreversible* damage will occur.

Thus it is evident that the prime cause of caries is the frequent and unrestricted consumption of sweet snacks *between* meals. It is not the amount of sugar eaten but the *frequency* with which it is eaten that is all-important. Along with knowledge of common (and unexpected) sources of free sugars, this fundamental fact forms the basis of personal caries prevention and good dental health education.

Sites of caries

The parts of a tooth most prone to caries are those where food tends to collect naturally and plaque bacteria can flourish. Such sites are known as *stagnation areas*. Occlusal fissures and the spaces between the mesial and distal surfaces of adjoining teeth (the interproximal areas, or contact points) are the most common stagnation areas. That is why caries occurs most often on occlusal and proximal surfaces. However, anywhere food debris can accumulate is a stagnation area where plaque will proliferate and caries is likely to occur. Such food traps include the necks of teeth covered by ill-fitting partial dentures; irregular teeth in an arch, where the contact points often overlap; and unopposed teeth in an arch, where the normal contact between upper and lower teeth that would dislodge food debris is lost.

Minimal harm is caused by partial dentures which fit perfectly, but those which do not are a menace to dental health. They leave spaces between the necks of the teeth and the acrylic or chrome plate, or between any metal clasps and the teeth, which are dangerous stagnation areas, especially if the patient does not routinely remove the denture to clean their natural teeth after a meal.

During mastication, the movement of saliva and the food bolus over the tooth surfaces as it is chewed actually helps to clean teeth which are in good occlusion. This does not prevent plaque formation, but does reduce the amount of retained food debris which is responsible for the harmful effects of plaque. Teeth which are not in good occlusion, such as irregularly positioned and unopposed teeth, are not so exposed to this beneficial cleansing effect. Consequently food collects around these instanding or outstanding irregular teeth. It also covers the crown of any tooth which has lost its opposite number, and remains unopposed because the space has not been replaced artificially. To make the situation even worse, the sticky sweet food most likely to produce caries needs the minimum amount of mastication anyway and therefore has a negligible cleansing effect, even on teeth in good occlusion.

Caries and cavity formation

Unrestricted consumption of carbohydrates and their sugar content produces an abundance of acid-forming bacteria in the plaque which collects in stagnation areas. The resultant series of continual acid attacks prevents remineralisation and allows acid to eat through the enamel until it reaches dentine, whereupon the caries spreads more rapidly through the more open, relatively hollow, structure of this inner tooth layer (Figure 11.3).

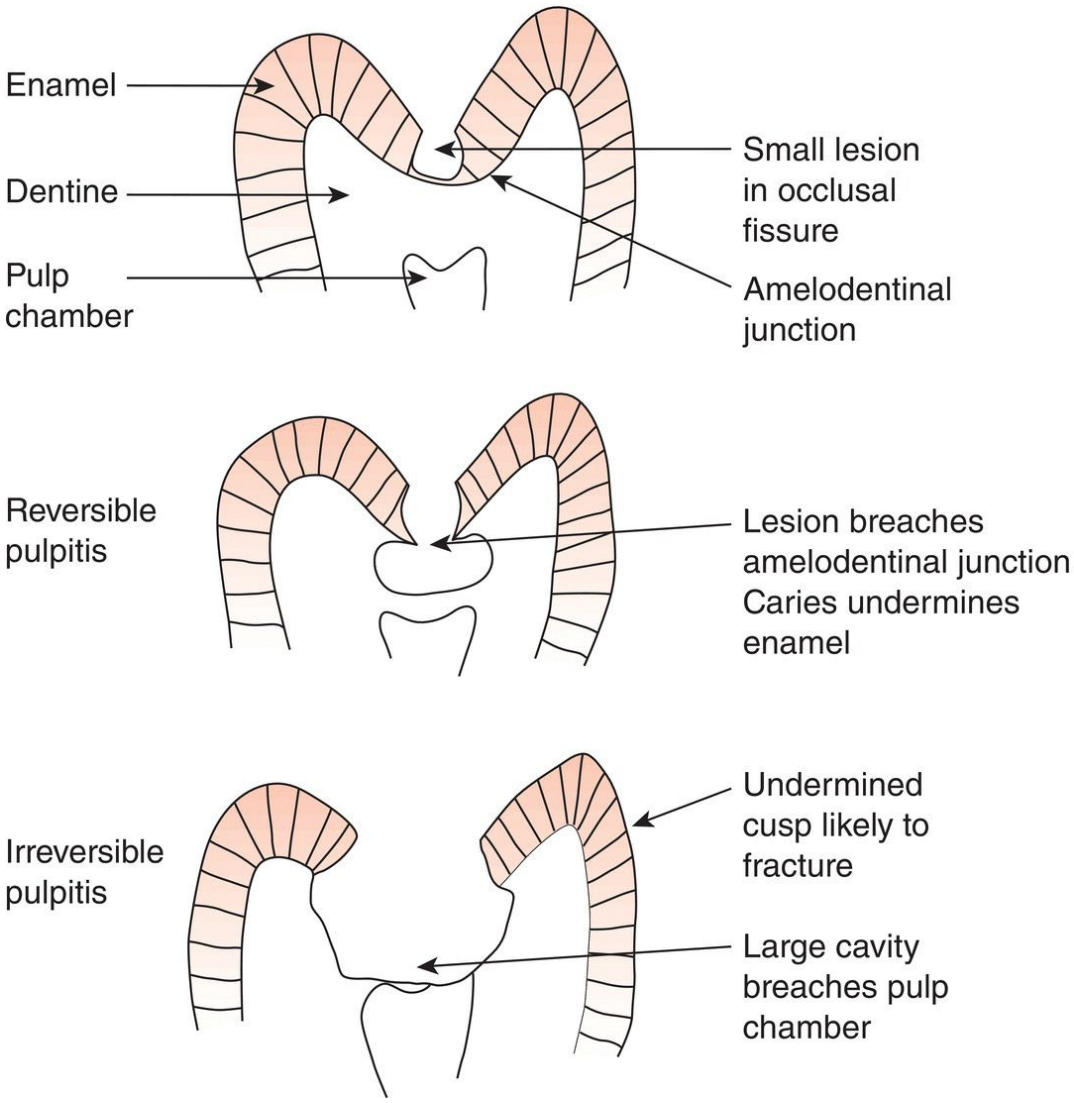


Figure 11.3 Cavity formation following caries attack in an occlusal fissure.

Microscopically, the process of cavity formation is as follows:

- Very early acid attacks will show as 'white spot lesions' on the enamel surface.
- Continued and frequent acid attacks will follow the prism structure of the enamel, and eat into any exposed cementum on the tooth root.
- **Demineralisation** occurs, followed by episodes of **remineralisation** if the acid attacks are not too frequent. These areas of repair often appear as brown lesions on the teeth, especially at contact points (Figure 11.4).
- With frequent or prolonged acid attacks, the mineral structure of the enamel is eventually destroyed and caries enters the tooth.

- Caries extends deep into the enamel and eventually reaches the **amelodentinal junction**.
- Up to this point, the patient will feel no pain as enamel contains no nerve tissue.
- Once past the ADJ, the caries enters dentine and can spread more rapidly because of the hollow structure of this tooth layer and its lower mineral content compared to enamel.
- This undermines the overlying enamel, and normal occlusal forces are able to fracture off pieces of the tooth surface, leaving a hole in the tooth structure. This is called a **cavity** (Figure 11.5).
- Odontoblast cells at the ADJ react to the bacterial attack by laying down **secondary dentine** in an attempt to protect the underlying pulp tissue.
- The nerve fibrils lying within the dentine tubules will be stimulated as the caries progresses, and the patient will begin to feel sensitivity in the tooth, to temperature changes and to sweet foods.
- The pulp tissue will also become irritated and inflamed; this is called **pulpitis**.
- At this point, the caries can be removed by the dentist and the cavity restored with a **filling** (see Chapter 15). The inflamed pulp will settle and the tooth will be restored to its normal function; the inflammation is better described then as **reversible pulpitis**.
- Otherwise, if no dental intervention is made the cavity will continue to enlarge and the caries will progress towards the pulp chamber, as the production of secondary dentine by the odontoblasts is overrun by the speed of the bacterial attack.
- The patient will be experiencing more severe pain of longer duration at this point, and will eventually be unable to bite with the affected tooth.
- When the carious attack reaches the immediate surroundings of the pulp chamber, the level of inflammation is too great to be resolved simply by removing the caries; this is called **irreversible pulpitis**.
- The pain will become constant and throbbing in nature, often disturbing the patient's sleep.
- Once the pulp chamber itself is breached by the caries, a **carious exposure** of the contents occurs and the pulp will eventually die.
- The tooth can now only be treated by undergoing an endodontic procedure (see Chapter 15) or by extraction (see Chapter 17).

Figure 11.4 Brown spot lesion on the mesial surface of the lower right first molar.

Figure 11.5 Cavity in a deciduous lower right second molar.

Irreversible pulpitis

Irreversible pulpitis occurs when caries extends through the dentine to reach the pulp. The pulp is then said to be *cariously exposed* and the sequence of events described under inflammation (the five signs of inflammation; see Chapter 7) follows.

- There is an increased blood flow through the apical foramen into the pulp.
- Swelling cannot occur, however, as the pulp is confined within the rigid walls of the tooth, in the root canal and pulp chamber.
- Pressure therefore builds up within the tooth and causes intense pain.
- A much more important result of this pressure is the compression of blood vessels passing through the tiny apical foramen. This cuts off the blood supply to the tooth and causes death of the pulp.
- When the pulp dies, its nerves die too, and the severe toothache stops abruptly.
- The respite is short, as pulp death leads to another very painful condition called **alveolar abscess**.

Pulpitis may be acute or chronic. It has many causes, apart from caries, but almost always ends in pulp death. Other causes of pulpitis are covered in Chapter 15.

Alveolar abscess

When irreversible pulpitis occurs, the pulp eventually dies as its blood supply is cut off by inflammatory pressure. The dead pulp decomposes and infected material passes out of the tooth through the apical foramen and into the alveolar bone at the apex of the tooth. These irritant products give rise to another inflammatory reaction in the tissues surrounding the apex. Pus formation occurs and an *acute alveolar abscess* develops.

- This is an extremely painful condition.
- The affected tooth becomes loose and very tender to the slightest pressure.
- There is a continual throbbing pain and the surrounding gum is red and swollen (see Figure 7.3).
- Frequently the whole side of the face is involved in the inflammatory swelling (Figure 11.6) and the patient may have a raised temperature.
- Looseness of the tooth is caused by swelling of the periodontal ligament.
- Pain is caused by the increased pressure of blood within the rigid confines of the periodontal ligament and alveolar bone. The tooth is so tender that it cannot be used for eating.

- Thus an acute alveolar abscess may show all the cardinal signs of acute inflammation:
  - pain
  - swelling
  - redness
  - heat
  - loss of function
  - raised body temperature.

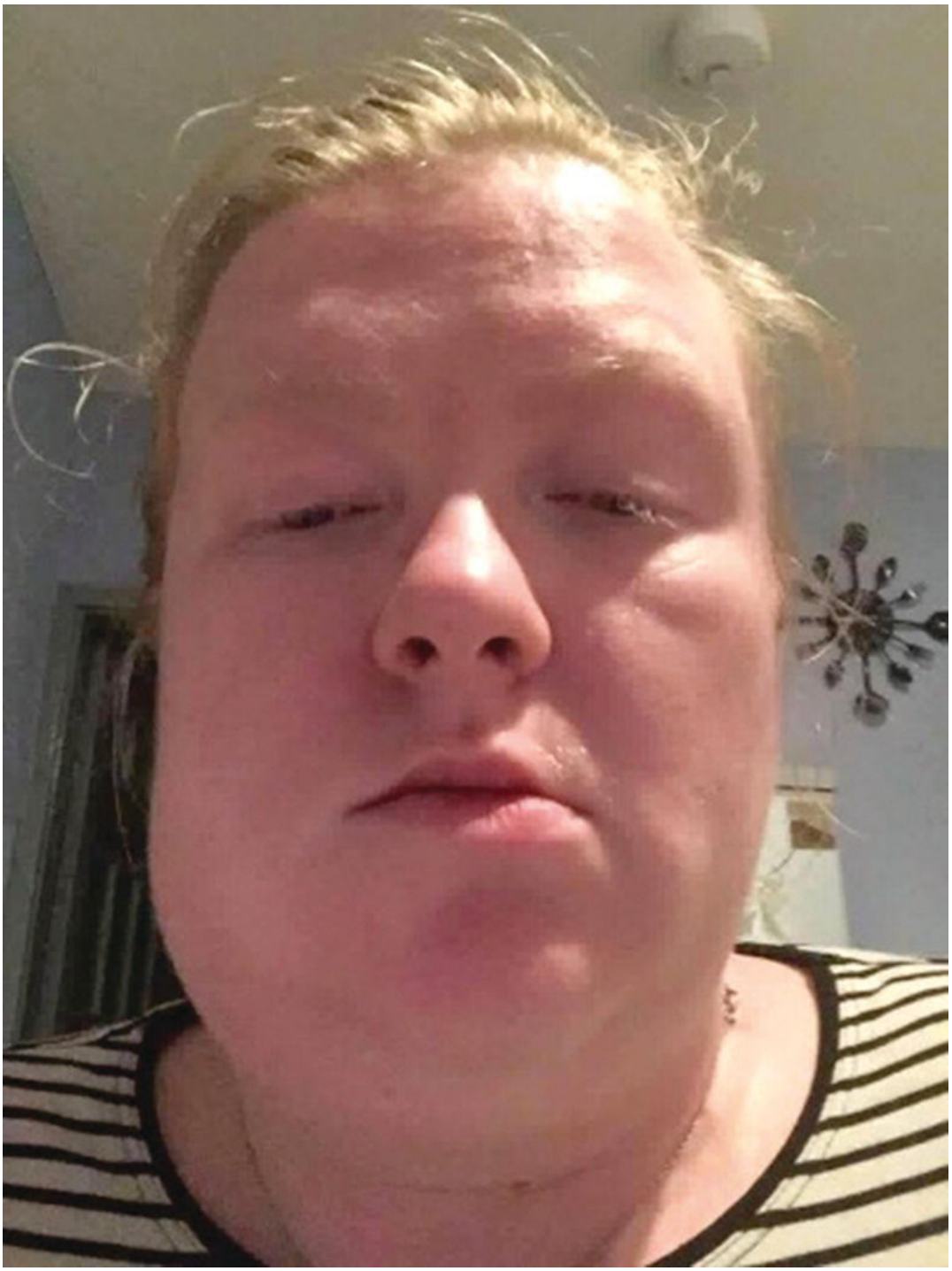


Figure 11.6 Facial swelling with alveolar abscess.

Pulp death is sometimes followed by the development of a *chronic alveolar abscess* instead of an acute one. This usually gives rise to very little pain and most patients are quite unaware of its presence. It may often be detected by the presence of a small hole in the gum called a *sinus*, which is a track leading from the abscess cavity in the alveolar bone to the surface of the gum. Pus drains from

the abscess through the sinus into the mouth. This outlet prevents a build-up of pressure inside the bone and explains the lack of pain. Patients often refer to this lesion as a 'gum boil'.

If an acute abscess is not treated, it eventually turns into a chronic abscess by the drainage of pus through a sinus (see Figure 7.4). This relieves the pain and the features of acute inflammation largely disappear. The relative freedom from pain does not last indefinitely, however, as a chronic alveolar abscess is liable to revert into an acute abscess at any time.

It should now be clear that irreversible pulpitis is followed by pulp death, and this eventually leads to an acute alveolar abscess, either directly or via a chronic abscess.

It was formerly taught that all carious dentine should be removed, but this is now considered unnecessary with some carious lesions. Adequate preparation, filling and sealing of a cavity cuts it off from further plaque and acid formation, and allows a vital pulp to remineralise the deeper underlying dentine. Removal of carious dentine should therefore stop short of exposing the pulp when possible.

Role of saliva in oral health

The oral soft tissues in health are constantly bathed in saliva, which is the watery secretion from the three pairs of major salivary glands as well as from the numerous minor salivary glands present in the cheeks and lips (see Chapter 10).

Saliva contains the following components:

- **Water**, as a transport agent for all the other constituents.
- **Inorganic ions and minerals**, such as calcium ions and phosphate.
- **Ptyalin**, a digestive enzyme which acts on carbohydrates (also called **salivary amylase**).
- **Antibodies**, as part of the defensive immune system, and known as **immunoglobulins**.
- **Leucocytes** or white blood cells, also part of the body's defence system.

These constituents all have important functions in the maintenance of a healthy oral environment.

- The **inorganic ions** and **minerals** are released as required to act as **buffering agents** to help control the pH of the oral environment, by neutralising the organic acids produced by bacteria. So, when food is eaten and the pH in the mouth falls to become acidic, the minerals chemically neutralise the acids and the pH in the mouth rises again to 7.

- A high inorganic ion/mineral content produces thick, stringy saliva which gives the teeth good protection against caries, but allows **dental calculus** (tartar) to form easily and in large amounts.
- A low inorganic ion/mineral content produces watery saliva, which offers the teeth little protection against caries but prevents large amounts of calculus from forming.
- Calculus formation is associated with **periodontal disease**.
- **Water** forms the carrying agent for the other salivary constituents, and allows self-cleansing of the oral environment to occur by dislodging food debris from the teeth before being swallowed.
- The water also moistens the food bolus and the soft tissues, allowing **swallowing** (deglutition) and **speech** to occur.
- It also **dissolves** food particles, so that the sensation of **taste** is produced – the taste buds on the tongue can only detect the taste of food when it is in solution.
- Both **antibodies** and **leucocytes** help to protect and defend the oral environment from infection by micro-organisms.

Reduced salivary flow

The condition of reduced salivary flow is called *xerostomia* or dry mouth. There are many reasons why a patient can suffer from xerostomia.

- Normal age-related changes to the salivary glands and their reduced ability to function, as occurs with all body tissues over time.
- Low fluid intake over a period of time, or even dehydration. This often occurs with the elderly, especially those who live alone.
- Some autoimmune disorders, especially **Sjögren's syndrome** which specifically affects the salivary glands and the lacrimal glands of the eyes, which produce tears.
- Several routinely prescribed drugs have the side-effect of reducing salivary flow, including **diuretics** (prescribed to alleviate water retention in patients with heart failure), some **antidepressants** (prescribed to alleviate anxiety), and **beta-blockers** (prescribed to slow down the heart rate, especially in angina sufferers).

Reduced salivary flow has several important and detrimental consequences to the oral health of the patient, and is therefore also of importance to the oral health team.

- Reduced self-cleansing in the oral cavity allows more food debris to accumulate around the teeth, increasing plaque biofilm production and

therefore the likelihood of caries and periodontal disease developing.

- It will also allow food debris to stagnate in the mouth, causing **halitosis** (bad breath).
- Reduced buffering of the oral environment allows longer and more frequent acid attacks to occur, increasing the likelihood of caries developing.
- Poor lubrication of the oral soft tissues makes speech and swallowing more difficult.
- Reduced amounts of water in the saliva has a detrimental effect on the patient's sensation of taste.
- Reduced salivary flow and reduced volume of saliva in the mouth will make the retention of dentures more difficult, especially a full denture which relies on a good suction film between it and the oral soft tissues to stay in place.

The opposite condition to xerostomia, that of excessive saliva production, is called *ptyalism*, which is often seen in patients with periodontal disease. It can also occur in patients with Parkinson's disease (a debilitating and progressive neurological disease affecting the muscles) and in pregnancy.

Diagnosis of caries

Before caries can be treated, it must first be detected. Early diagnosis is very important in controlling the extent of the damage done to the tooth structure, as well as the level of discomfort experienced by the patient. The earlier a cavity is detected, the better the chance of saving the tooth. This is why regular dental examinations are recommended, and the frequency of attendance should be determined by the caries experience of the patient – those with a high caries incidence need to be examined more frequently than others. Unfortunately, these are often the very patients who do not attend regularly for dental examination, for whatever reason.

Large cavities are obvious to the naked eye but it is easier to treat caries before cavities reach such a size. The dentist has various methods available for detecting smaller carious lesions.

- Close visible inspection under magnification (Figure 11.7), with the help of a bright examination light and a mouth mirror to reflect the light onto less visible areas where necessary.
- The use of various **blunt dental probes** to detect any stickiness in suspicious areas, particularly a **sickle probe** or **right-angle probe** for occlusal surfaces, and a special double-ended **Briault probe** for interproximal areas (Figure 11.8).
- **Transillumination** of anterior teeth, using the curing light to shine through their contact points and viewed from behind with a mouth mirror to

detect any shadowing (Figure 11.9).

- **Caries dyes** wiped into prepared cavities to visibly stain any residual bacteria still present and allow their removal.
- Periodical **horizontal bite-wing radiographs** (Chapter 12) to detect interproximal caries in posterior teeth.
- These can also detect **recurrent caries** beneath existing restorations, as well as early caries beneath occlusal fissures.

Figure 11.7 Enamel undermined by caries distally in the upper left central incisor.

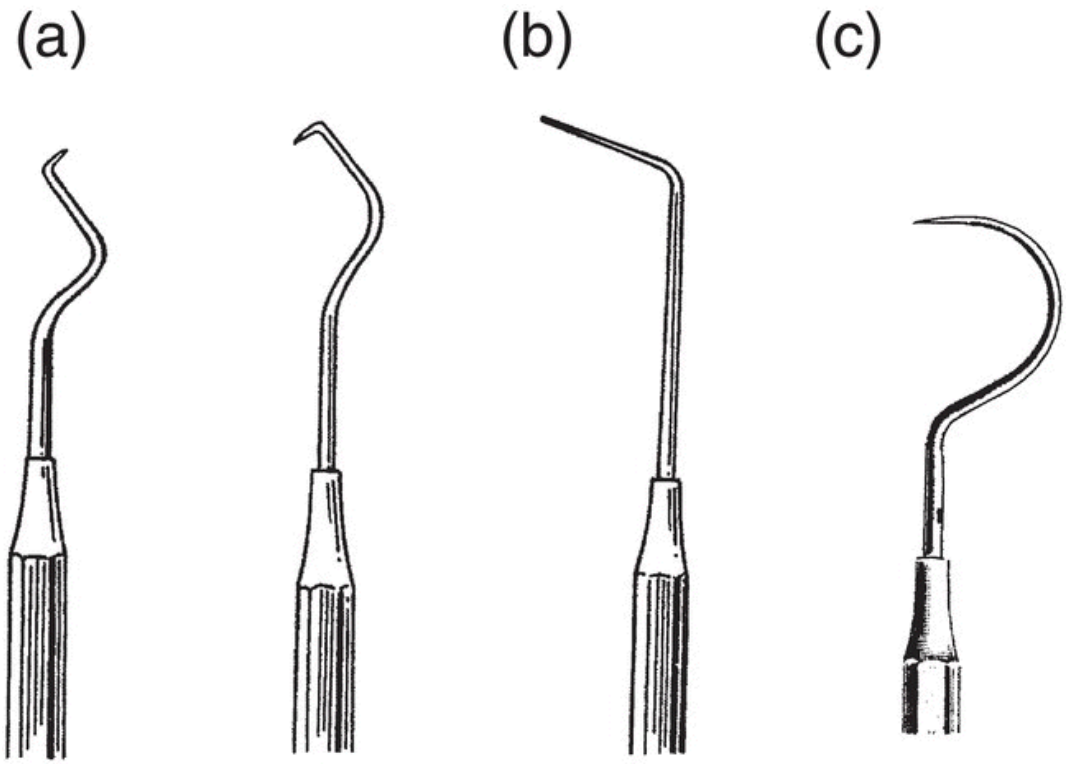


Figure 11.8 Probes. (a) The two ends of a Briault probe. (b) Right angle probe. (c) Sickle probe.

Figure 11.9 Transillumination technique to detect interproximal shadowing.

Although probes have traditionally been manufactured as sharp instruments, it is now realised that they may pierce and damage the enamel in the earliest stages of caries. For early detection of occlusal caries, current advice is to thoroughly clean and dry the surface, and carefully examine it with the aid of a very bright light and magnification. Early caries will then be indicated by loss of the normal shiny enamel surface, and its transition to a dull white matt appearance. Early mesial and distal caries is detected with bite-wing X-ray films, as already described.

The assessment methods used to diagnose and record the presence of carious lesions are discussed in detail in Chapter 12.

Prevention of caries

Caries is a breakdown of the mineralised tooth structure, caused by acid produced by plaque bacteria from dietary free sugars. Therefore, there are three main areas of caries prevention available.

- **Modification of the diet**: include fewer cariogenic foods and drinks containing free sugars, and to reduce the frequency of their intake.
- **Control of bacterial plaque**: carry out regular and thorough removal of the plaque biofilm, using good oral hygiene techniques.
- **Increase tooth resistance to acid attack**: by incorporating fluoride into its crystal structure.

All these methods of caries prevention are discussed in detail in Chapter 13.

Non-carious tooth surface loss

The enamel surface of the tooth can be lost due to causes other than dental caries, specifically by the following processes:

- Erosion
- Abrasion
- Attrition
- Abfraction

Erosion

Erosion occurs due to the action of extrinsic acid on the enamel. This is dietary acid that has been directly ingested in foods or drinks by the patient, rather than that produced by the action of oral bacteria on ingested carbohydrates within the mouth. The usual dietary sources of these extrinsic acids are as follows:

- Carbonated fizzy drinks, whether labelled as 'diet' or 'zero sugar' types or not; the fact the drink is carbonated (has had carbon dioxide gas incorporated into it to make it fizzy) makes the resultant liquid acidic.
- Acidic fruits such as lemons, oranges, limes and grapefruit which are eaten raw in large quantities.
- Pure juices of the above fruits, especially when consumed in large quantities and between meals.
- Wines, whether red, rosé or white.
- Excessive vinegar consumption, either sprinkled on foods such as chips or consumed as pickled food products.

In a similar way, there are some medical conditions and eating disorders that involve the regular regurgitation, or actual vomiting, of the stomach contents into the mouth. As described in Chapter 5, the gastric juices of the stomach are very acidic (pH 2), and have a similar erosive effect on the tooth enamel as extrinsic acids. Some likely conditions and disorders are listed below (see Chapter 5 for details of general anatomy).

- Bulimia: an emotional disorder where periods of compulsive overeating are followed by episodes of self-induced vomiting.
- Reflux oesophagitis: a condition where the weakened muscle ring at the base of the oesophagus allows the stomach contents to reflux (flow back) into the oesophagus, and up into the mouth.
- Hiatus hernia: an abnormal protrusion of part of the stomach up through the diaphragm, allowing reflux to occur more readily.

- Stomach ulcers: ulcerous breaches of the internal stomach wall, often due to stress-related excess acid production in the stomach.
- Some chemotherapy treatments for cancer.

In contrast to tooth surface loss due to dental caries, no bacteria are involved in the enamel loss caused by erosion. The tooth surface appears pitted and worn but shiny and clean, with no plaque present. Erosion particularly affects the labial or palatal surfaces of the upper incisors, and the occlusal surfaces of the lower molars (Figure 11.10). The teeth affected are often hypersensitive to hot, cold and sweet stimulation as the underlying dentine is exposed. This therefore mimics the symptoms of caries, but no cavity is present.

Figure 11.10 Enamel erosion affecting the occlusal surfaces of the lower right molars.

Treatment of erosion does not necessarily involve restoration, but does involve all the following:

- Dietary and/or medical advice.
- Desensitisation of the dentine, either at the chairside using specific dental products or by the patient using specific oral hygiene products on a regular basis.
- The use of high-concentration fluoride toothpastes and mouthwashes to help restore the pH balance of the oral cavity (Figure 11.11).

Figure 11.11 High-fluoride toothpaste and mouthwash to combat erosion damage.

Abrasion

Abrasion occurs when patients scrub their teeth using excessive side-to-side sawing forces, rather than brushing them correctly to remove plaque. The condition is especially seen in smokers with significant tar staining on their teeth, who either brush with a sawing action or use abrasive smokers' toothpastes to remove the stains.

Abrasion is seen at the cervical necks of the teeth, as a deep ridge on the buccal or labial surfaces (Figure 11.12). The surface is shiny rather than carious, and

sometimes the ridge is deep enough to see the pulp chamber within the tooth itself. Again, no bacteria are involved in the production of these lesions, and the patient often experiences hypersensitivity with temperature changes. As the ridges can be so deep, they are often restored with glass ionomer cements or composites (Chapter 15). In extreme cases the pulp can be exposed, and endodontic treatment will be required to save the tooth from extraction.

Figure 11.12 Abrasion cavities of the upper right premolars and first molar.

Attrition

Attrition is the loss of enamel specifically from the biting surfaces of the teeth (incisal or occlusal), and is caused by any of the following:

- Normal wear and tear of chewing, especially in older patients (Figure 11.13).
- Occlusion of natural teeth onto ceramic restorations, such as crowns and bridges (see Chapter 16).
- **Bruxing**: the abnormal, and often subconscious, action of clenching and grinding the teeth, usually over a prolonged period.

Figure 11.13 Tooth attrition with severe incisal wear.

Bruxing is a very common condition, seen in many patients but especially those under stress. It can also occur habitually while undertaking repetitive tasks, such as while exercising. Besides the obvious enamel loss and tooth fracture that occur due to bruxing, patients often experience face pain and disruption of the TMJ. The joint and the muscles of mastication go into spasm in severe cases, and can cause jaw clicks or even jaw locking. Various muscle relaxants, anti-inflammatory drugs and occlusal splints can be used to alleviate these symptoms, but the reason for the bruxing must also be investigated and reduced or removed.

Abfraction

Abfraction is the specific loss of tooth in the cervical (neck) region, due to the shearing forces that occur by overloading single standing teeth. It appears visibly as an abrasion cavity but can affect the buccal, lingual or palatal surfaces of a tooth and will occur suddenly rather than as a gradual loss of tooth structure, as happens with abrasion.

The teeth affected are usually single standing premolars, especially where the molars have been lost in the same jaw (Figure 11.14). Treatment involves not only restoration of the affected tooth but also replacement of any missing teeth to reduce the occlusal loading of the affected tooth and prevent a recurrence of the tooth loss.

Figure 11.14 Abfraction of untreated lower left first premolar with resultant caries.

Periodontal disease

Periodontal disease affects the supporting structures of the teeth: the gingivae, the periodontal ligament (formerly called the periodontal membrane) and the alveolar bone. In addition, the intimate anatomical relationship between the cementum covering the tooth root and the periodontal ligament accounts for the cementum being included as a supporting structure, and therefore being affected by periodontal disease too.

Periodontal disease and caries are among the most common diseases of civilisation, with many archaeological examples of skulls exhibiting tooth cavities and periodontal bone loss dating back many hundreds of years. In modern times, caries is the major cause of tooth loss in children and young adults, while periodontal disease is the major cause in older people. This does not mean that periodontal disease starts much later in life, only that it takes so much longer than caries to cause tooth loss. Indeed, there is a relatively uncommon but specific type of periodontal disease that begins in childhood rather than in adults, called *juvenile periodontitis*.

The earliest stage of periodontal disease is *chronic gingivitis* which is a chronic inflammation involving the gingivae alone. This can occur in a localised area and affect only a few teeth, or it can occur generally and affect the majority of the dentition. Once present and if allowed to continue, the chronic inflammation spreads deep into the underlying cementum and periodontal ligament, and eventually to the alveolar bone. These structures are gradually destroyed and the teeth become very loose as their supporting tissues are lost. The name given to this late stage of the disease is *chronic periodontitis*. There is no obvious dividing line between the two stages, as untreated chronic gingivitis usually progresses to chronic periodontitis.

Although the disease process occurs gradually, there are usually intermittent episodes of disease activity occurring throughout quiescent phases of no activity, in a sporadic manner.

Causes of periodontal disease

Periodontal disease is a bacterial infection of the supporting structures of the tooth, caused by an initial accumulation of *bacterial plaque biofilm* at the gingival margin of the tooth. Plaque biofilm is a tenacious transparent film of saliva, micro-organisms and oral debris on the tooth surface (Figure 11.15). Food debris adheres to plaque and the resultant paste of saliva and food remnants attracts more micro-organisms which feed and multiply on it.

Figure 11.15 Gingival plaque present on the lower anterior teeth.

It is the same plaque as that involved in the onset of dental caries. However, whereas caries can only occur when sugar is present in the plaque to form the acids that cause enamel demineralisation, the presence of sugar is not necessary for periodontal disease to occur. Any sort of food debris will allow plaque microbes to proliferate and cause periodontal disease.

Plaque can be removed by adequate toothbrushing and other oral hygiene techniques, but in the absence of these counter-measures the biofilm thickens as its microbial population flourishes amid a permanent food supply. Toxic by-products of the plaque micro-organisms then act as a continual source of bacterial irritation which causes chronic inflammation of the gum margin (chronic gingivitis). The plaque extends above and below the gum margin, and wherever it is present *calculus* (tartar) formation can occur.

Calculus is the hard rock-like deposit commonly seen on the lingual surface of lower incisors. Two factors are necessary for its formation: plaque and saliva. Their interaction allows mineralisation to occur within the plaque and produce a deposition of calculus, which may be defined as solidified plaque. It is most easily seen opposite the orifices of salivary gland ducts on the lingual surface of lower incisors and the buccal surface of upper molars. This visible calculus on the crowns of teeth has a yellowish colour and is called *supragingival calculus* as it forms above the gum margin. However, it also occurs in plaque beneath the gum margin on all teeth and in that situation it is known as *subgingival calculus*. This is harder and darker than supragingival calculus and its surface is covered with a layer of the soft microbial plaque from which it was formed.

Calculus plays only a *passive* mechanical role in periodontal disease. Its rough surface and ledges create food traps which are inaccessible to a toothbrush and thus allow even more food debris to fertilise the plaque. The *active* role in periodontal disease belongs to plaque micro-organisms.

This description shows that supragingival plaque and calculus are associated with poor oral hygiene. If teeth are cleaned properly the plaque and calculus are less able to accumulate. However, if they are allowed to do so, they spread subgingivally and become inaccessible to toothbrushing and other oral hygiene techniques available to the patient.

Furthermore, there are some additional reasons for potential plaque formation which are not the patient's fault. These are caused by imperfect dentistry and are known as *iatrogenic factors*, such as:

- fillings or crowns which have an overhanging edge at their cervical margin
- fillings or crowns with loose contact points
- ill-fitting or poorly designed partial dentures.

These defects are food traps which act as stagnation areas that the patient cannot keep clean. Plaque and calculus proliferate here and periodontal disease follows at these sites, even though the rest of the mouth may be perfectly healthy. Food stagnation also occurs on unopposed and irregular teeth, with consequent susceptibility to periodontal disease as well as caries. The full microscopic sequence of events leading to periodontal disease is described later in this chapter.

Periodontal tissues in health

To be able to recognise the presence of periodontal disease, the appearance of these tissues in health must first be realised. This appearance is illustrated in Figure 11.16 and anatomically is as follows:

- The tooth sits in its socket within the alveolar bone.
- It is attached to the bone by the fibres of the periodontal ligament, which run from the cementum of the root into the alveolar bone.
- Other periodontal ligament fibres run from the alveolar bone crest to the neck of the tooth, and from the neck of the tooth into the gingival papilla.
- The bone and the periodontal ligament are covered by the mucous membrane of the gingiva which lines the alveolar ridges.
- The gingiva is attached directly to the neck of the tooth itself at a specialised site called the **junctional epithelium**.
- In health, a gingival crevice of up to 3 mm deep runs as a 'gutter' around each tooth, the deepest part of which is the attachment of the junctional

epithelium. Looking at the tissues in the mouth, then, the gingiva is pink with a stippled appearance like orange peel (ethnic colour variations will occur).

- There is a tight gingival cuff around each tooth, with a gingival crevice no deeper than 3 mm.
- The interdental papillae between the teeth are sharp, with a knife-edge appearance (Figure 11.17).
- No bleeding occurs when the gingival crevice is gently probed during the dental examination.
- Subgingivally, the periodontal ligament and alveolar bone are intact; this will only be visible on X-ray.

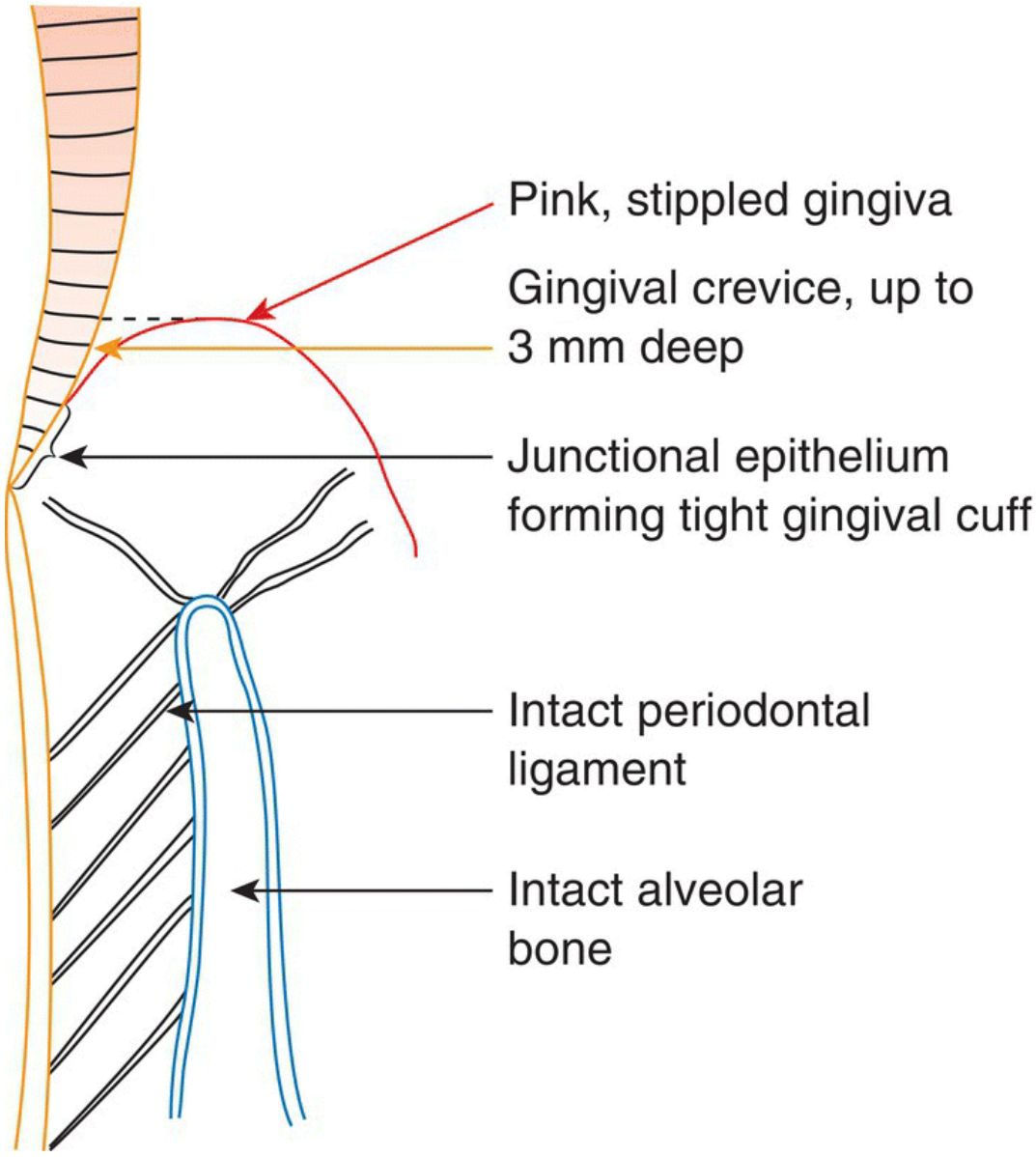


Figure 11.16 Periodontium in health.

Figure 11.17 Knife-edge papillae in healthy periodontium.

If plaque is allowed to accumulate around the gingival margins of the teeth, the gingiva will become inflamed and the first stage of periodontal disease, *gingivitis*, will develop. When this is a generalised condition affecting the oral cavity as a whole because of poor oral hygiene, it is called *chronic gingivitis*.

Chronic gingivitis

The sequence of events that occur microscopically and lead to chronic gingivitis is illustrated in Figure 11.18.

- The bacteria within the plaque at the gingival margins use food debris to nourish themselves, so that the colony grows in size.
- They produce **toxins** (poisons) as a by-product during their own food digestion.
- These toxins tend to accumulate in the gingival crevice, as they are not removed by oral hygiene measures, nor washed away by the normal cleansing action of saliva.
- The gingiva in direct contact with the toxins becomes irritated, causing inflammation and the early signs of **chronic gingivitis**.
- The inflamed gingiva becomes red in colour, and the swelling associated with the inflammation creates **false pockets** around the necks of the teeth – there appears to be a deepening of the gingival crevice but it is due to the

swelling only, not to a loss of attachment between the junctional epithelium and the tooth (Figure 11.19).

- The presence of these false pockets allows more plaque to accumulate, as cleansing becomes even more difficult, and the plaque now begins to extend below the gingival margin.
- In this environment, there is little oxygen available for the initial bacteria to use, and the plaque becomes colonised by specialised bacteria that are able to survive without oxygen, called **anaerobic bacteria**.
- Examples of these are ***Actinomyces***, ***Porphyromonas gingivalis*** and ***Prevotella intermedia***, bacteria specifically associated with periodontal disease.
- In the meantime, the inorganic ions within saliva are incorporated into the structure of the plaque so that it hardens and mineralises as **dental calculus** develops.
- Calculus forming above the gingival margin is called **supragingival calculus** and is **yellow** in colour (Figure 11.20).
- That forming below the gingival margin is called **subgingival calculus** and is **brown** in colour, due to the blood pigments incorporated into it from the bleeding gingival tissues.
- The rough surface of the calculus irritates the gingiva further, and allows more plaque to develop on it.
- The rough calculus and the irritation of the bacterial toxins cause painless **micro-ulcers** to develop within the gingiva, so that they **bleed** on touch or gentle probing.
- The red swollen gingiva and the presence of bleeding on probing are the classic visible signs of **chronic gingivitis**.

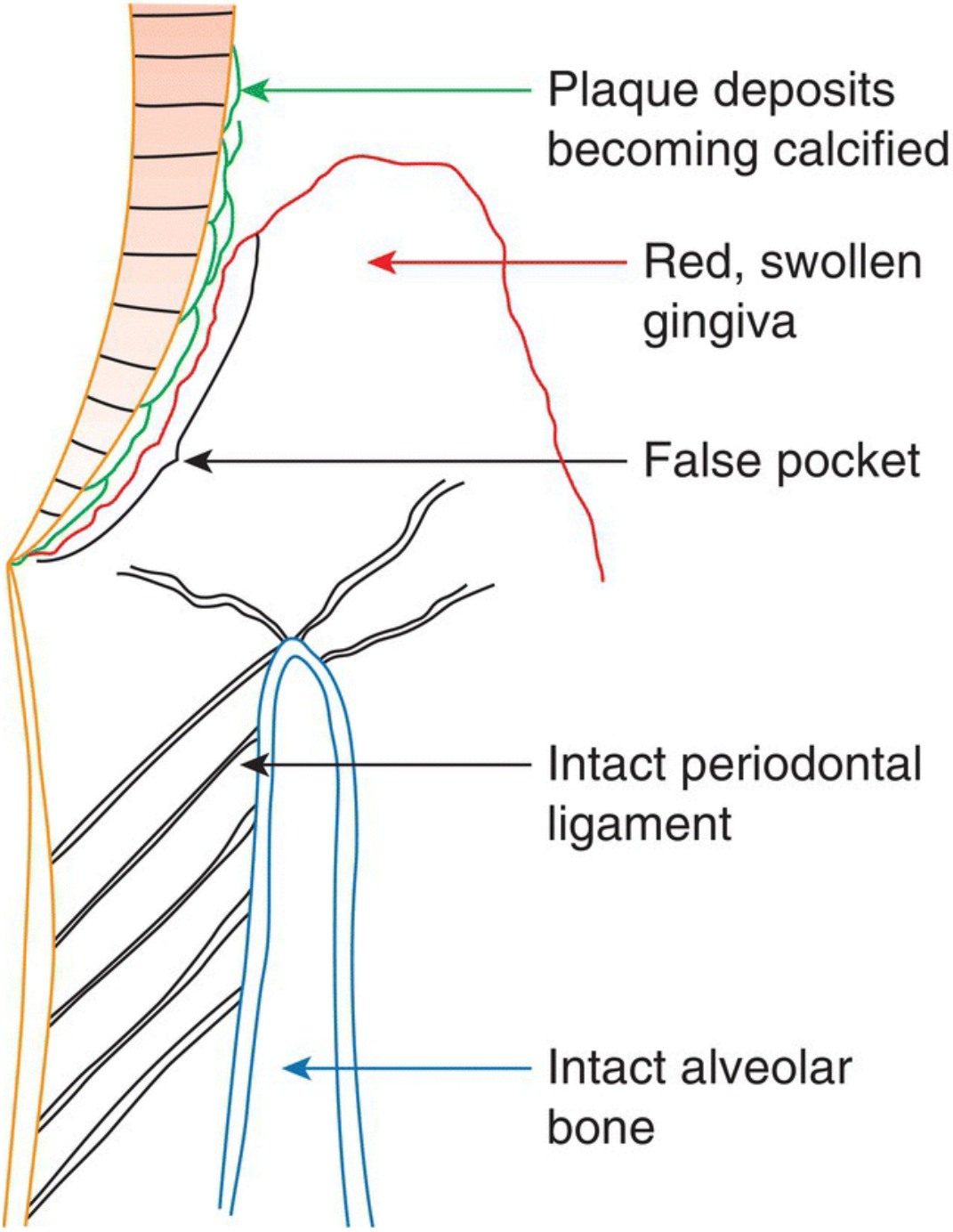


Figure 11.18 Chronic gingivitis.

(a) (b)

Figure 11.19 (a) Localised gingivitis between right incisors. (b) Chronic gingivitis with generalised false pockets and demineralised enamel.

Figure 11.20 Lingual rim of supragingival tartar.

Chronic gingivitis is fully reversible if the plaque and calculus are completely removed from above and below the gingival margins. This requires the intervention of the dental team, and then the patient must maintain a good standard of oral hygiene regularly to prevent a recurrence.

Chronic periodontitis

If chronic gingivitis is not treated, microbial poisons from the plaque soak through the micro-ulcers in the gingival crevice and penetrate the deeper tissues. These poisons gradually destroy the periodontal ligament and alveolar bone and while this is progressing the gingival pocket deepens, thus further aggravating

the condition. Whereas the false pockets of chronic gingivitis are caused by inflammatory swelling of the gum only, in chronic periodontitis they are *true pockets* caused by destruction of the base of the gingival crevice and its attachment to the tooth. In other words, the attachment between the junctional epithelium and the tooth surface is lost.

At the same time the gingival margin may recede, exposing the root to view. This *gingival recession* is commonly known as being *long in the tooth*. If no treatment is provided, so much bone is lost that the teeth eventually become too loose to be of any functional value.

The sequence of events that occur microscopically in the development of chronic periodontitis is illustrated in Figure 11.21.

- The bacterial toxins build up within the false pockets and eventually begin soaking into the gingival tissue itself, through the micro-ulcerated areas.
- Here, they gradually destroy the periodontal ligament and the attachment of the tooth to its supporting tissues, and a **true pocket** forms.
- The loss of attachment gradually moves down the tooth root, creating deeper pockets which allow more plaque and calculus to develop within them.
- The toxins eventually begin attacking the alveolar bone itself, destroying the walls of the tooth socket so that the tooth becomes loose.
- This is often the first indication that the patient has of the presence of their disease, as it is usually painless and often takes several years to reach this point.
- Periodontitis also tends to have intermittent active phases where much tissue destruction occurs, interspersed with quiet phases of little bacterial activity, rather than occurring as a gradually progressive condition.

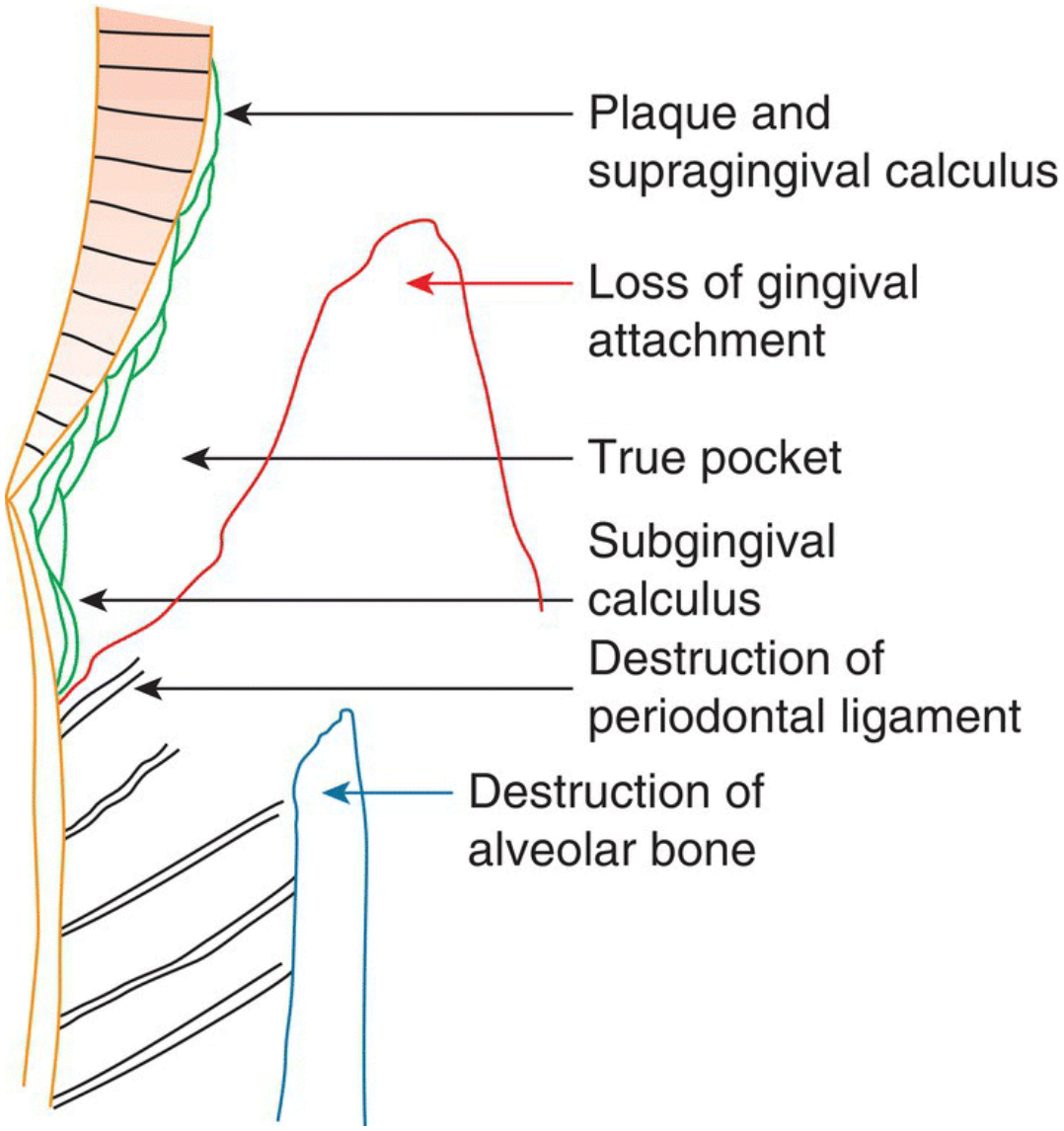


Figure 11.21 Chronic periodontitis.

This description of periodontal disease follows a slowly progressive but painless course of several years but, during that time, pus and micro-organisms in the pockets cause bad breath (*halitosis*). In addition, it has now been established that there is an association between the long-term leakage of inflammatory and bacterial products into the blood circulation and the occurrence of cardiovascular disease and type 2 diabetes. Further associations are emerging between chronic periodontitis and other diseases including some dementia disorders, rheumatoid arthritis, chronic kidney disease and osteoporosis.

Once periodontal disease is actually established it can be made worse by certain other factors which do not in themselves cause the disease alone.

- Smoking.

- Unbalanced or excessive masticatory stress.
- Natural hormonal changes such as puberty and pregnancy.
- Open lip posture (such as occurs during mouth breathing).

Certain medical conditions and drugs may also have the same effect.

- Diabetes (types 1 and 2), AIDS, leukaemia, and other blood disorders or diseases where resistance to infection is poor; these patients are referred to as being **immunocompromised**.
- Epilepsy treated with phenytoin (Epanutin).
- Vitamin C deficiency.
- Treatment with immunosuppressant drugs such as ciclosporin and cytotoxic agents (used to fight cancers).

Dental plaque forms in everyone's mouth a short time after toothbrushing, but some factors exacerbate its accumulation in certain areas and in some patients' mouths. These are called *plaque retention factors*, some of which have already been mentioned.

- Poor oral hygiene due to patient apathy.
- Poorly aligned teeth, which increases the number of stagnation areas available for plaque to accumulate (Figure 11.22).
- Incompetent lip seal, which allows the oral soft tissues to dry out and prevents the self-cleansing action of saliva.
- Small oral aperture, which makes effective toothbrushing more difficult for the patient to achieve.
- Iatrogenic causes (poor density), such as poorly finished restorations or poorly fitting partial dentures.

Figure 11.22 Severe crowding with inadequate tooth cleaning.

The rate of progress of periodontal disease depends on the balance between the patient's individual resistance to the bacterial attack and the toxic effects of plaque bacteria. Both these factors vary from time to time and in different parts of the mouth, and the predominant one will determine whether the disease appears dormant or progressive.

Diagnosis of periodontal disease

The diagnosis of periodontal disease is based on the medical history, appearance and recession of the gums, depth of gingival pockets, amount of bone loss, tooth mobility and the distribution of plaque.

Medical history

Periodontal disease affects the vast majority of the population, but most people are otherwise healthy and the disease should be curable if they exercise adequate plaque control. However, patients with certain conditions are more at risk of severe periodontal disease and less likely to respond so favourably to treatment.

A regularly updated medical history is an essential feature of all patients' records, whatever their reason for attendance or the treatment required. As far as periodontal disease is concerned, the dentist will be particularly interested in:

- past and present illnesses
- drugs prescribed

- hormonal changes (e.g. pregnancy)
- smoking habits.

Relevant illnesses are those where resistance to infection is low.

- Diabetes, leukaemia and other blood disorders.
- Vitamin deficiencies.
- AIDS.
- Treatment with immunosuppressant drugs, such as ciclosporin, used for some types of cancer and for organ transplant patients.
- Patients at risk of infective endocarditis may require antibiotic cover prior to scaling and periodontal surgery; this will need to be clarified with their cardiologist.

Certain drugs can cause a severe non-inflammatory enlargement of the gums called *gingival hyperplasia*, which requires surgical correction.

- Phenytoin (Epanutin) used to control epilepsy.
- Nifedipine (and other similar drugs) used to control angina pectoris and reduce high blood pressure.
- Ciclosporin used to prevent organ rejection after transplant.

There are many clinical signs that the dentist will look for at a routine dental examination to determine if periodontal disease is present. The signs of early-onset chronic gingivitis are as follows:

- The gingiva bleed on brushing or on gentle probing.
- They appear visibly red and swollen.
- Plaque is visible at the gingival margins of the teeth, or can be shown using disclosing solution (see Chapter 12).
- The patient has halitosis.

With established gingivitis, pus can be expressed from the gingival crevice when the gingiva is gently pressed.

The clinical signs of the presence of chronic periodontitis are as follows:

- Periodontal probing detects pockets greater than 3 mm.
- Both supragingival and subgingival calculus will be present.
- Some teeth may be mobile.

- Radiographs will show destruction of the alveolar bone in long-standing cases, with associated deep periodontal pockets present.

It can be seen that one of the early diagnostic signs of periodontal problems is bleeding of the gingiva. The nicotine from tobacco smoking acts on the gingival blood vessels to constrict them, causing less bleeding, if any. The resultant lack of bleeding on brushing or probing masks the presence of periodontal disease in smokers, so that the disease is not evident to either the patient or the dentist without other clinical signs being present.

The easiest assessment carried out by the dentist is to determine the presence of periodontal pockets, by using special *periodontal probes* (Figure 11.23).

Figure 11.23 Periodontal probes. (a) WHO/BPE probe. (b) Williams probe. (c) UNC probe.

Basic periodontal examination

Normal healthy gums are firm and pink (ethnically variable) and do not bleed. They have a stippled surface, and the gingival crevice is no deeper than 3 mm. In chronic gingivitis the gums have a soft smooth surface, are darker in colour and swollen, bleed on pressure, and have a deeper gingival crevice which may contain subgingival calculus. In chronic periodontitis these gingival changes may not be so obvious, as pockets are deeper and the active disease processes are occurring out of sight at that deeper level.

Tooth mobility and the appearance of the gums are easily checked. Detection of plaque and subgingival calculus, and the assessment of pocket depth, gingival recession and bone loss require examination with periodontal probes and the use of special charts, such as the example shown in Figure 11.24. Computer dental software programs also have similar versions of periodontal charting screens

available for users. Dental nurses are advised to study the definitive format and accepted notation of the current periodontal charts in the current version of the NEBDN charting booklet.

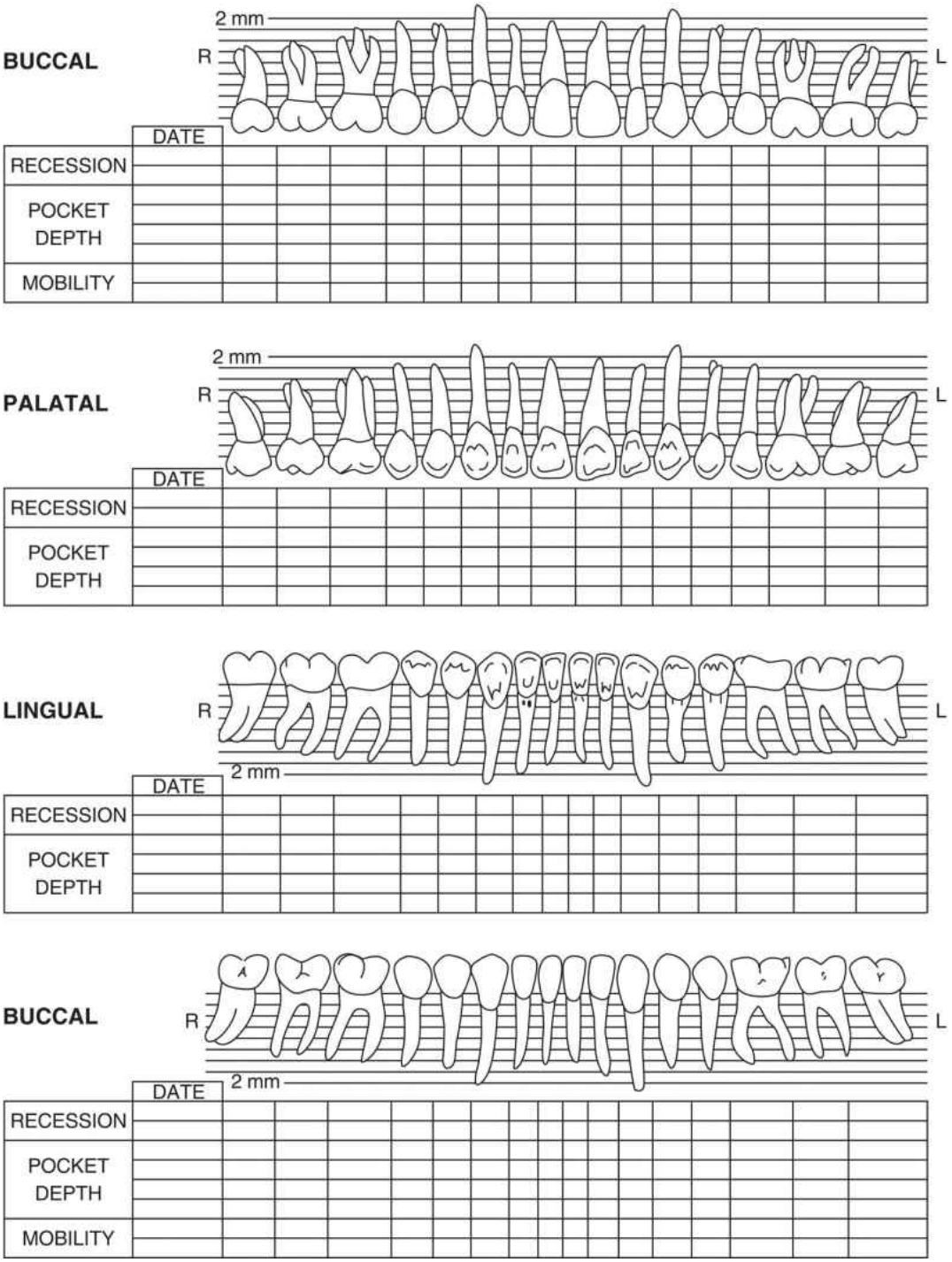


Figure 11.24 Example of periodontal charting sheet.

A WHO probe, also known as a Community Periodontal Index of Treatment Needs (CPITN) or basic periodontal examination (BPE) probe (Figure 11.23a), is

often used for initial screening and charting. This has several measured shaded bands which indicate pocket depth by the measurable amount of band showing (if any) after insertion into the gingival crevice, and a tiny ball on the end which detects subgingival calculus and prevents any bleeding that would otherwise be caused by a sharp point.

A Williams pocket measuring probe (Figure 11.23b) may also be used for periodontal charting. This has a blunt end with a millimetre scale marked on it. When inserted into the gingival crevice, the pocket depth is read off from the scale. Although the measurement can be more accurately read (as it is scored in millimetres rather than a shaded range, like the BPE probe), the lack of shading can make it difficult to read sometimes.

A combination of the two (shading and millimetre measurements) is available with the University of North Carolina (UNC) probe (Figure 11.23c), which is a popular choice for accurate periodontal assessment nowadays.

Subgingival calculus may be specifically detected with a *calculus probe*. This resembles a Briault probe but has blunt ends which catch on the rough scales of calculus in the gingival crevice.

The presence of periodontal bone loss can be assessed from pocket depth measurements and dental radiographs (see Chapter 12). As true pockets extend almost to the bone margin, a pocket measuring probe will indicate the amount of bone loss present. X-rays show this as well, together with the presence of interdental calculus and the cervical edges of restorations (Figure 11.25).

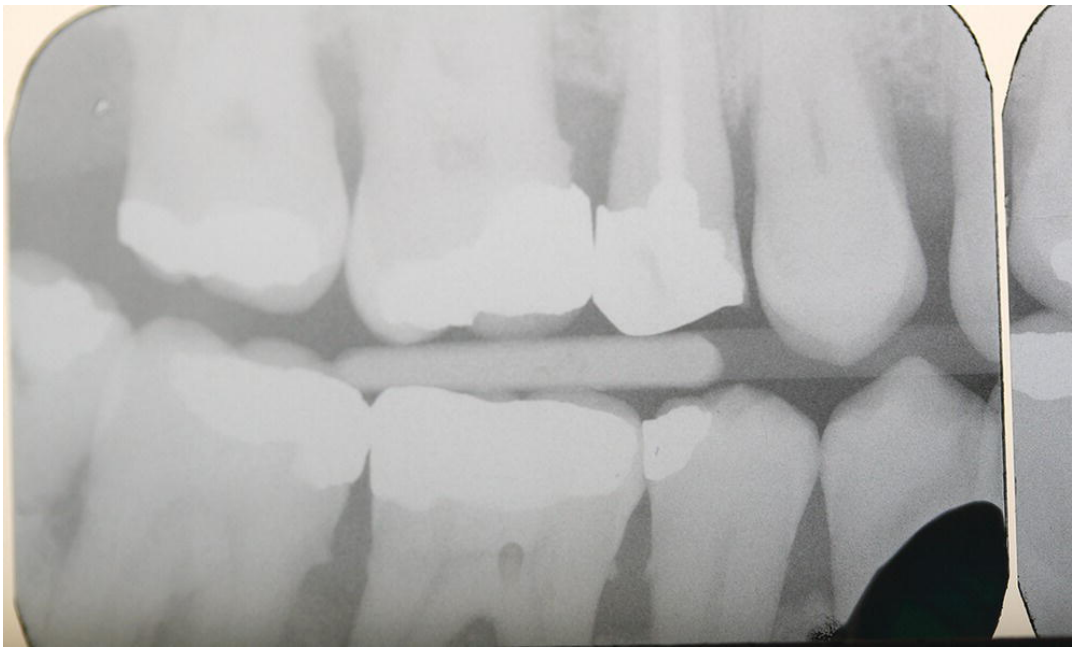


Figure 11.25 Radiograph showing the presence of interdental calculus.

Plaque is normally invisible as it is a thin transparent film, but is visible to the trained eye as a creamy white deposit on the gingival margin of the tooth.

However, if a coloured dye is painted on the teeth, supragingival plaque becomes stained and shows up clearly. Dyes used for this purpose are called *disclosing agents* (Figure 11.26). This part of the examination is left until last as the coloured dyes can mask any gingival colour changes that are already present.

Figure 11.26 Disclosed teeth showing the extent of plaque present.

Periodontal charting

Full details of the assessment methods used to detect periodontal disease are discussed in Chapter 12, while oral disease prevention is discussed in Chapter 13. A brief summary of periodontal charting is given here.

Whereas the mouth is divided into quarters (quadrants) for tooth charting (Chapter 12), sixths (sextants) are used for basic periodontal charting. The sextants are upper and lower, left, centre and right:

- molar sextant (8, 7, 6)
- premolar and canine (5, 4, 3)
- incisor (2, 1).

A periodontal probe is used to determine the presence of any features indicating periodontal disease in each sextant, graded from 0 to 4 (see Chapter 12), and then scored as the highest number recorded in that sextant. Higher numbers (3 and 4) will instigate the recording of individual pocket depths at their precise location, often using a periodontal chart such as that shown in Figure 11.24.

A similar sextant system is used by orthodontists for descriptive purposes when assessing the orthodontic treatment needs of patients (see Chapter 12).

Non-surgical treatment of periodontal disease

The prevention of periodontal disease is far more desirable than having to cure it, so good oral hygiene instruction from the dental team from an early age is the best course of action for many patients. Obviously, this is not possible for patients who are seen initially as adults, especially if they already have periodontal disease. Oral hygiene instruction and methods of achieving a good standard of oral hygiene are discussed in Chapter 13.

The oral health messages given by the dental team will need to be reinforced regularly if problems persist, and the advice given will vary for the different age groups. Removal of all plaque and its subsequent control by the patient will bring about a complete resolution of chronic gingivitis. Failure to achieve this will allow calculus to form, and the dental team will then have to intervene to remove it.

Accessible plaque is removed by the patient by *toothbrushing* and *interdental cleaning*. Subgingival plaque and calculus are inaccessible to patients and require removal by members of the dental team during *scaling*. Once these aims have been achieved and then routinely maintained, the causal sources of irritation which produce the disease are lost.

In chronic gingivitis, bleeding ceases, swollen gums return to their normal healthy condition and false pockets are thereby eliminated. The patient's condition is then resolved but strict oral hygiene and regular dental checks are required thereafter to prevent recurrence of plaque and calculus formation.

In chronic periodontitis there is no regeneration of lost bone, but milder cases can be resolved in the same way as chronic gingivitis. In the advanced stages of the disease, scaling alone cannot eliminate true pockets if they are too deep to be accessible. In such cases they are treated surgically by repositioning and/or recontouring the gingival margin as described in Chapter 17.

In this way, even advanced periodontal disease can be arrested but a return of the condition is inevitable unless the patient follows the advice given and the instructions on supragingival plaque control, and also attends regularly for the team to check progress and continue subgingival plaque control.

Apart from scaling and gingival surgery, appropriate treatment is given for any other conditions facilitating plaque retention; for example, unsatisfactory fillings are replaced with margins that are flush with the tooth, poor crowns and dentures are replaced, unopposed teeth are opposed with a denture or bridge, and irregular teeth are ideally straightened.

Although periodontal disease is an infection of the supporting tissues of the teeth by plaque bacteria and other micro-organisms, the use of systemic antimicrobials

alone has little effect in resolving the disease; of much greater importance is the effective and regular removal of both supragingival and subgingival plaque and calculus. As an adjunct to effective oral hygiene and debridement methods, the application of antimicrobial drugs or slow-release chlorhexidine gluconate directly into the gingival crevice and pockets, such as with PerioChip, Dentomycin gel and Gengigel applications, is one method of assisting in the control of plaque in difficult to reach areas that is carried out by some. While the products are useful in helping to manage acute episodes of periodontitis, their routine and long-term usefulness is less clear.

Supragingival plaque control

Supragingival calculus and any overhanging cervical margins of restorations are removed in the surgery. At home, thorough twice-daily toothbrushing by the patient will then keep accessible plaque under control. Appropriate instruction in the surgery, and the use of disclosing agents at home, will show patients how well they are performing and indicate where improvement is required.

Areas of the oral cavity which are inaccessible to an ordinary toothbrush are the interdental spaces above or below the contact points of adjacent teeth (interproximal areas). They can be cleaned with dental floss, interdental brushes (correctly sized) and an interspace brush. The dentist or hygienist must give the patient special instruction in these methods as they can do more harm than good if used incorrectly or unnecessarily.

Dental floss is thread or tape which is worked between the teeth to keep their contact areas clean and dislodge any trapped food debris (Figure 11.27). Where recession of the gum has occurred or gingival surgery has been performed, the resulting interdental spaces may be too large for flossing.

Figure 11.27 Flossing.

Interdental brushes and *interspace brushes* are special types of toothbrush designed to clean interdental spaces and the interproximal tooth surfaces in the same way as floss. The former appear similar to a bottle brush and are available in a range of sizes, depending on the amount of space between adjacent teeth, while the latter have only one tuft of bristles (Figure 11.28).

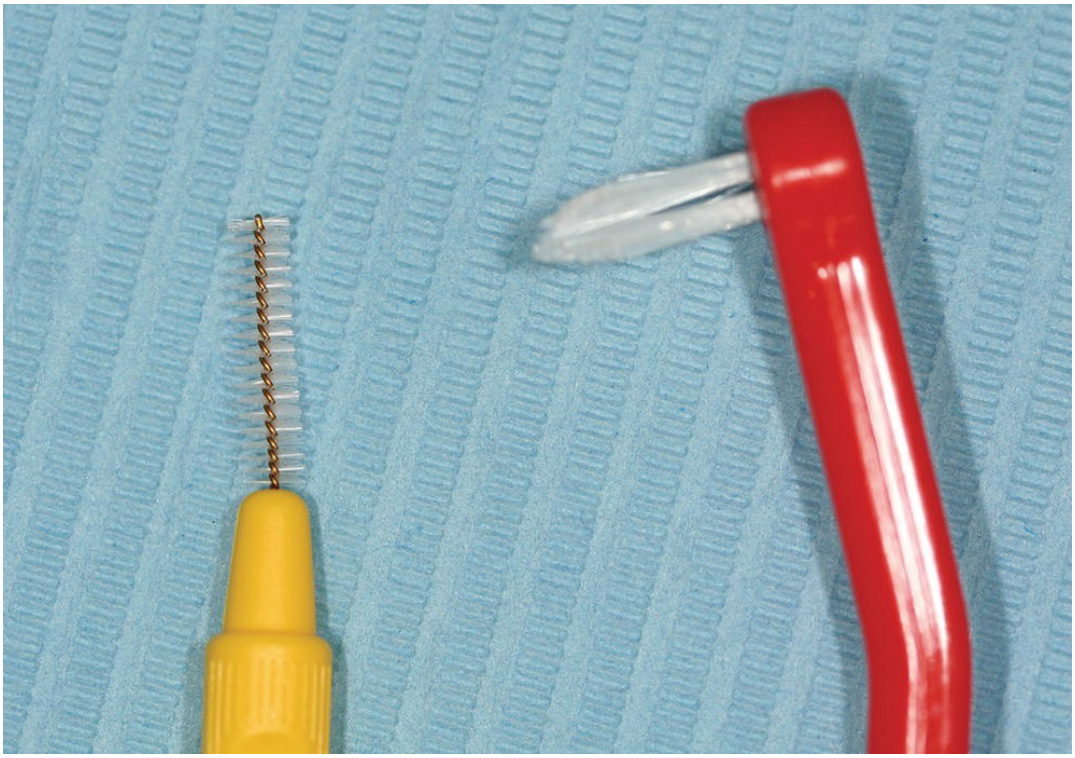


Figure 11.28 Examples of interdental and interspace brushes.

Any calculus present cannot be removed by the patient as it is hardened onto the tooth surface, and instead must be treated by regular scaling. This is done by a dentist, therapist or hygienist and the patient's own efforts at supragingival plaque control are checked at the same time. Supragingival scaling removes plaque and calculus deposits from the enamel surface of the teeth down to the gingival crevice.

Scaling hand instruments are made in various designs appropriate for the removal of calculus from any part of a tooth, and those used for supragingival calculus removal include the following:

- Sickle scaler.
- Cushing's push scaler.
- Jaquette scaler.

Hand scaling is tiring for the operator to carry out but gives excellent tactile sensation, so specks of residual calculus are easily detectable and can be fully removed. Alternatively, an ultrasonic scaler may be used which is much faster and less tiring. However, its action depends on the water spray produced during use, and this can be uncomfortable for patients with sensitive teeth unless performed under local anaesthesia. Once scaling has been completed, the teeth are polished with prophylactic polishing paste using a rubber cup or bristle brush in the slow handpiece (Figure 11.29). The paste is abrasive and removes any

residual surface stains, leaving a smooth tooth surface that slows down the reaccumulation of plaque.

Figure 11.29 Polishing cup and polishing brushes.

Subgingival plaque control

With chronic periodontitis any alveolar bone loss is permanent, although techniques have been developed in the use of synthetic bone in both humans and other animal species, to replace that lost due to natural resorption or periodontal disease. Synthetic bone is now also available for use in dental implant cases, where a patient's remaining alveolar bone is insufficient to support implants alone. In the meantime with periodontal cases, if subgingival calculus is thoroughly and regularly removed by the dental team, and a good standard of oral hygiene is maintained by the patient, there is every chance that the periodontal ligament will reattach and any periodontal pockets will heal.

The instruments used to remove subgingival calculus have to be long enough to reach the base of any periodontal pockets, and thin enough to do so without tearing the gingival tissues. In addition, they are used to scrape the tooth root surfaces and dislodge any contaminated cementum, which is then removed from the pockets by both aspiration and irrigation. This technique is called subgingival/root surface debridement. The instruments used for subgingival scaling and root surface debridement include the following (Figure 11.30):

- Gracey curette.
- Other subgingival curettes.
- Periodontal hoe.

- Ultrasonic scaler.

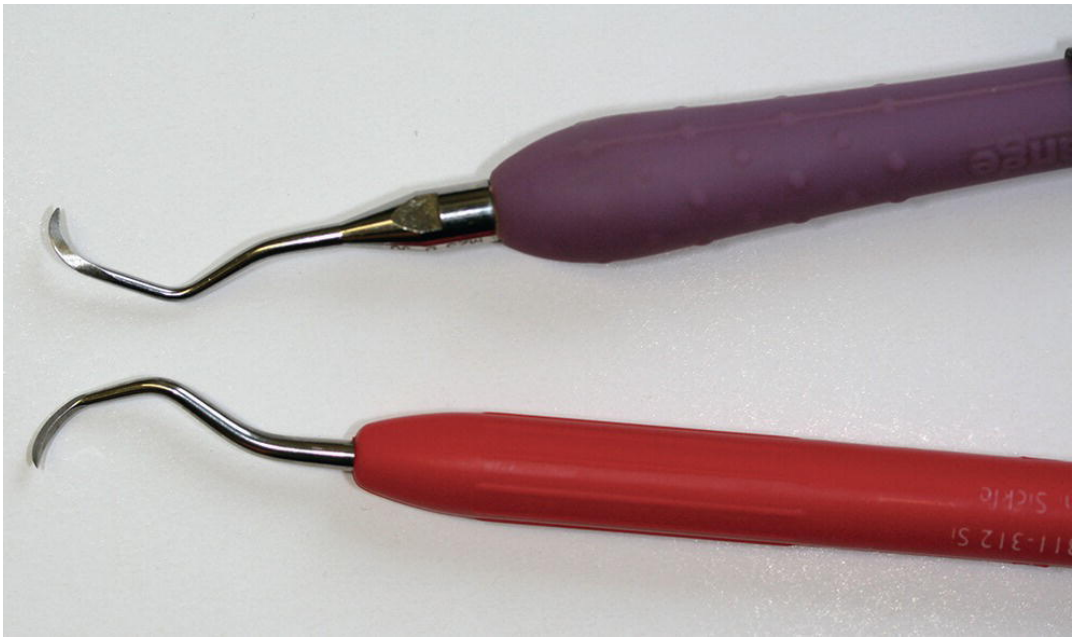


Figure 11.30 Curettes.

Once subgingival debridement is complete, the periodontal tissues can heal and the junctional epithelium can reattach to the tooth surface. In doing so, the periodontal pockets are eliminated.

Subgingival scaling entails much instrumentation within the gingival crevice and pockets. This, in addition to the gingivitis already present, produces considerable bleeding and trauma, and requires the use of local anaesthesia. Scaling with hand instruments is a tedious procedure for operator and patient, but may be done more easily and quickly with an *ultrasonic scaler* (Figure 11.31). This produces ultrasonic vibrations which are transmitted through a cable to a special scaling instrument. When it is applied to a tooth, the vibrations help loosen the plaque and calculus and they are flushed away by a water-cooling spray which is part of the apparatus. The scaling instrument consists of a special handpiece with a range of detachable scaling tips of various shapes. Use of a chlorhexidine mouthwash by the patient, before scaling, reduces the risk of cross-infection of staff. Patients are advised to take analgesic tablets, if required, as the area may feel rather sore for a day or two afterwards.

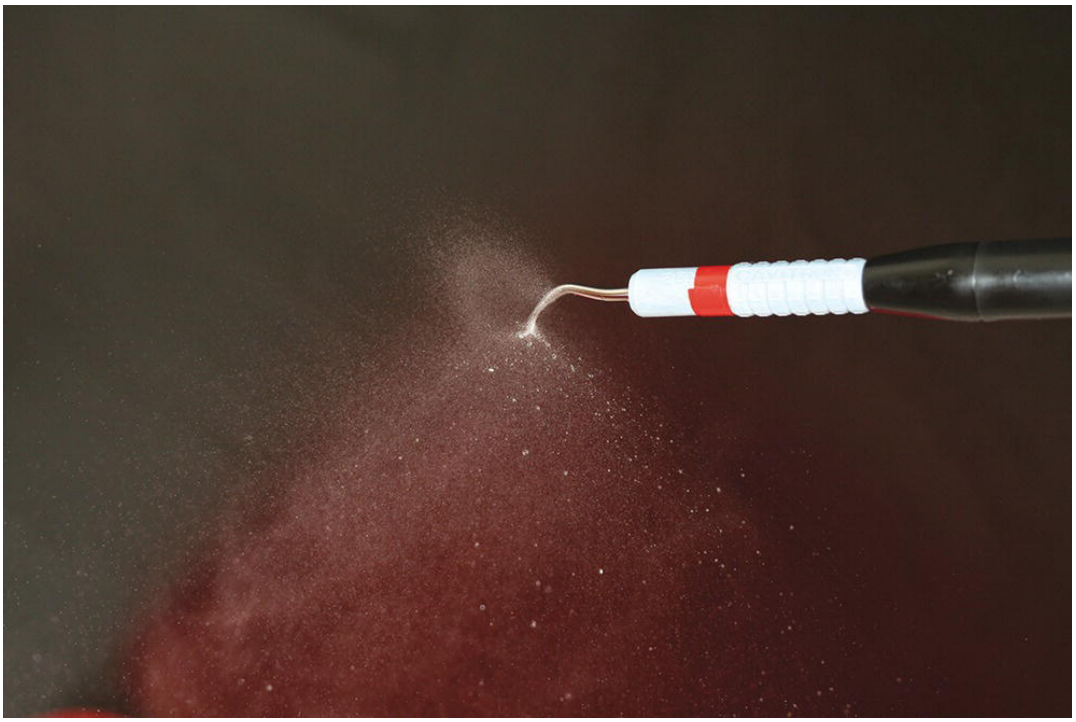


Figure 11.31 Ultrasonic scaler showing water discharge.

Scaling, as just described, cannot always remove the deepest, hardest and most adherent layer of calculus from the root surface of teeth. The additional stage of *subgingival debridement* is then carried out, using Gracey curettes. These are distinguished from other curettes by having only one cutting surface. Their planing action eliminates any residual plaque and calculus as it scrapes away some of the root cementum, to provide a smooth root surface.

Provided the patient achieves adequate supragingival plaque control while the dentist deals with any restoration overhangs, imperfect partial dentures or other hindrances to plaque removal, and the hygienist/therapist or dentist can maintain subgingival plaque control, most cases of straightforward chronic periodontitis can be resolved. Continued periodontal health is dependent to a large degree on the co-operation and motivation of the patient to maintain a consistently good standard of oral hygiene. Of all the exacerbating factors that can worsen the situation, smoking plays a large part in the failure of periodontal treatment and the ultimate loss of teeth for the patient.

Also, some cases will remain where non-surgical periodontal treatment alone cannot succeed. Patients with very deep pockets, especially those involving multi-rooted teeth, may present a problem of inaccessible subgingival plaque and calculus which can only be removed by surgical procedures to gain and maintain access to it.

These and other surgical techniques are described in Chapter 17.

Other periodontal conditions

Several other interesting periodontal conditions exist, which may present from time to time in the dental workplace, although they are not as common as chronic gingivitis and periodontitis.

Subacute pericoronitis

This is an infection of the gingival flap that lies over a partially erupted tooth, called the *operculum*, and sometimes affects the surrounding soft tissues too (Figure 11.32). It especially affects the lower third molars as they erupt, because these teeth are not only difficult to clean, allowing plaque bacteria to proliferate, but the operculum is often traumatised by the opposing tooth during normal mouth closure. The combination of infection and trauma produces inflammation of the operculum, which then swells and becomes more traumatised still. The condition is treated in a number of ways, depending on the severity of the infection and the regularity of its occurrence.

- Irrigation of any food debris from under the operculum, ideally using a chlorhexidine-based disinfectant.
- Oral hygiene instruction for the area, especially the use of hot salt water or disinfectant mouthwashes, or an oxygen-releasing mouthwash to remove the ideal conditions for the bacteria involved.
- Antibiotics if the patient has a raised temperature (anaerobic bacteria are usually involved, so metronidazole is often prescribed).
- Operculectomy if the condition recurs (the surgical removal of the operculum from over the tooth).
- Alternatively, the extraction of the opposing tooth to break the cycle of trauma and inflammation.

Figure 11.32 Pericoronitis affecting the lower left third molar.

Acute herpetic gingivitis

This condition is caused by the herpes simplex virus and most commonly affects infants. All the signs of acute inflammation are present and the rest of the oral mucous membrane may also be involved in the form of tiny blisters which leave painful ulcers (*acute herpetic gingivo-stomatitis*). The condition is short-lived but uncomfortable; the patient feels unwell and may be unable to eat solids, but it resolves without treatment and the gingival condition returns to normal.

However, the virus remains dormant in the body and can be reactivated later by a common cold to produce a cold sore (herpes labialis) on the lip (Figure 11.33). During the acute phase or the presence of a cold sore, the condition is highly infectious and dental treatment is best deferred until the condition has resolved.

Figure 11.33 Cold sore lesion on upper lip.

Acute necrotising ulcerative gingivitis

This is abbreviated to ANUG and was formerly called acute ulcerative gingivitis (AUG) or Vincent's disease. It is an acute gingivitis characterised by pain and halitosis (bad breath). The affected gingiva appears bright red, with a covering layer of yellow/grey sloughing membrane where the gum margin has been destroyed by bacterial action. The bacteria involved include *Bacillus fusiformis* and *Treponema vincenti*.

Where the condition has been present for some time, rather than as sudden onset, it is referred to as necrotising ulcerative gingivitis (NUG) and appears as described above but with loss of the gingival papillae and often with tenderness of the submandibular salivary glands too. NUG is common among smokers, and in patients with consistently poor oral hygiene. When there is loss of attachment between the tooth and its supporting tissues, the condition is referred to as necrotising ulcerative periodontitis (NUP).

With ANUG, all the features of acute inflammation are present: red, swollen, painful gums; loss of function, because it is too painful to chew hard food; and the patient often has a raised temperature.

It usually affects young adults and usually occurs in areas already affected by chronic gingivitis. In many cases stress, heavy smoking and a lowered general resistance precipitate an attack; thus it is more common in winter when colds, influenza and other infections are rife, but more importantly in AIDS and perhaps as its first sign. It is treated as follows:

- Antibiotic treatment that is specific for anaerobic bacteria, usually **metronidazole**.
- If the patient is pregnant, this cannot be used so penicillin is substituted.
- Use of a disinfectant mouthwash, such as those containing chlorhexidine, while the area is too painful to clean by brushing.
- Thorough scaling and polishing once the symptoms have settled, followed by oral hygiene instruction.
- Smoking cessation advice, where relevant.
- Long-term use of mouthwash and an adequate brushing technique.

Acute lateral periodontal abscess

This is an occasional complication of chronic periodontitis in which pus formation in a deep pocket is unable to drain through the gingival crevice. The pus accumulates instead at the base of the pocket to form an abscess. This condition must not be confused with an acute alveolar abscess, which follows pulp death and occurs at the root apex. Acute lateral periodontal abscess occurs on a *vital* tooth at the side of the root (the lateral region of the root).

Treatment depends on the depth of the pocket and the probability of curing the underlying periodontal disease. The options are as follows:

- Drainage of the pus present.
- Thorough subgingival scaling of the affected tooth.
- Local administration of antibiotic into the pocket itself, especially metronidazole.
- Oral hygiene instruction.
- If all else fails, extraction of the affected tooth.

Oral cancer

Oral cancer (see also Chapter 7) can affect various areas of the mouth, the soft tissues, the salivary glands or the jaw bones. Ninety percent of oral cancers affect the soft tissues initially, as a lesion called *squamous cell carcinoma*. The suggested causative factors are as follows:

- **Tobacco habits**: all tobacco products contain chemicals capable of causing cancer (**carcinogens**).
- **High alcohol consumption**: alcohol acts as a solvent for the carcinogens, and allows their easier entry into the soft tissues.
- **Both together**: smokers who also drink to excess are at most risk of SCC.
- **Sunlight**: in fair-skinned people, sunlight is associated with SCC affecting the lower lip.
- **Diet**: research is ongoing into links between SCC and diets high in fats and red meat, or low in vitamin A and iron intake.
- **Genetics**: some people are genetically predisposed to developing SCC.

The signs and symptoms of SCC may include any of the following, and will be specifically looked for during routine dental examinations by the dentist.

- Painless ulcer that has no obvious cause, and which fails to heal fully within 2–3 weeks. Obvious causes are trauma from denture flanges, chipped restorations or vigorous toothbrushing, or even burns from hot foods and drinks.
- In particular, an ulcer occurring beneath or on the side of the tongue, or in the floor of the mouth, as these are the oral areas where more sinister lesions develop.
- Presence of a white or red patch of oral mucous membrane that is associated with the ulcer (these are called leucoplakia and erythroplakia, respectively).

The risk factors described previously make the occurrence of the signs and symptoms far more serious in certain individuals, and any suspicious lesions must be referred to an oral surgery hospital department for investigation immediately. Even then, the 5-year survival rate for SCC is only around 55%, which is very dependent on early detection and aggressive treatment.

The aggressive surgical treatment required to remove the cancer will be carried out by maxillofacial surgeons, and often involves the removal of large sections of the jaw and facial bones and their surrounding soft tissues, depending on the position of the cancer and the depth and area of its spread.

Years ago, the typical oral cancer sufferer was a 60-plus male patient, usually from a lower socioeconomic background, who was a lifelong smoker and drinker.

In recent years, this has changed and those being diagnosed with oral cancer are more likely to be much younger patients (even in their twenties), both male and female, usually smokers and especially binge drinkers, and also those who use sunbeds or sunbathe with little ultraviolet protection for their lips. This last group will also be at much greater risk of developing skin cancer (melanoma).

The dental team has a vital role to play not only in early detection of SCC but also with patient education about the risk factors, especially in these high-risk patients. This is especially important with smoking and tobacco usage, whether with cigarettes, cigars or pipes, and including the habitual chewing of betel nuts and tobacco paan by some Asian societies.

In addition, the effects of smoking on dental and general health should also be discussed with suitable patients, and should cover all the following topics:

- Oral health effects:
  - Oral cancer.
  - Development of oral precancerous lesions (especially white patches in the mouth).
  - Periodontal disease.
  - Poor wound healing, especially after extraction.
  - Tendency to develop 'dry socket' after extraction.
  - Stained teeth.
  - Halitosis (bad breath).
- General health effects:
  - Heart disease, particularly hypertension and coronary artery disease.
  - Stroke.
  - Respiratory disease, particularly chronic bronchitis and emphysema.
  - Other cancers, particularly throat, lung and stomach cancer.

In the last few years, and in recognition of the alarming increasing incidence of smoking-related cancers and illness in the population, the Department of Health has developed an excellent national 'Smoking Cessation' scheme that is freely accessible to anyone wishing to stop smoking (see Figure 7.7). The dental team has a valuable role to play in advising patients of this scheme, referring them for help and treatment whenever possible, and supporting them as they undergo any treatment.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

12
Oral Health Assessment and Diagnosis

Key learning points

A **working knowledge** of

- the assessment methods used to examine the oral tissues and structures
- the methods used to chart teeth
- the methods used to record malocclusion
- the methods used to assess the periodontal tissues
- processing techniques

A **factual knowledge** of

- ionising radiation and the principles of its use in dentistry

A **factual awareness** of

- determining radiographic faults

Oral health assessments are carried out each time that a patient attends the dental workplace, usually for an examination.

Some patients attend more or less frequently than others by their own personal choice, and some require more frequent attendance than others, in the dentist's professional opinion. The dentist's opinion is based on the known risk factors of various oral diseases and the patient's frequency of exposure to these risk factors, and is guided by the publication *Dental recall*, issued by NICE as Clinical Guideline 19 (see Figure 13.28).

The two main purposes of carrying out the oral health assessment are:

- prevention of disease by regular opportunities to reinforce oral health and general health education messages

- early detection and diagnosis when disease is already present.

If disease is already present, regular oral assessment will detect it at an earlier stage and allow the necessary treatment to be carried out so that a full recovery is more likely. If a serious and potentially life-threatening disease is present, such as oral cancer, regular inspection will identify it earlier and allow the patient to be referred for urgent specialist care, with a better chance of successful treatment and recovery.

Although the oral health assessment should detect an abnormality in any of the areas assessed, the obvious oral diseases that are particularly looked for are dental caries, chronic gingivitis and chronic periodontal disease.

The whole dental team has an important role to play in this assessment and prevention process.

- **Dentist**: makes the initial diagnosis, formulates a treatment plan and carries out all treatments restricted to the dentist only.
- **Hygienist**: works either direct with patients or under the prescription of the dentist to help patients maintain their oral health, by preventing and treating periodontal disease and promoting good oral health practices (full range of skills is shown in the GDC's *Scope of Practice* document; see Figure 3.4).
- **Therapist**: works either direct with patients or under the prescription of the dentist to carry out certain treatments as necessary (full range of skills is shown in the GDC's *Scope of Practice* document).
- **Dental nurse**: assists the dentist and other registrants by providing clinical and other support during the assessment and treatment of patients, and reinforces all the oral hygiene messages given to the patient.

Assessment of oral health is carried out in the following areas:

- Extraoral soft tissues.
- Intraoral soft tissues.

- Deciduous and mixed dentition of children.
- Permanent dentition.
- Occlusion.
- Periodontal tissues.

Methods used to carry out assessment

The main methods available to carry out oral health assessments are the following:

- Use of **vitality tests** to determine if an individual tooth is alive, dying or dead (non-vital).
- Use of **study models** to record the occlusion of the teeth, the presence and extent of any non-carious tooth surface loss, and the individual appearance and position of each tooth.
- Use of **photographs** to record the visible appearance of a structure at that time, and for comparison with earlier or later views.
- **Visual inspection** to detect visible abnormalities, such as size and colour changes.
- **Manual inspection** to feel abnormalities, such as a lump where none should be present.
- Use of **mouth mirrors** for intraoral soft tissue and tooth charting assessments.
- Use of various **dental probes** for tooth inspections and charting.
- Use of **transillumination** of anterior teeth to detect interproximal cavities (bright light such as that from the curing lamp is shone through the tooth, and cavities show as dark lesions when viewed from the opposite side).
- Use of various **periodontal probes** for periodontal assessment.
- Use of various intraoral or extraoral **radiograph** views, to determine the presence or absence of various structures or pathology.

Vitality tests

These are sometimes necessary to help in determining whether a tooth is vital (alive) or non-vital (dead).

- Cold stimulus with one of various products which produce ice crystals when sprayed out at room temperature (Figure 12.1).
- Hot stimulus with warmed **greenstick compound** (a type of gutta percha; Figure 12.2).
- Electrical test with **electric pulp tester**.


roeko
Endo-Frost
-50 °C
F+
Zusammensetzung: Propan/Butan
Ingredients: Propane/Butane
Composition : Propane/Butane
Composizione: Propano/Butano
Composición: Propano/Butano
Composição: Propano/Butano
Samenstelling: propaan/butaan
Ingredienser: Propan/Butan
Innehåll: Propan/butan
Sammensetning: Propan/Butan
Ainesosat: Propaani/Butaani
Συνθεση: Προπάνιο/Βουτάνιο
Compoziție: propan/butan
Skład: Propan/Butan
Sestava: Propan/butan
Sudėtis: propanas ir butanas
Koostisosad: Propaan/butaan
Složení: propan/butan
Összetétel: Propán/bután
Zloženie: Propán/bután
Състав: пропан/бутан
Sastāvdaļas: Propāns/butāns
Innihald: Própan/bútan
Coltène/Whaledent
P.O. Box 1130
D-89121 Langenau
Made in Germany
Coltène/Whaledent
CH-9450 Altstätten
Switzerland
CE

Figure 12.1 Example of ‘cold test’ product.

Figure 12.2 Greenstick compound, used warmed for ‘hot test’.

The first two techniques are used to diagnose toothache in a particular tooth where the symptoms include pain with cold or heat, whereas electric pulp testers are more accurate in determining the ‘degree’ of vitality of a tooth, as follows:

- Normal response: healthy pulp.
- Increased response: early pulpitis present.
- Reduced response: pulp is dying, or tooth has heavily lined deep restoration present so the voltage cannot be adequately transmitted to the pulp.
- No response: pulp tissue is dead.

Patients will vary in their response to electric pulp testers, so it is always advisable to test several apparently healthy teeth to establish what their ‘normal’ response is, before testing the suspect tooth itself.

Electric pulp testers are either battery operated or mains operated, and they work by sending an increasing voltage into the tooth until the patient is aware of a tingling sensation in that tooth. The point at which the patient indicates a sensation is recorded numerically on a scale, so that the 'degree' of vitality can be determined in relation to 'test' teeth.

Ethyl chloride and other products are liquids that vaporise quickly when sprayed out at room temperature onto items such as a cotton wool roll, leaving ice crystals which provide a cold stimulus when the roll is touched to the skin or onto a tooth. This cold sensation is detected particularly well by a hypersensitive tooth, and can help to indicate which one requires dental treatment.

Gutta percha is a natural rubber-like product with several uses in dentistry. As a compound of greenstick (see Figure 12.2), it can be gently warmed in a flame and placed on a pulpitic tooth to determine a hypersensitivity reaction to heat, indicating which tooth requires dental treatment. The teeth to be tested should be dried in both cases first, and a thin smear of Vaseline placed before applying the warm greenstick compound to avoid the substance sticking to the tooth and causing continued pain to the patient.

Study models

In some situations, it is necessary for the dentist to consider the patient's occlusion before being able to decide on any treatment necessary, for example when providing partial dentures or orthodontic treatment. Impressions are taken of both dental arches using alginate impression material (see Chapter 16) and then cast up to produce a set of study models (Figure 12.3).

Figure 12.3 Study model set.

Study models are useful in the following cases:

- Occlusal analysis in complicated crown or bridge cases.
- Orthodontic cases, to determine if extractions are required and which type of appliance is necessary.
- Occlusal analysis where full mouth treatment may be necessary, to determine the functioning of the dentition.
- Where tooth surface loss is evident, either by erosion from acidic foods and drinks or by attrition due to tooth grinding, so that the progression of the tooth wear can be monitored and treatment determined.
- Where unwanted tooth movement is suspected, such as with periodontally involved teeth which are gradually drifting apart or are proclining, so that the movement can be monitored.

Photographs

These can be taken to record various aspects of the dentition or soft tissues, for future reference. They can be produced using conventional cameras (especially 'Instamatic' types), digital cameras with 'macro' lenses for close-up shots, or by using specialist intraoral digital cameras. Specialised computers and equipment are required for this last technique.

Photographs are useful for recording:

- soft tissue lesions to aid diagnosis
- the extent of injury following trauma
- before-and-after views of dental treatment.

Extraoral soft tissue assessment

The dentist will often be visibly assessing the extraoral soft tissues (those outside the mouth) of the patient while greeting them into the surgery area, and chatting to them before beginning the intraoral assessments. In particular, they will be looking at and palpating the following structures for any signs of abnormality.

- **External facial signs**: checking for skin colour, facial symmetry, the presence of any blemishes, especially moles and cold sores.
- **The lips**: checking for any change in colour or size, the presence of any blemishes, and palpating for any abnormalities.
- **The lymph nodes**: lying under the mandible and in the neck, these are palpated to detect any swellings or abnormalities, the presence of which may indicate an infection or a more sinister lesion.

Variations in skin colour do occur, especially in different ethnic groups. Some patients are naturally pale and others are naturally ruddy. However, an unusual facial appearance can sometimes indicate problems, such as nervous patients becoming pale and clammy as they are about to faint or the unnatural ruddiness of a patient with hypertension.

Facial asymmetry (where one side of the face is shaped differently from the other) could indicate the presence of a swelling, or problems with the nerve supply or muscular control of that area, all of which require further investigation.

The sudden appearance of unusual skin blemishes, especially moles, may indicate the presence of an early skin cancer (*melanoma*), which will need urgent referral for treatment.

Similarly, the lips are examined and details recorded of blemishes, such as the presence of a cold sore indicating infection with the herpes simplex type 1 virus, or the presence of minor salivary gland cysts (*mucoceles*).

Lips that are generally tinged bluish-purple indicate some degree of chronic heart failure, which needs noting before local anaesthesia and traumatic dental procedures are carried out. Scrutiny of the patient's completed medical history form will indicate if any cardiovascular problem has already been diagnosed, and if not then the patient should be advised to seek medical assessment.

Lymph nodes are part of the body's immune system and are present in certain areas throughout the body. Any enlargement of those accessible to the dentist in the head and neck region indicates that the body is fighting infection or some other disease process, and requires further investigation.

Intraoral soft tissue assessment

This is carried out at each dental examination and in a systematic manner, so that no areas or lesions are missed.

- **Labial, buccal and sulcus mucosa**: checked for their colour and texture, the presence of any white patches (especially the buccal mucosa; Figure 12.4), and the moisture level is noted.
- **Palatal mucosa**: both the hard and soft palates, the oropharynx and the tonsils (if present).
- **Tongue**: checked for colour and texture, symmetry of shape and movement, the level of mobility; all surfaces are checked, especially beneath the tongue, as this is one of the most common sites for oral carcinoma to develop.

- **Floor of mouth**: checked for colour and texture, the presence of any white or red patches, and the presence of any swellings.

Figure 12.4 Leucoplakia of right buccal mucosa.

Low moisture levels in the mouth can indicate problems with the functioning of the salivary glands, such as *Sjögren's syndrome*, or *xerostomia* (dry mouth) due to age-related changes to the glands or as a side-effect in those taking certain medications. Saliva has important functions with regard to defence, cleansing and dental disease initiation, and any indication of reduced flow levels is of great importance to the dental team, with regard to maintaining a healthy oral environment for the patient.

The more likely areas for oral cancers to develop are on the borders of, or beneath, the tongue and in the floor of the mouth, and these areas will be particularly well examined in patients with known risk factors, such as smoking and excessive alcohol consumption. All findings can then be recorded on a suitable assessment sheet (Figure 12.5). In addition, photographs can be taken at the time and retained for comparison at a later date, while any benign lesions are kept

under observation. If a sinister lesion is suspected, the photograph can be uploaded and sent with an urgent referral to the local hospital maxillofacial department, to assist in their determination of the urgency of the case.

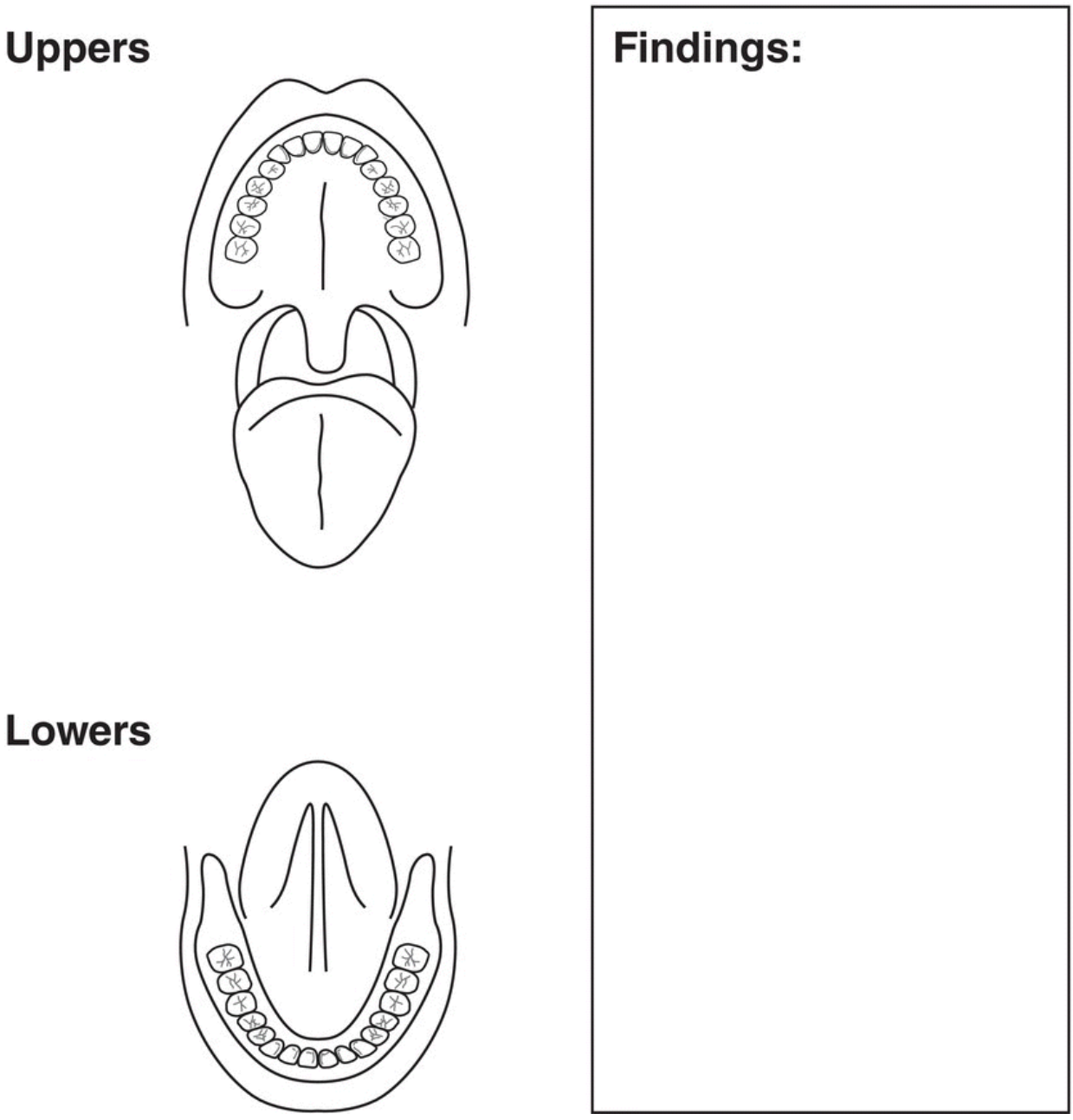


Figure 12.5 Soft tissue assessment sheet.

Tooth charting

Accurate tooth charting is one of the most important skills acquired by a dental nurse in their role as an assistant to the dentist and other registrants, both during oral health assessments and during the provision of dental treatment. Inaccuracies in the charting can result in catastrophic consequences for the patient, such as the wrong classification or type of restoration being provided or even the wrong tooth being extracted (an example of a 'significant event'). It is a fundamental skill of all members of the dental team to record and follow a tooth chart correctly.

Charting is used as a style of 'dental shorthand' to quickly and accurately record a patient's dentition, as it appears at the time of the oral health assessment. Dental nurses are referred to the definitive charting booklet produced by the NEBDN. This describes the approved current charting notations used both for teeth and for periodontal conditions, following the three styles currently in use.

- **Palmer notation**: for tooth charting.
- **International Dental Federation (FDI) notation**: for tooth charting.
- **Basic periodontal examination (BPE)**: for periodontal charting.

However, they should also be aware of the Universal system particularly in use in the USA, where teeth are numbered from 1 (the upper right third molar) across to 16 (the upper left third molar), then down to 17 (the lower left third molar) and across to 32 (the lower right third molar), as well as the increasingly popular Alphanumeric system of tooth charting. This simply converts the long-hand system of writing, say, 'upper right second molar' into 'UR7'. So, with these various charting systems the upper right second molar can be recorded as shown in Table 12.1.

Table 12.1 Comparison of tooth charting notation for the same tooth.

Long-hand	Upper right second molar
Alphanumeric	UR7
Palmer	_7/
FDI	17
Universal	2

In addition, and although many dental workplaces are now computerised, the software systems in use for tooth charting vary enormously (Figure 12.6) and very often cannot actually distinguish the finer points of the written notation, which may lead to errors. Therefore, it is necessary for student dental nurses to be taught tooth charting using written records, so that they are standardised upon qualification.

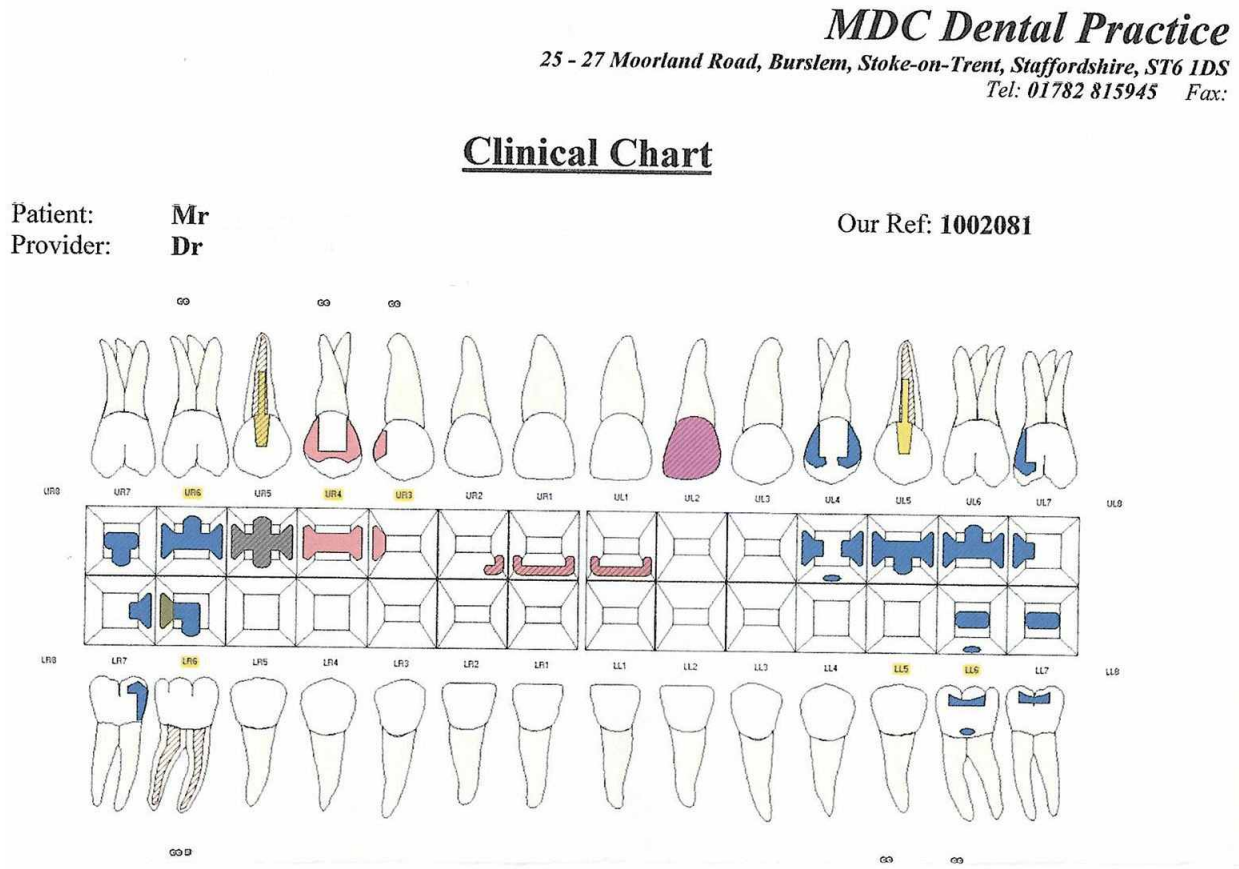


Figure 12.6 Computer chart example.

When tooth charting the dentition of an actual patient, a two-grid system is used (forensic notation) which separates the current dental status from any treatment required. Each anterior tooth charted diagrammatically is shown with four surfaces and an incisal edge or canine cusp, and each posterior tooth with five surfaces, as shown in Figure 12.7.

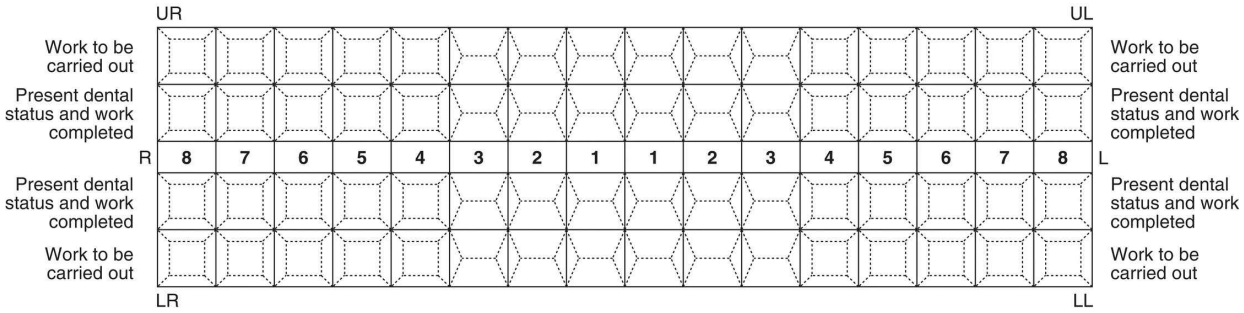


Figure 12.7 Manual charting grid.

The teeth are recorded from the centre-line backwards for both the deciduous and the permanent dentition, and the charting grid is arranged as follows:

- Inner grid: shows current dental status and dental treatment already present in the mouth.
- Outer grid: records all dental treatment that needs to be carried out.

For the purpose of tooth charting, current dental status refers to the following notations only:

- The presence or absence of a tooth.
- The presence of a root.
- The notation of any tooth that is stated as unerupted, and charted as ‘UE’.
- The notation of any tooth that is stated as partially erupted, and charted as ‘PE’.
- The position of a tooth in relation to the normal dental arch, and may be stated as ‘instanding’or ‘buccal to the arch’, for example.

The condition of the teeth and the presence of any restorations can then be charted in a code form on the inner grid, and work to be carried out is recorded in the outer grid. Examples of some of the recognised charting notations are shown in Figure 12.8, but readers are again advised to consult the charting booklet produced by NEBDN for the full range of current definitive notations.

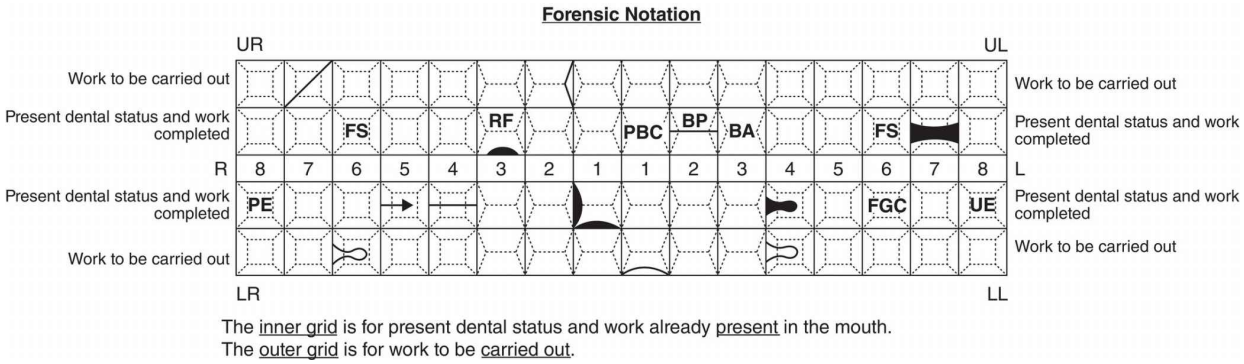


Figure 12.8 Completed charting grid.

The notable exception to the usual rules of inner grid versus outer grid is the charting of a fracture to a tooth. A fracture can range from a minimal incisal edge chip of a tooth which requires no treatment (and is therefore charted on the inner grid as it represents current dental status), or it can be a full fracture of the whole crown of the tooth from its root at gingival level (and is therefore charted on the outer grid as it represents dental treatment that needs to be carried out).

The charting symbol in both these instances of a fracture is '#', so the dental nurse must be careful to determine if an indication is made as to whether the tooth is to be restored or not, as this will determine which grid should be used for the notation.

Palmer notation incorporating alphanumeric system

This is based on the division of the dentition into four quadrants when looking at the patient from the front: upper right and left, and lower left and right. Using either the letters representing the deciduous dentition or the numbers representing the permanent dentition (see Chapter 10), each tooth can then be written and identified individually. With the increased use of computers to record the patient's dental records, including tooth chartings, the use of the

quadrant symbol has been superseded by the use of the following alphanumeric notations:

- UR for upper right.
- UL for upper left.
- LL for lower left.
- LR for lower right.

So, individual teeth are charted as, for example, UR6 (upper right first permanent molar) and LLE (lower left second deciduous molar), and so on.

The Palmer system relies on the use of the English language for its correct interpretation, and a more international system of tooth charting is also available that is not language dependent, but is based on numbers only.

Two-digit FDI notation

This system replaces the quadrant symbol or use of UR, UL, etc. with a quadrant number as well as a tooth number.

- Upper right: permanent quadrant 1, deciduous quadrant 5.
- Upper left: permanent quadrant 2, deciduous quadrant 6.
- Lower left: permanent quadrant 3, deciduous quadrant 7.
- Lower right: permanent quadrant 4, deciduous quadrant 8.

The quadrant number forms the first digit while the second identifies an individual tooth as 1–8 in the same way as the Palmer system. Reading clockwise from the upper right third molar, all 32 permanent teeth and 20 deciduous teeth have their own two-digit number indicating their quadrant (first digit) and identity (second digit).

For permanent teeth:

18 17 16 15 14 13 12 11	21 22 23 24 25 26 27 28
48 47 46 45 44 43 42 41	31 32 33 34 35 36 37 38

And for deciduous teeth:

55 54 53 52 51	61 62 63 64 65
85 84 83 82 81	71 72 73 74 75

The lower left second premolar, for example, is written as 35 and pronounced 'three-five', not 'thirty-five', and the upper right deciduous first molar would be written as 54 and pronounced 'five-four', and so on. The issue with the FDI system is that it relies purely on numbers to identify teeth, as does the (mainly USA) Universal system, and the numbering of the teeth for each system is different (see Table 12.1), which may lead to confusion and inaccuracies in charting.

While examining the teeth, the dentist will also record any evidence of non-carious tooth surface loss that is evident: erosion, abrasion or attrition. This information will be linked with other information (such as diet, toothbrushing habits) provided during medical, social and dental history taking (see Chapter 13).

The dental instruments normally used to carry out the tooth charting assessment are as follows:

- **Mouth mirror**: used to reflect light onto the tooth surface, to retract the soft tissues to provide clear vision, and to protect the soft tissues during the assessment.
- **Angled probe**: used to detect soft tooth surfaces and margins on existing restorations.
- **Tweezers**: used to hold cotton wool pledgets to wipe tooth surfaces dry, or to place cotton wool rolls (Figure 12.9).
- **Briault probe**: two-ended probe specially designed to detect interproximal caries, either mesially or distally (Figure 12.10).

Figure 12.9 Mirror, angled probe and tweezers.

Figure 12.10 Briault probes showing both ends.

Occlusion

Occlusion is the term used to describe the situation when the mouth is closed and the teeth of both jaws interlock together so that their occlusal surfaces are in contact. When each jaw is of normal size in relation to the other, and they have developed during childhood in the correct relationship to each other, the cusps of the teeth in one arch should interdigitate with the fissures and interproximal areas of the other (Figure 12.11).

Figure 12.11 Buccal occlusion on a set of study models.

In normal occlusion, all the teeth are well aligned and there is no crowding, no protruding teeth and no undue prominence of the chin. Upper incisors slightly overlap the lowers vertically and horizontally and special names are given to this overlap: vertical overlap is called *overbite* and horizontal overlap is called *overjet* (Figure 12.12). With the mouth closed and the teeth touching together in occlusion, the position of the first molars and the canines in each jaw determines ideal occlusion and malocclusion. This is called *Angle's classification*.

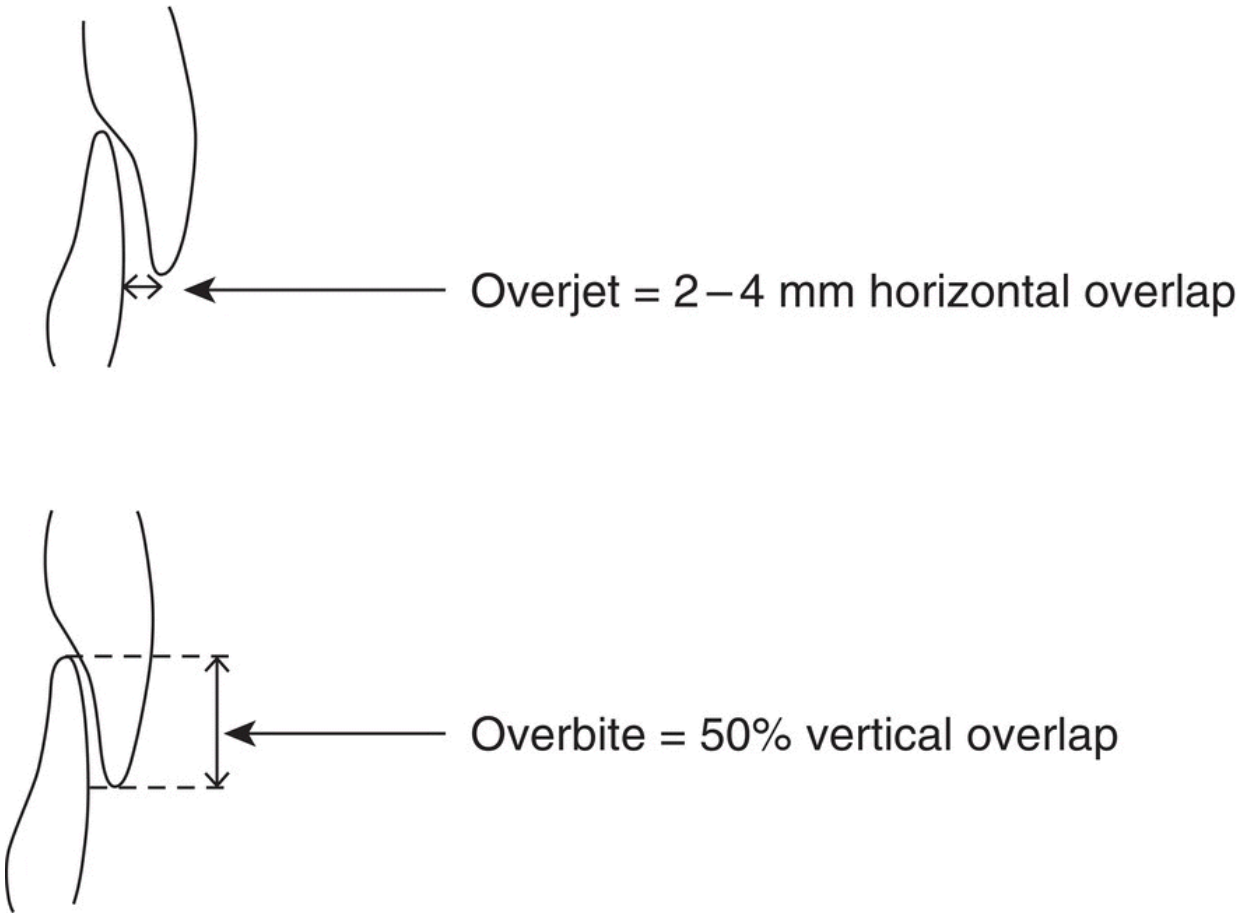


Figure 12.12 Ideal overjet and overbite.

Ideal *class I occlusion* occurs where the mesiobuccal cusp of the upper first molar lies in the buccal groove of the lower first molar (Figure 12.13). The ideal overjet is within a 2–4 mm horizontal overlap and the ideal overbite is a 50% vertical overlap.

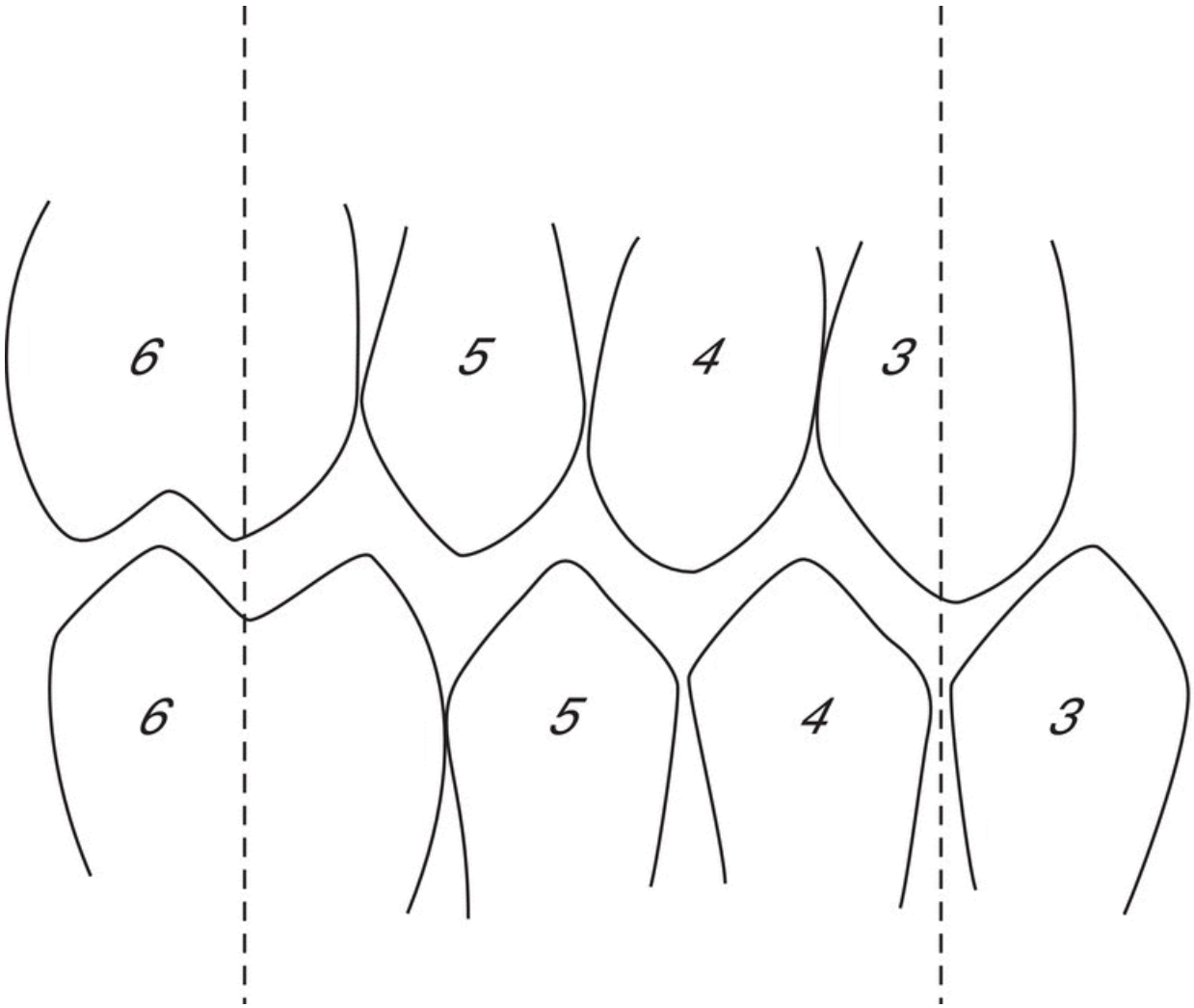


Figure 12.13 Class I molar and canine relationship.

For teeth to erupt into normal occlusion, the jaws must be in correct horizontal and vertical relationship to each other, and of sufficient size to accommodate their full complement of teeth. The teeth can then erupt into a normal position of balance between the pressures exerted by the lips and cheeks on their outer side, and the tongue on the inner side of the dental arches.

When normal occlusion is not present, the patient is described as having a *malocclusion*.

Types of malocclusion

The basic types of malocclusion are caused by a combination of any of the following:

- Crowding.
- Protruding upper incisors.
- Prominent lower jaw.

Crowding

Crowding is caused by insufficient room for all of the teeth to erupt in line and occurs in jaws which are too small to accommodate 32 permanent teeth. The teeth become crooked and overlapping as the permanent dentition erupts, and those which are normally last to erupt cannot take up their proper position in the dental arch as there is insufficient room left. Thus, the upper canines are usually displaced buccally (Figure 12.14), the lower second premolars lingually and the lower third molars are impacted within the bone of the mandible at the ramus.

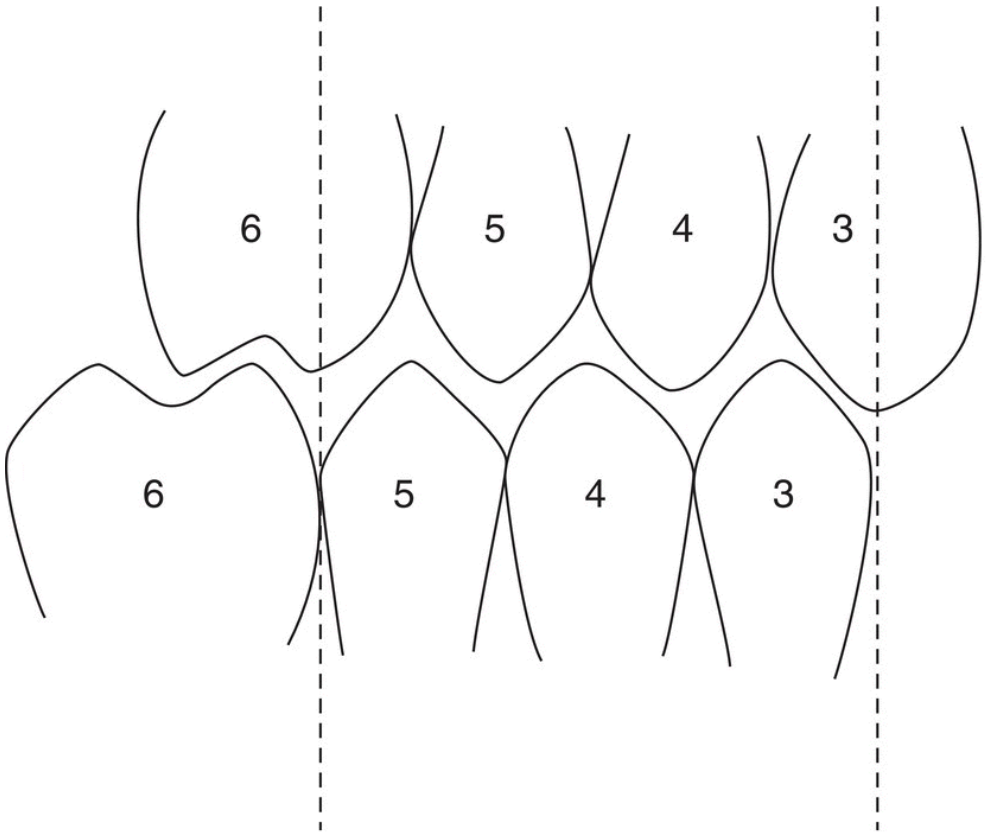
Figure 12.14 Buccally displaced upper canines.

Early extraction of carious deciduous molars also contributes to the crowding in these cases. The gap left by an extraction soon closes, as

the remaining posterior tooth drifts forward and takes up some of the space required for the permanent successor.

Protruding upper incisors

Many children attend for orthodontic treatment because their upper front teeth protrude (procline) between their lips. This condition usually arises from a jaw relationship in which the upper teeth are too far forward relative to the lowers. It is commonly associated with an open lip posture and is called a *class II division 1 malocclusion* (Figure 12.15).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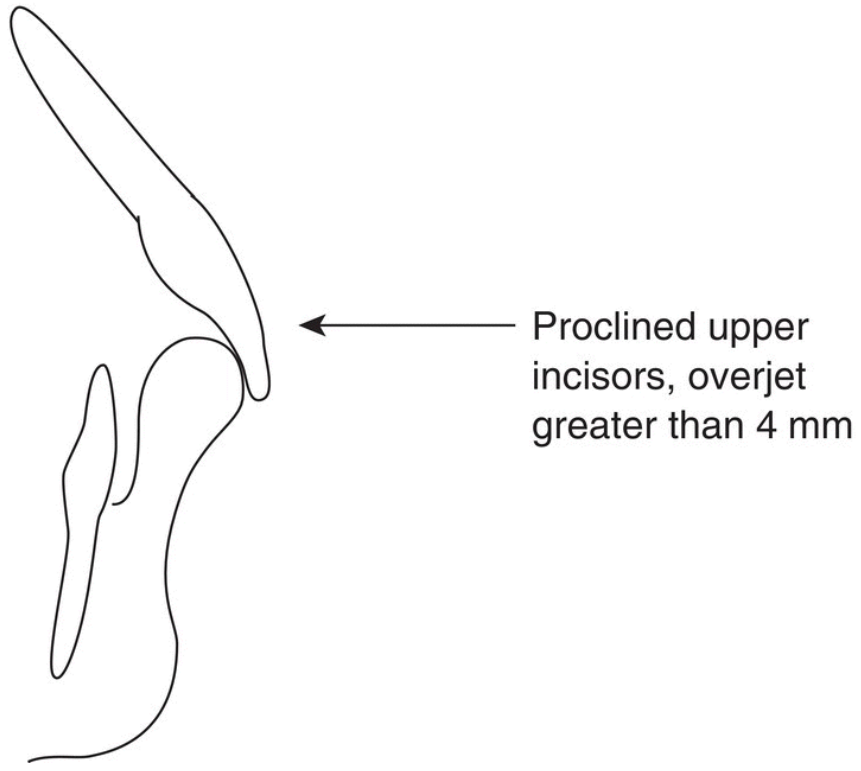

Proclined upper incisors, overjet greater than 4 mm

Figure 12.15 Class II division 1 malocclusion.

This tends to occur because the mandible is too far behind its normal position, and not because the maxilla is too far forwards, as may be thought. The maxilla is a fixed bone of the facial skeleton and cannot alter its position during growth, whereas the mandible is the only moveable bone of the skull and its position can alter markedly as it grows and develops.

When the mandible is not so far posterior to its normal position, so that the jaw relationship is not quite so severe, the upper incisors become trapped behind the tightened lower lip and erupt upright, or even pulled back (retroclined). This is called a *class II division 2 malocclusion* (Figure 12.16).

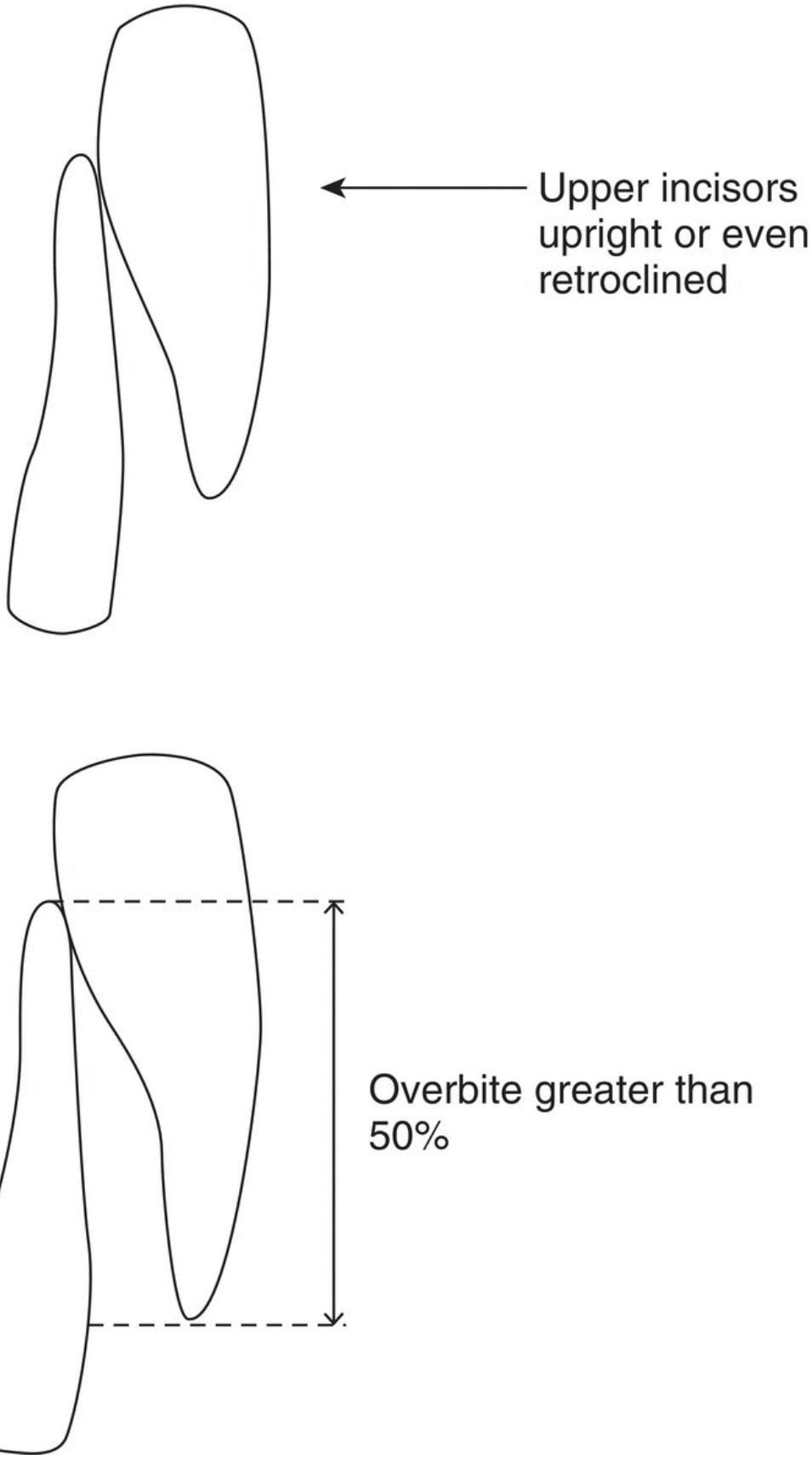
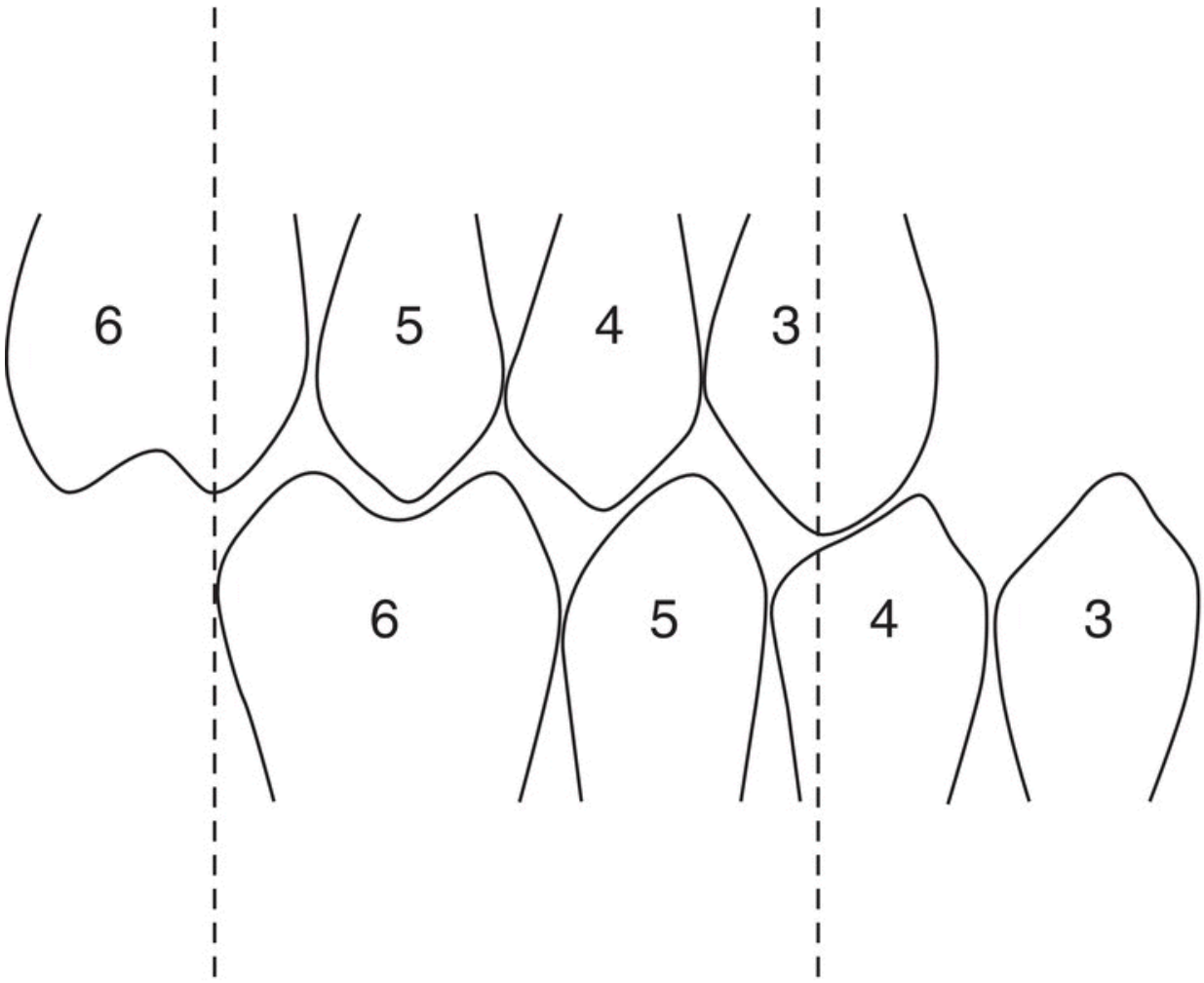

Upper incisors
upright or even
retroclined
Overbite greater than
50%

Figure 12.16 Class II division 2 malocclusion.

Prominent lower jaw

This condition, in which the chin is unduly prominent, is caused by a jaw relationship in which the mandible and the lower teeth are too far forward relative to the maxilla and the upper teeth. It usually results in the incisors biting edge to edge or with the lowers in front of the uppers, instead of behind them. This is called a *class III malocclusion* (Figure 12.17).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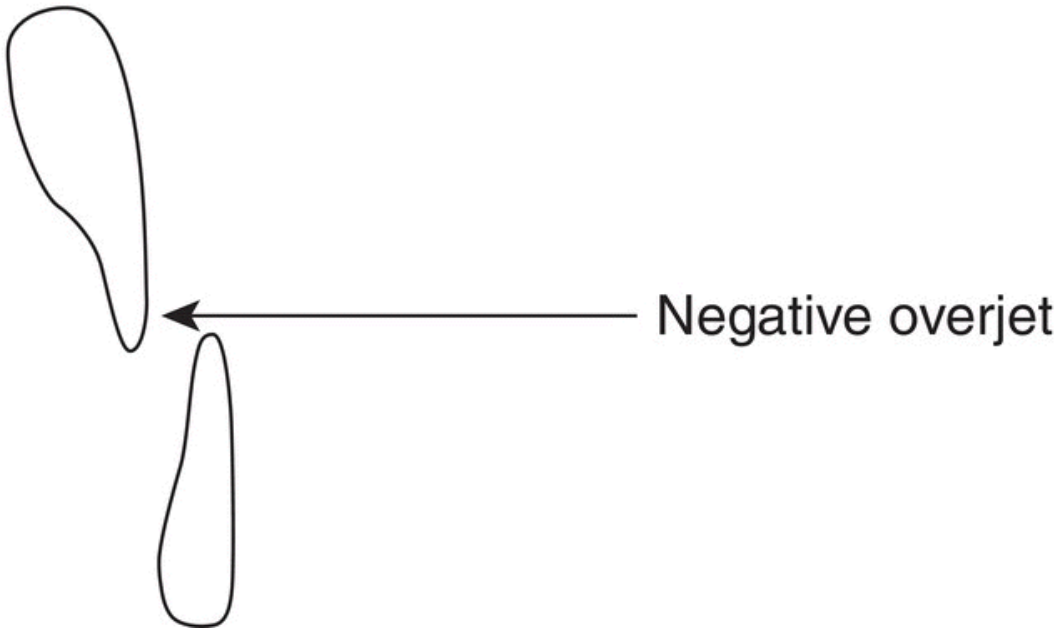

Negative overjet

Figure 12.17 Class III malocclusion.

Causes of malocclusion

Most kinds of malocclusion are genetic in origin (inherited from a family member); far fewer are acquired. The most common are inheritance of an abnormal jaw relationship or jaw size. Other genetic factors include supernumerary teeth and missing teeth. The most common acquired causes of malocclusion are early loss of teeth and thumb-sucking habits.

Jaw relationship

With a normal (ideal) jaw relationship, the teeth should occlude in a class I relationship as shown in Figures 12.12 and 12.13. This is the most attractive type of occlusion and is accordingly regarded as normal. Other jaw relationships give rise to either a class II or class III malocclusion.

A jaw relationship in which the lower jaw is too far back causes two different types of class II malocclusion.

- Class II division 1 in which the upper incisors protrude, the overjet is increased and the lower lip is usually trapped behind the upper incisors (Figure 12.18).
- Class II division 2 in which the upper central incisors tilt backwards into contact with the lowers, giving a decreased overjet and increased overbite (Figure 12.19), maintained by a tight, strap-like action of the lower lip across the labial surface of the upper incisors.

Figure 12.18 Class II division 1 study models.

Figure 12.19 Class II division 2 with increased overbite.

A relationship in which the lower jaw is too far forward causes a class III malocclusion. The chin appears prominent and the overjet is reversed, with lower incisors occluding in front of the uppers (Figure 12.20) or, in milder cases, edge to edge.

Figure 12.20 Class III with reverse overjet.

Angle's classification is based on the relationship of the first molars to each other, as described previously, but this is no longer suitable as the early loss of teeth may cause changes in the position of the first molars. It is more convenient to use the incisor relationship as the determination of classification.

Jaw size

Among the most common abnormalities of all jaw size discrepancies are those jaws which are too small to accommodate all the teeth. This is a genetic cause of crowding which is usually localised to the front teeth whereas the effect of premature loss, described previously, is an acquired cause and is usually localised to the premolar region. Unfortunately, all causes of crowding often occur together, thus producing an even worse malocclusion.

Jaws which are too large cause spacing of the teeth but this type of malocclusion is not so common.

Supernumerary teeth

A supernumerary tooth is an extra one, in addition to the normal complement of 32 teeth. It occurs most commonly in the midline of the upper incisor region as a *mesiodens* and may either prevent a central incisor from erupting or cause it to erupt in an abnormal position.

Congenitally missing teeth

This is the opposite condition to supernumerary teeth where a patient is born with an absence of one or more of their permanent teeth. Upper lateral incisors are often missing and orthodontic treatment may be necessary to close the resultant gaps. Sometimes, instead of being absent, upper lateral incisors develop as tiny conical teeth, called *peg laterals*. Again, the appearance is unsightly and restorative treatment may be required to build up these abnormally small lateral incisors to a more normal size. The other teeth which are most commonly missing are third molars and second premolars. If several teeth are missing, the condition is called *hypodontia*, but this is a rare occurrence.

Sucking habits

Habits such as finger or thumb sucking can cause displacement of anterior teeth resulting in a decreased overbite and increased overjet. In addition, the sucking action tends to exert excess pressure on the cheeks, so that the upper buccal teeth are forced to develop inside the arch of the lowers. This is called a *cross-bite*. These displacements may correct themselves if the sucking habit is stopped early enough, otherwise orthodontic treatment will be necessary.

Periodontal tissue assessment

The periodontal tissues are those acting as *supporting tissues* around the tooth: the gingivae, the periodontal ligament and the underlying alveolar bone forming the tooth socket. These tissues can undergo disease processes to varying degrees, and in the worst-case scenario healthy teeth can be lost due to periodontal disease. Periodontal disease is the most common dental disease found in adult patients, and its presence can easily be missed or remain undetected for many years due to its slow onset and painless nature.

As with tooth charting, a system has been developed whereby the presence of periodontal disease can be quickly recorded during routine oral assessment, by dividing the mouth into sextants (six areas: right and left buccal, and labial in each arch) and recording the presence and depth of any unnatural spaces down the side of the teeth; these are called *periodontal pockets*. This recording technique is called a *BPE assessment* and is noted as shown in Figure 12.21.

Upper teeth

18–14	13–23	24–28
48–44	43–33	34–38

Lower teeth

Figure 12.21 BPE chart.

Healthy periodontal tissues appear pink, firmly attached to the necks of the teeth with a gingival crevice no deeper than 3 mm, and they do not bleed when touched. Teeth are firmly held in their sockets by the periodontal supporting tissues, and no plaque is present on the tooth surfaces.

Specially designed periodontal probes (such as a BPE probe; Figure 12.22) are used to record the presence and depth of any periodontal

pockets discovered in each sextant of the dental arches, and the coding system used is as follows:

- **Code 0**: healthy periodontal tissues with no bleeding on probing, no calculus or overhangs present (plaque retention factors).
- **Code 1**: pocket no more than 3.5 mm, bleeding on probing, no calculus or overhangs present.
- **Code 2**: pocket no more than 3.5 mm but supragingival or subgingival calculus or other plaque retention factor present.
- **Code 3**: pocket present up to 5.5 mm deep.
- **Code 4**: pocket present deeper than 5.5 mm.
- **Code** *: furcation involvement present.

Figure 12.22 BPE probe.

A typical completed BPE chart is shown in Figure 12.23.

2	0	4
2	1	3

Figure 12.23 Completed BPE chart.

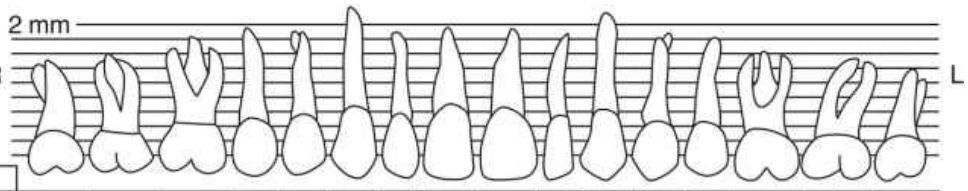
Higher codes therefore indicate a more serious periodontal problem, such as that shown in Figure 12.24. Where code 3 is recorded, radiographs should be taken to record bone levels, then all plaque retention factors should be removed and the patient instructed in effective oral hygiene measures. If pocket depths remain unaltered 3 months later, that sextant should have pocket depths recorded and root surface debridement should be carried out where necessary. Where codes greater than 3 are recorded, radiographs and a full pocket depth record will be made of each tooth in that sextant so that specific problem areas can be identified, and intensive periodontal treatment can be initiated. In addition, the presence and extent of any plaque found will be recorded, as well as the mobility of any tooth. Tooth mobility is graded as follows:

- **Grade I**: side-to-side tooth movement less than 2 mm.
- **Grade II**: side-to-side tooth movement more than 2 mm.
- **Grade III**: vertical movement present.

Figure 12.24 Periodontal pocket recording.

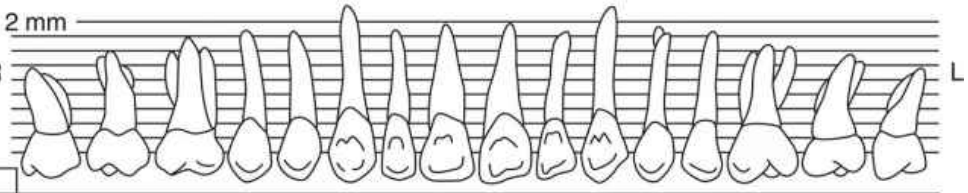
All these assessments can be recorded manually, either on the patient's record card or on specific preprinted charts (Figure 12.25), or directly into the relevant files of computerised record systems.

BUCCAL



	DATE																
RECESSION																	
POCKET DEPTH																	
MOBILITY																	

PALATAL



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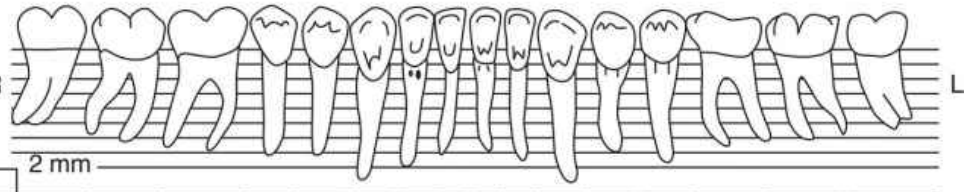

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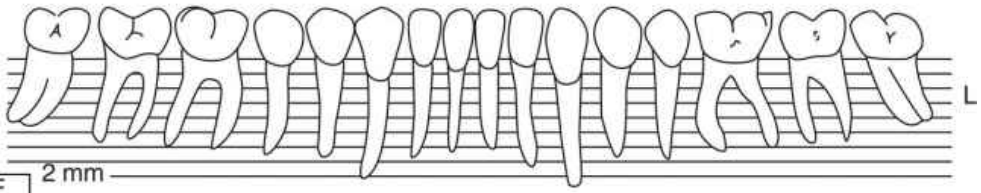

	DATE																
RECESSION																	
POCKET DEPTH																	
MOBILITY																	

Figure 12.25 Periodontal disease recording chart.

The standard of oral hygiene can be graded as excellent, good, fair or poor, and should be recorded at each oral health assessment so that patient motivation and compliance can be monitored.

Dental radiography

Dental radiography is an important diagnostic tool used in dentistry and medicine to help the clinician to see within the body tissues and help to diagnose the cause of dental and medical problems. In dentistry, radiographs are used to detect and diagnose the following lesions and structures:

- **Dental caries**: this shows up as a dark area of destruction extending inwards from the enamel surface of a tooth.
- Presence and extent of **periodontal disease**: this shows up as a loss of the lamina dura forming the crest of the alveolar bone, loss of height of the alveolar bone, and a widening of the periodontal ligament space.
- Periodontal and periapical **abscesses**: chronic alveolar abscesses show up as a dark circular area at the apex of an affected tooth, caused by destruction of the apical lamina dura and spongy bone.
- **Cysts** affecting the dental tissues: these can show up as enlarged darker areas surrounding other structures, and can sometimes be seen to be pushing tooth roots out of their normal positions.
- **Iatrogenic problems**: that is, those caused by the dentist, such as overhanging restorations or root perforations by posts.
- To detect **supernumerary** teeth and **unerupted** teeth, or to determine the **congenital absence** of unerupted teeth.
- To diagnose **hard tissue lesions**, such as bone cysts and tumours, salivary calculi and jaw fractures.

In addition, radiographs are used during the provision of dental treatment to avoid problems occurring and to ensure that the treatment is successful. Examples include:

- aiding in **endodontic** treatment
- determining the number and position of tooth roots before **extraction**

- ensuring the health of a tooth before it undergoes **crown or bridge** preparation
- ensuring the health of a tooth before it is used as an abutment during **denture construction**
- assisting in the correct placement of **implants**
- determining the presence or absence of teeth during **orthodontic assessment**
- ensuring the health of teeth before repositioning them during **orthodontic treatment**.

For examination purposes, dental nurses are not expected to interpret radiographs but they should be able to describe both normal and abnormal radiographic appearances of common dental conditions.

Nature of ionising radiation

Ionising radiation is commonly referred to as 'X-rays'. X-rays are a type of electromagnetic radiation that possess energy, as are ultraviolet light, microwaves and visible light. The radiation types differ from each other in the amount of energy they possess, X-rays having high energy so that they are capable of passing through target matter such as human tissue. When they do so, one of three events will occur (Figure 12.26).

- X-rays pass cleanly between the atoms of the target matter and are **unaltered**.
- X-rays hit the atoms of the target matter and are **scattered**, releasing their energy as they do so.
- X-rays hit the atoms of the target matter and are **absorbed**, releasing their energy as they do so.

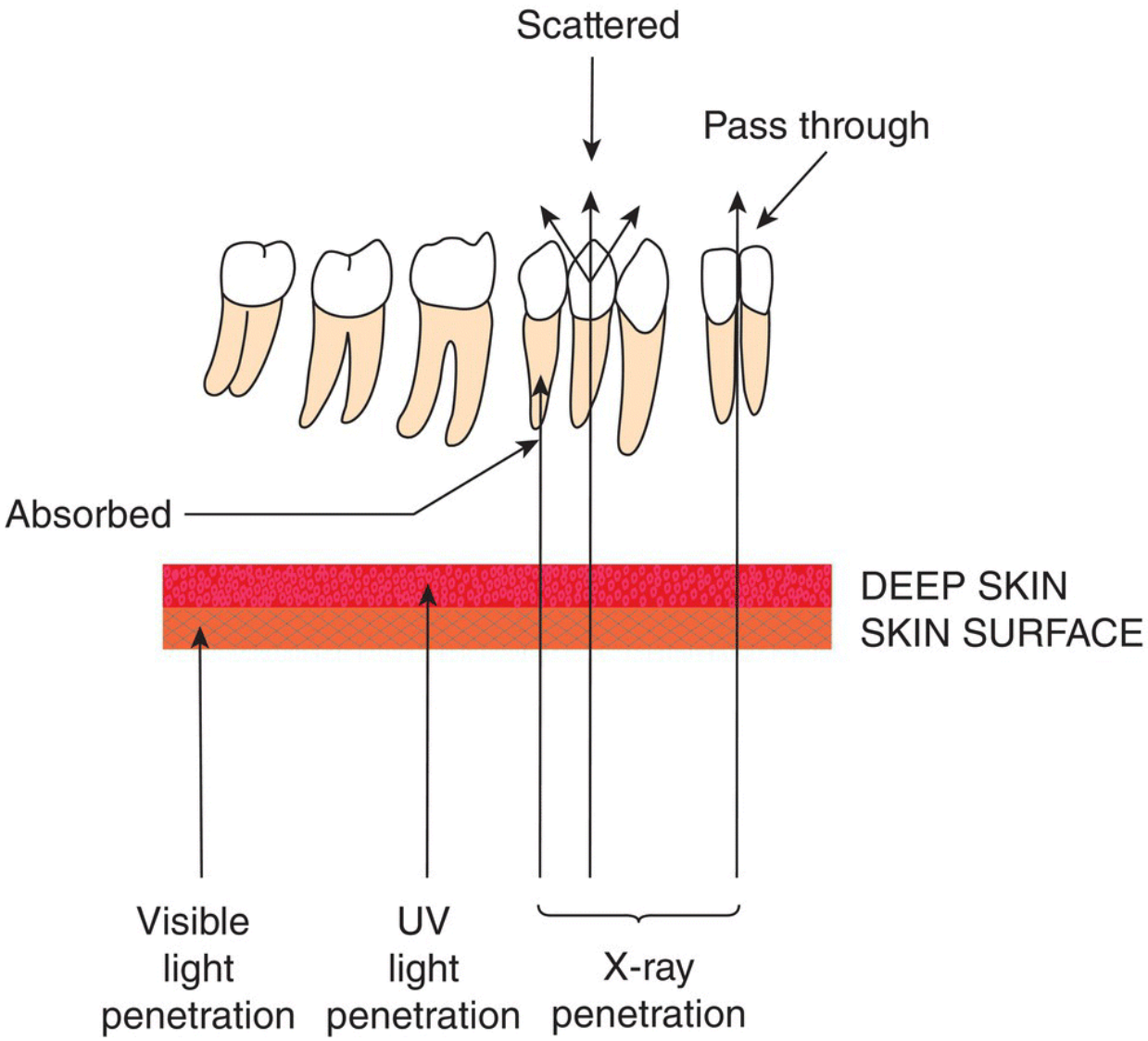

Figure 12.26 Passage of X-rays in human tissue.

With larger atoms of target matter, such as some metals (including calcium in bones and teeth), most of the X-rays are absorbed or scattered, and these are *radiopaque* substances – they appear light grey to white on radiographs. Those which allow the majority of the X-rays to pass through unaffected are called *radiolucent* substances, and include cavities in teeth, and soft tissues – they appear dark grey to black on radiographs.

As bone and enamel have a high calcium content, and dentine and cementum also contain calcium hydroxyapatite crystals but to a lesser extent, these four tissues appear as a variable degree of radiopacity on processed radiographs. The more radiopaque tissues will show as the

whitest structures, so enamel is whiter than dentine, and dentine is whiter than cementum. Similarly, the outer layer of bone will be whiter than the cancellous inner layer.

Effect of ionising radiation on the body

The energy released when X-rays interact with human tissue is capable of causing cellular tissue damage, so it is imperative that X-rays are used only as necessary and at the lowest dose possible, to reduce the amount of energy released and therefore reduce the amount of tissue damage which occurs.

Effects occur when the X-rays hit the atoms of the tissue cells and are either scattered or absorbed, because of the energy that is released during these events. The energy released can cause *tissue damage* to the human tissue cells. The cells contain chromosomes which are made up of our DNA, the building blocks of life that determine exactly the organism that we are, and if the energy hits the chromosomes it can damage them so that they undergo change (*mutation*) or even die.

This ability of X-ray exposure to cause cell death is used in medicine to treat some types of cancer, during radiotherapy treatment. The cancer cells can be accurately targeted by the ionising radiation beam so that they are killed outright, or so that the cancerous tumour is reduced to a size that can undergo surgical removal. High doses of X-rays are used for this treatment, and tissue cells that divide and grow rapidly, such as skin cells and the body cells of children, are more easily affected.

However, cell death is an undesirable effect during the production of dental images. As there can be no ‘safe’ level of exposure to ionising radiation (that is, there is always some cell damage caused during X-ray exposure), strict legislation and guidelines are in place to ensure that the following occur when X-rays are used in dentistry.

- All use of dental imaging has to be **clinically justified**: there must be a clinical reason why the patient is being exposed to the X-rays, and this will be one of the diagnostic or treatment reasons listed above.

- The dose of X-rays used must be kept **as low as reasonably achievable (ALARA)**: the minimum dose of X-rays must be used, for the shortest time, and aimed at the smallest area of tissue possible, to produce a functional image.
- This technique is now more usually referred to as being **as low as reasonably practicable/possible (ALARP)**.
- Only the patient should be exposed to the X-ray beam, so all staff and family members must be outside the **controlled zone** during the exposure (the only exception being when a parent assists a small child during exposure).
- Machines must be well maintained and serviced regularly.
- No untrained personnel can be involved in radiation exposure procedures.
- **Quality assurance (QA) systems** must be regularly operated (as audits) to ensure that the dental images produced are to a consistently high standard.
- Where an audit uncovers a lower standard of image production than expected or desirable, investigations should be carried out to determine the cause of the fault and the method and actions required to correct it.

Ionising radiation legislation in detail

Despite its valuable uses in the diagnosis and treatment of dental disease, ionising radiation presents a hazard to the whole dental team, their patients and the general public.

X-rays cannot be seen, heard or felt, and therein lie the dangers as it can easily be forgotten that this type of ionising radiation is potentially hazardous to health. There is no ‘safe’ level of use – every exposure can cause some amount of tissue damage in the patient, or in anyone else in the imaging area that is exposed to the X-ray beam. An overdose can cause serious health effects, ranging from a mild burn to leukaemia and ultimately death.

For this reason, specific legislation is in place to ensure full compliance with the health and safety aspects of ionising radiation by

all dental workplaces, under the following regulations:

- Ionising Radiation Regulations 2017 (IRR17, replacing IRR99).
- Ionising Radiation (Medical Exposure) Regulations 2017 (IR(ME)R 2017, replacing IR(ME)R 2000).

While IRR17 is enforced by the HSE for England, Wales and Scotland, specific guidelines have been produced by the HSE for Northern Ireland which affects dental practices there and are available to view or download at www.hseni.gov.uk.

IR(ME)R 2017 and IR(ME)R(NI) 2017 is enforced by:

- CQC for England
- HIW for Wales
- IRMER Inspector of the Scottish Ministers and Health Facilities Scotland
- RQIA for Northern Ireland.

While IRR17 is concerned with the regulation of occupational exposures to ionising radiation and therefore with the protection of staff, and IR(ME)R 2017 similarly with the protection of patients, the aim of both sets of regulations is to keep the number of X-ray exposures, and their dose levels, to the absolute minimum required for clinical necessity at all times. This is the ALARA/ALARP principle referred to above. This applies not only to the actual direct X-ray beam that is fired at the patient during the film exposure, but also to the scattered radiation that inevitably occurs during this process. Scattered radiation, as its name suggests, is that which bounces off tissue cells during exposure in an uncontrolled manner, and can re-expose the patient several times over, thereby increasing their actual radiation dose.

In the dental workplace, three simple factors required for the ALARA/ALARP principle to be achieved have helped to reduce by 40% the amount of scattered radiation that is created during a dental exposure.

- Use of ‘fast’ films: currently, F-speed intraoral films require the shortest possible exposure time to create the radiographic image, once processed. Previous films were D-speed or E-speed.
- Short exposure time: achievable with a combination of modern X-ray machines, fast films and fast intensifying screens in extraoral cassettes (see later).
- Rectangular collimator tubes: these have replaced the old plastic aiming cones of intraoral machines and provide a parallel X-ray beam as it leaves the tube end, rather than a disorganised ‘spray’ effect with lots of scattered rays. The rectangular tube end has the same dimensions as a standard intraoral film too (Figure 12.27).

Figure 12.27 X-ray machine head with rectangular collimator.

Compliance with IRR17

This set of regulations replaced IRR99 in January 2018 and there have been some dentally relevant changes. The regulations are

concerned with the safety of staff in the dental workplace where ionising radiation is used, as well as with ensuring the correct functioning of the radiation equipment. The initial act of compliance under IRR99 was to inform the HSE of its use on the premises: this was referred to as 'notification'. One of the changes of IRR17 is that a three-point risk-based assessment of regulatory control was introduced, and all dental workplaces had to formally 'register' with the HSE in January–February 2018, whether previously registered or not. The new 'graded approach' to the HSE application depends on the level of risk of the work carried out involving ionising radiation on the work premises:

- Low risk: applicants must '**notify**' the HSE that low amounts of radionuclides are in use.
- Medium risk: applicants must '**register**' with the HSE as they operate ionising radiation generators, including X-ray machines.
- High risk: applicants must receive '**consent**' from the HSE to carry out work using high levels and/or dangerous types of ionising radiation.

Other than the hospital environment, the vast majority of dental workplaces fall into the medium-risk category and must therefore register with the HSE. The publication *Approved Code of Practice and Guidance of IRR17* is available at www.hse.gov.uk/pubns.

Reapplication is not required after January–February 2018 unless the information given in the initial re-registration process changes significantly, such as when new X-ray machines are installed, and with each change of ownership or location of the business thereafter. The process is quite simple and can be completed online at www.hse.gov.uk, although a fee is now payable, and a copy of the initial application and the return acknowledgement email from HSE should be kept as evidence of compliance with the regulations.

Four formal appointments must then be made by the workplace owner.

- **Legal Person**: a designated person who ensures the workplace's full compliance with both sets of regulations (this is the

employer).

- **Radiation protection advisor (RPA)**: a specialist person/organisation who is formally appointed by the dental workplace to be available to give advice on staff and public safety in relation to both sets of regulations, and normally also provides routine radiation surveys.
- **Medical physics expert (MPE)**: a specialist who is appointed in writing to give advice on matters of radiation protection concerning medical exposures (diagnostic dental imaging) and non-medical exposures (for medico-legal reasons rather than for diagnosis), including the measurement and optimisation of patient doses and QA. The role of the MPE falls under IR(ME)R 2017 and is summarised later.
- **Radiation protection supervisor (RPS)**: a designated person within the workplace who can assess risks and ensure precautions are taken to minimise them, in accordance with IRR17 (this is usually a senior dentist or a DCP with a post-registration qualification in dental radiography).

Legal Person

The Legal Person must now be the employer/business owner and he or she is legally responsible for implementing the requirements of the new ionising radiation regulations. They may also be the RPS in the same workplace, or this role may be delegated to a suitably qualified member of staff.

The Legal Person is responsible for organising a 3-yearly assessment of radiation safety within the workplace. This involves arranging for an inspection by a competent authority such as the Radiation Protection Division of the Health Protection Agency (which has replaced the previous authority, the National Radiological Protection Board) or by using the workplace's own X-ray machine and processing test kit to carry out the necessary checks and then sending them to the competent authority for analysis.

In addition, the Legal Person must draw up a set of Local Rules which have to be displayed at each X-ray machine, so that they can be referred to by all staff. A copy of all must also be held in the radiation

protection file. The Local Rules must give all the following information:

- The name of the designated RPS, RPA and MPE.
- The identification of each controlled area to all staff and patients, to limit unauthorised entry during exposure. This is usually an area of 1.5 m from the machine head and the patient, and directly in the primary beam of the radiation during exposure. The designation of a 2-m safety zone from the machine head will then ensure that only the patient remains within the controlled area during X-ray exposure (Figure 12.28).
- Show the standard warning sign at each controlled area, indicating the use of ionising radiation; this is a black sign on a yellow background (Figure 12.29).
- A summary of the correct working instructions for each controlled area, including a 'No entry' rule for the designated 2-m safety zone around the X-ray machine head.
- A summary of the contingency plan to be followed in the event of a machine malfunction.
- Details of the dose investigation level: this is usually anything above 1 mSv per year in most dental workplaces.
- The use of a red light or display, and an audible buzzer to indicate the actual exposure time.
- The arrangements in place for the safety of pregnant staff.

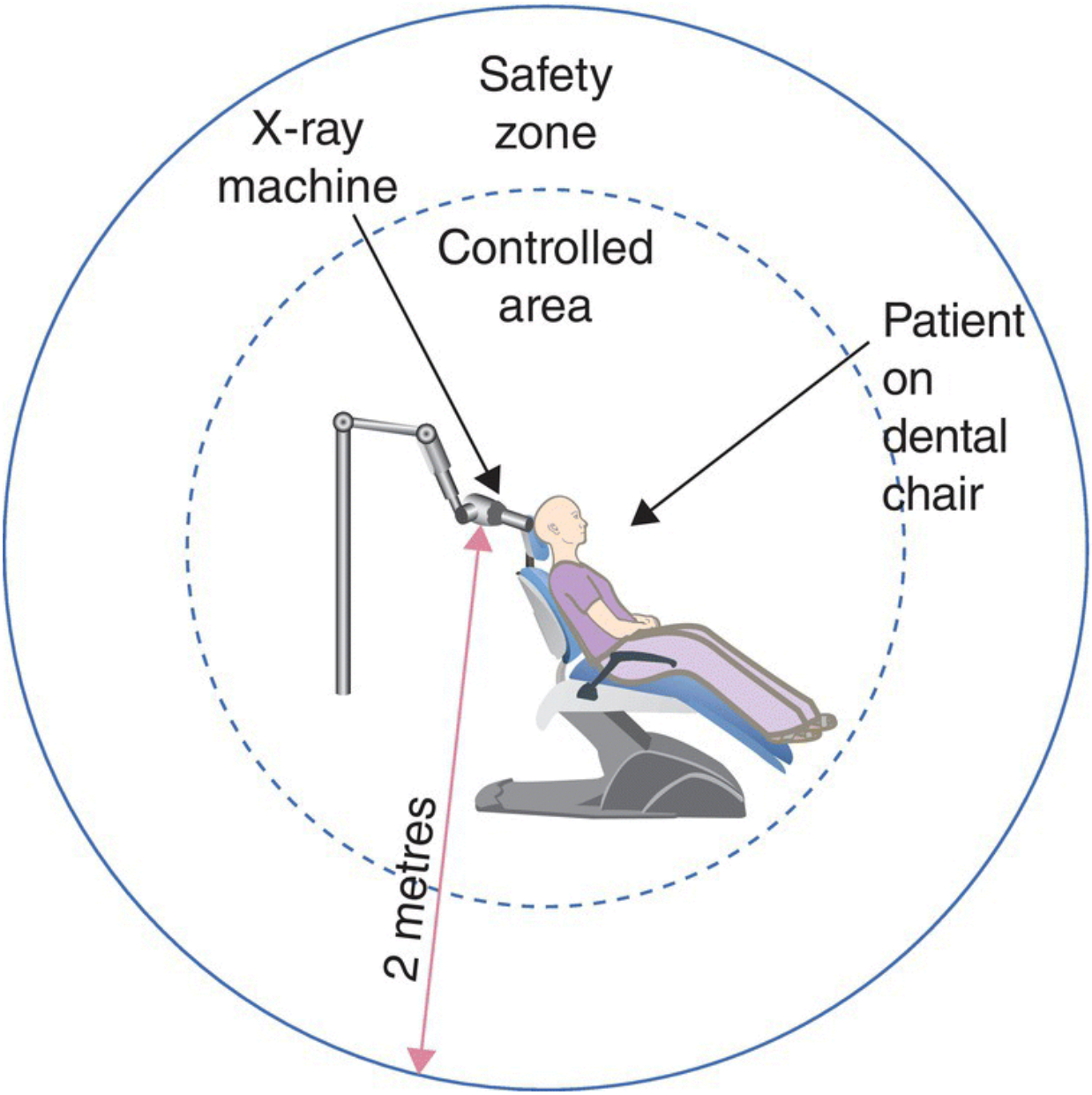

Figure 12.28 Safety zone (2 m) and controlled area (1.5 m) around the X-ray machine head.

Figure 12.29 X-radiation warning sign.

IRR17 also requires the following two points to be included in the Local Rules:

- Information about the procedures in place for ensuring staff have received sufficient information, instruction and training in their relevant roles, particularly if the RPS role is to be delegated from the Legal Person to a member of staff.
- An appropriate summary of the working instructions of the workplace in relation to X-rays, including the written arrangements relating to non-classified persons (carers or comforters) entering or working in designated controlled areas (see later).

Radiation protection advisor

The RPA must hold a Certificate of Competence to be a Radiation Protection Adviser which is recognised by the HSE, and their

certificate number must be issued to the dental workplace as part of their formal appointment and included in the Local Rules.

The role of the RPA is to give advice on the actions the workplace must take to comply with both sets of regulations and will cover the following points:

- The correct installation of all new X-ray machines (acceptance testing, under IR(ME)R 2017).
- The regular maintenance and certificated checks that are required for each X-ray machine to ensure that the minimum exposure to radiation occurs (routine testing, under IR(ME)R 2017).
- The contingency plans that need to be in place in case of a malfunction of an X-ray machine, so that staff or patients are not exposed to X-rays unwittingly.
- The investigation of any malfunction of an X-ray machine.
- The designation of a 1.5-m controlled area around each X-ray machine and within the primary beam direction, where no one but the patient may be present during an exposure.
- Advise on risk assessments with regard to restricting staff and patient exposure to ionising radiation and review the assessments every 5 years.
- Advise on the necessary staff training required so that designated duties are carried out competently and safely.
- Assess staff protection with regard to the numbers of exposures carried out on the premises. If more than 150 intraoral films or 50 dental pantomographs are taken weekly, staff are legally required to wear a personal monitoring badge.
- Advise on the appropriate action to take if analysis of the badges indicates excessive exposure to any staff.
- Advise on the running of QA programmes so that the principle of ALARA/ALARP is maintained at all times.

Medical physics expert

The MPE must be formally appointed by the dental workplace, and their name and unique reference number must be included in the Department of Health's List of Medical Physics Experts in the UK.

The role of the MPE falls into both sets of regulations and is to provide advice on the following:

- Matters relating to radiation protection of patients in relation to medical exposures and non-medical imaging (in relation to the latter, those exposures carried out for health screening or medico-legal reasons).
- Measurement and optimisation of patient doses (ensuring exposures result in clinically diagnostic films which are taken at the lowest possible radiation dose to the patient).
- Making realistic estimates of the exposures to the public for comparison with the dose limit of 1 mSv per calendar year (whole-body dose).

Radiation protection supervisor

The RPS may be the Legal Person or the role may be delegated to a suitably qualified member of staff; for dental nurses this is one who holds a post-registration qualification in dental radiography. Suitable accredited qualifications are available from the NEBDN and the BDA (see Chapter 2).

The role of the RPS is to carry out the following:

- Ensure all staff have suitable training according to the level of their legal responsibility (see later).
- Carry out risk assessments with regard to restricting radiation exposure.
- Ensure the Local Rules remain current or are updated as necessary.
- Maintain the contents of the necessary radiation protection file.
- Organise and run QA programmes in relation to the safe use of ionising radiation.

- Organise and run quality control tests or delegate the tests to suitably trained staff.
- Can also be made responsible for ensuring that all staff receive the necessary hours of CPD in relation to dental radiography, as it is one of the recommended subjects for all qualified staff working in the dental surgery environment.

Compliance with IR(ME)R 2017

This set of regulations replaced IR(ME)R 2000 in February 2018 and there have been some dentally relevant changes. The regulations are concerned with the safety of patients in the dental workplace, and with their protection during exposure to ionising radiation. They are of most concern to those dental personnel who have the qualifications and legal right to actually expose the patient to ionising radiation; that is, the dentist and any DCP holding a recognised dental radiography qualification. The regulations are therefore of less importance to the student dental nurse, and consequently only the basics are covered here.

Roles and responsibilities

The regulations set out the responsibilities of the various dental personnel who may be involved in taking and processing radiographs within the dental workplace and restricts those responsibilities by referring to each category with specific appointment titles.

- **Referrer**: the dentist, or a suitably radiation-qualified therapist or hygienist, who refers the patient for radiation exposure, either to themselves (in all three cases) or to another dentist or specialist dental radiographer (for dentists only) who can carry out that exposure.
- **IR(ME)R practitioner**: the dentist or specialist dental radiographer who takes responsibility for *justifying* the taking of the radiograph, by determining that the diagnostic benefits gained will outweigh the risks of the exposure to the patient.
- **Operator**: any member of the dental team who carries out all or part of the practical duties involved with the exposure and processing of the radiograph, including:

- patient identification
- positioning of the film, the patient, and the machine tube head
- setting the exposure controls
- pressing the exposure button
- processing the film
- evaluating the quality of the radiograph
- carrying out test exposures for QA purposes
- running QA programmes.

Except in the hospital setting then, only a dentist can be an IR(ME)R practitioner. Therapists and hygienists are likely to have undertaken study and qualification in dental radiography as part of their training course and will therefore be able to act as referrers to themselves only, and to carry out all the above duties as operators. With suitable and authenticated training, or qualification, the dental nurse can also carry out a variety of duties under the title of 'operator', as shown in Table 12.2.

Table 12.2 Details of duties allowed to operators.

Duty	Radiography qualified dental nurse	NEBDN qualified dental nurse	Level 3 Diploma* qualified dental nurse	Student dental nurse
Patient identity	Yes	Yes	Yes	Yes
Positioning	Yes	No	No	No
Setting exposure	Yes	No	No	No
Pressing exposure button	Yes	Yes, in the presence of the set-up operator	Yes, in the presence of the set-up operator	Yes, in the presence of the set-up operator
Processing	Yes	Yes	Yes	Yes
Quality audit	Yes	Yes	Yes	Yes
QA test exposures	Yes	Yes, in the presence of the set-up operator	Yes, in the presence of the set-up operator	Yes, in the presence of the set-up operator
QA programmes	Yes	Yes	Yes	Yes

*Level 3 Diploma, formerly National Vocational Qualification.

Table 12.2 lays out the various duties involved in the exposure of patients to ionising radiation in the dental workplace, and the processing of the images into radiographs. The four other columns then identify which duty can be carried out by each level of experienced dental nurse, from those holding a post-registration qualification in dental radiography, through a qualified registrant to a student dental nurse. It can be seen that there is no difference between the final three categories: there is no suitable 'extended duties' training that will allow any additional duties to be carried out by a dental nurse, whether registered or in training. The risk of

potential harm to a patient and others from unnecessary exposure to ionising radiation is so great that only further specialised qualification is recognised as enabling a qualified dental nurse to carry out the additional duties of positioning the patient and setting the exposure. While all categories can press the exposure button, only those dental nurses holding the dental radiography qualification can do so unsupervised.

A dental nurse holding the basic registrable qualification will have received documented training in the majority of these duties throughout their training course, supplemented by documented in-house training in any additional duties allowed (under the GDC *Scope of Practice* document) within the workplace. Similarly, the student dental nurse must receive the same documented training to be allowed to carry out any of the duties listed above.

The ability of suitably trained personnel to press the exposure button during radiation exposures is of great help in reducing the risks of cross-infection, as the operator setting up the procedure would otherwise contaminate the exposure button unless they repeatedly removed and replaced their gloves between setting up and retrieving each film from the patient's mouth.

The medico-legal importance of all personnel receiving adequate documented training in these operator duties cannot be stressed too highly.

Patient protection

The IR(ME)R regulations are mainly concerned with the protection of patients while undergoing ionising radiation exposure in the dental workplace, so that they are not exposed unnecessarily and that all exposure levels are as low as reasonably possible, to reduce the chance of any tissue damage occurring. The key points covered are summarised below.

- **Patient identification**: of particular importance when the dentist referrer is not also the IR(ME)R practitioner, as occurs when patients are referred to hospital or to a specialist practice for dental treatment. To avoid the wrong patient being exposed,

name, address and date of birth should be used as a minimum for identification purposes.

- **Referrer**: can be a suitably radiation qualified hygienist or therapist when referring to themselves only or can be a dentist.
- **IR(ME)R practitioner**: can only be a dentist (unless the patient is referred to a specialist dental radiographer), as only they have the training to determine when an exposure is justified.
- **Justification**: the benefit of exposing the patient should outweigh the risk of causing tissue damage (remember, there is no 'safe' level of X-ray exposure), so every exposure should be expected to provide new information to help the patient's diagnosis, treatment or prognosis as a minimum requirement, otherwise it should not be undertaken. Thus the taking of 'routine' bite-wings for example is no longer acceptable.
- **Optimisation**: the dose of radiation used should follow the ALARA/ALARP principle at all times.
- **Pregnant patients**: routine dental exposure techniques do not irradiate the pelvic area and involve such low doses that pregnancy is not considered a contraindication to irradiation; for similar reasons, lead aprons are also not required.
- **Staff training**: written evidence of all necessary training pertinent to ionising radiation techniques must be kept for all personnel in the radiation protection file, as documented proof of their competence in the duties that they undertake.
- **QA programmes and audits** provide a valuable tool in determining whether the systems in place to protect patients (and staff) from any potential harm from ionising radiation are actually working, by looking at the procedures and the results achieved, and analysing any problems encountered so that policies and techniques can be suitably adjusted and updated where necessary.
- **Accidental exposure**: all X-ray machines must have an isolation switch outside the controlled area, an illuminated control panel or switch to indicate when the mains power is on, and an additional light and/or an audible buzzer that is activated

during the exposure time itself. If a machine malfunctions during use, it will then be obvious by the lights and buzzers, and the mains power can be switched off without the operator having to enter the controlled area.

The additional changes that have occurred under IR(ME)R 2017 are as follows:

- **Non-medical imaging**: this covers exposures for health screening or medico-legal reasons, rather than to gain clinical information and diagnosis for the health benefit of the patient. With advice from the MPE, dose constraints for these exposures must now be established and the dental workplace can decide not to carry out non-medical imaging exposures if they wish, although this must be stated as a written protocol.
- **Carers and comforters**: these are people who assist the patient during an exposure, thereby knowingly exposing themselves to the ionising radiation; an obvious example is a parent holding a young child while an exposure is taken. Additional protection for these people is now required, by the provision of written employer's procedures (with advice from the MPE) that:
    - establish appropriate dose constraints for carers and comforters
    - provide guidance on how they may be exposed and protected
    - have a procedure in place to justify their exposure
    - allow the dental workplace the option to disallow this type of assistance, although this must be stated as a written protocol.
- **Other written procedures**: as well as the two points above, written procedures are now required in relation to the following:
    - Where practicable before an exposure, adequate information about the risks and benefits of the radiation dose is given to the patient (or their carer/comforter).
    - Where a clinically significant unintended or accidental exposure occurs, the referrer, practitioner and the patient (or

their carer/comforter) are made aware and are informed of the analysis outcome of the event.
    - In the event of such an occurrence, the RPA must be notified and their advice sought immediately.
- **Estimates of population dose**: guidance is to be issued for the employer to collate this information, with the help of the MPE, in readiness for its provision to the Secretary of State if requested.
- **MPE**: this person must be formally appointed by the dental workplace and their details held by the Department of Health on the List of Medical Physics Experts in the UK.
- **Equipment testing**: both the 'acceptance testing' of a new dental imaging set and the 'routine survey' of existing equipment is now a requirement under IR(ME)R 2017, rather than under IRR regulations as previously.

Radiation protection file

Effectively, this acts as a summary document that holds as much information as possible about the procedures in place to ensure radiation protection within the particular workplace and should be reviewed and kept updated annually to ensure that it remains relevant and effective. It should contain all the following information and have references included for any information that is kept elsewhere (such as qualification and relevant training details that are kept in personnel files).

- Formal appointments of staff on the premises, including referrers, IR(ME)R practitioners and all operators (with details of the range of their duties).
- Reference to the initial risk assessment carried out by the Legal Person, in consultation with the RPA.
- Local Rules for each X-ray set on the premises.
- Procedures for ensuring patient protection, as required under IR(ME)R.
- Information on how ALARA/ALARP is achieved.

- Details of protocols followed in relation to justification and authorisation of exposures (usually referenced to the FGDP booklet *Selection Criteria for Dental Radiography*).
- Details of protocols followed in relation to clinical evaluation of radiographs (so written notes are kept of each radiograph taken and what the findings were).
- Details of QA programmes to ensure consistently accurate radiographs, including their frequency and the named persons who run them.

Quality assurance of films

All the faults that may occur during the taking or processing of a radiograph, which may result in the patient having to undergo a retake, are avoidable. However, it may not be realised by the dental team that a recurring problem exists unless radiographs are regularly checked for quality, and this is especially so in large multi-dentist workplaces. A processing fault may affect the radiographs of several dentists but unless someone is analysing the radiographs from all surgeries, it can easily be overlooked. This is the purpose of a QA system, in which all radiographs are analysed and scored according to a universal system of quality so that commonly occurring problems will be identified.

With suitable training, a QA system of radiograph analysis can easily be run by the dental nurse, the aim being to reduce all faults to a minimum or to eliminate them completely. Indeed, in line with the relevant ionising radiation legislation and with clinical governance, the running of a QA system in dental workplaces is now a legal requirement.

The types of faults that may occur during the exposure, handling and processing of radiographs are detailed later. To protect both patients and the dental team from unnecessary ionising radiation exposure, it is everyone's duty to ensure that the occurrence of these faults is kept to a minimum or eliminated completely. To do this involves assessing the quality of the films processed to determine the following points:

- How readable is the film?
- Is a fault present?

- What is the fault?
- How has it occurred?
- How can it be prevented from recurring?
- Is re-exposure of the patient necessary?

When run correctly, the QA system should achieve the following results:

- Involve a simple-to-use scoring system that is understood and followed by all staff.
- Easily identify any areas of concern.
- Develop solutions to the problems identified.
- Limit the number of patient exposures to the minimum required for clinical necessity.
- Therefore, to achieve ALARA/ALARP.

A simple-to-use scoring system set out in clinical governance guidelines is as follows:

- **Score 1**: **excellent** quality radiograph with no errors present.
- **Score 2**: **diagnostically acceptable** quality, with minimal errors present that do not prevent the radiograph from being used for diagnosis.
- **Score 3**: **unacceptable quality**, where errors present prevent the radiograph from being used for diagnosis, and will therefore involve a retake.

Score 1 should at a minimum constitute 70% of all exposures, while score 3 should at a maximum constitute 10%. The results need to be easily recorded after every exposure so that they can be analysed on a regular basis and any problems identified.

A typical recording system is shown in Figure 12.30. The simple record sheet shows, at a glance, all the information required to enable a retrospective QA audit of the workplace radiographs to be carried out. As the operator is identified (by their initials), the audit can be

used to track the performance of individuals, while the identification of the views used (detailed in the fourth column) also allows an audit of each type of radiograph to be carried out. The final column should give the information required to explain the QA score of 2 or 3 that has been awarded in each case, so that trends can be identified. For example, if an operator takes periapical radiographs without using a holder and regularly scores 2 or 3 due to coning or elongation, the audit will identify that this as a recurrent problem and that it can be resolved by the suitable use of film holders. Similarly, when all radiographs begin to score 2 or 3 due to poor processing from a certain date onwards, it may indicate a faulty machine or that the processing chemicals are spent.

Date	Operator	Patient ID	Radiograph	QA score	Details
4.4.12	DTH	4173	L/R BWs	1 and 1	N/A
4.4.12	JM	854	PA UL6,7	2	Coned, unable to use holder
5.4.12	TNL	1559	DPT	1	N/A
5.4.12	DTH	6212	PA UR2	1	N/A
5.4.12	CSH	377	AO-maxilla	2	Elongated but canines visible
6.4.12	JM	5458	L/R BWs	1 and 2	R BW coned
6.4.12	TNL	905	PA UL4	3	Missed apex for endo - retake
6.4.12	TNL	905	PA UL4	1	N/A

Figure 12.30 Example of quality assurance radiograph record sheet.

When a score 3 occurs the radiograph has to be rejected and the patient irradiated again, as the initial radiograph is deemed clinically unacceptable – the image could not be read and a diagnosis could not be made. Information on score 3 radiographs stored in the image quality log can be transferred to a reject image analysis sheet such as that shown in Figure 12.31 on a 6-monthly basis. The type of view, the reason for the rejection of the radiograph, the total number of rejects

and their percentage of the total number of radiographs taken can then be analysed so that any recurring issues can be investigated. The fewer the number of score 3 radiographs and therefore repeat exposures for patients, the safer the working practices of the workplace, although this reject information is likely to go undetected unless a robust QA and analysis system is in place.

Reject Image Analysis

An analysis of radiographs which had to be rejected because they were deemed to be clinically unsatisfactory (ie quality rating 3) can identify areas where there may be consistent problems. The reason for each rejection can be recorded in the image quality log kept at the practice. These data can then be analysed and entered in the table below at six monthly intervals. The percentage of radiographs rejected should be kept under review and any consistent trends should be investigated.

JUNE 2016 – DECEMBER 2016

Type of radiograph*	Date	Rejected radiographs												Total no. of rejects	Rejects as a % of total radiographs
		Too dark		Too light		Poor contrast		Artefact†		Unsharp image		Poor positioning‡			
		No.	% of total	No.	% of total	No.	% of total	No.	% of total	No.	% of total	No.	% of total		
BW	7/6			1		DEVELOPER SPENT								4/72	5%
BW	30/7			1		DEVELOPER COLD								4/72	5%
DPT	2/9					LIGHT CONTAMINATION		1						1/11	9%
BW	18/9							1	SCRATCH					4/72	5%
anterior PA	3/11								CONED			1		3/58	5%
anterior PA	28/11								CONED			1		3/58	5%
posterior PA	4/12								CONED			1		3/58	5%
BW	22/12							1	STUCK ON ROLLERS					4/72	5%

* Intra-oral, panoramic or cephalometric.

† Artefact – any unintentional mark or image on the radiograph. This may be due to chemical splashes, finger prints, pressure marks, fogging, obscured or damaged digital detector, computer software problems, etc.

‡ Including incorrect angulation.

Figure 12.31 Reject image analysis sheet.

Similar QA systems can be set up to monitor other areas of dental radiography, such as equipment, working procedures or staff training.

Dangers of ionising radiation

X-rays cannot be seen, heard or felt, and therein lie the dangers of their use. As they cannot be perceived by any of the senses, it is easily forgotten that they are potentially dangerous to health and it is just as easy to ignore every safety precaution. An overdose can give rise to serious health effects, ranging from a mild skin burn to the onset of leukaemia. This is why the special legal requirements described previously are in force for dental workplaces, and other workplaces where X-rays are used.

In the course of dental radiography the patient never receives an overdose. It is the operator, not the patient, who is most at risk, as the former is continually taking X-rays and must therefore take strict precautions to avoid their own accidental exposure.

- Radiation safety must be checked at least every 3 years to ensure that X-ray sets are adequately shielded to prevent stray radiation and that processing equipment and procedures are satisfactory. All sets must have regular professional maintenance.
- Use of the fastest film (E and F speed) will allow the shortest possible exposure time. Indeed, there is no justification for using anything but the fastest available film. Cassettes should be fitted with the fastest (rare earth) intensifying screens.
- Plastic aiming cones on X-ray sets are no longer acceptable (as they allowed dangerous scatter to occur) and must be replaced by lead-lined, rectangular collimator tubes to further reduce beam size to the safest level.

This combination of fastest film, shortest exposure and narrowest beam will alone reduce the amount of scattered radiation by 40%. In addition, the following are important:

- Special film-holder/beam-aiming devices should be used for periapical and bite-wing radiographs, so that the paralleling

technique of image production is used in preference to the bisecting angle method.

- The operator must stand well clear of the X-ray beam during exposure, at the full length of the cable on the time switch; this should be not less than **2 m**. On no account must a dental nurse hold the film in place for a patient. If a child cannot keep still during the exposure, the parent must hold the film packet in place and wear a protective lead apron, if the workplace has opted to allow the assistance of carers and comforters, in line with IR(ME)R 2017 requirements.
- Exposure of the reproductive organs to X-rays has produced abnormalities in the offspring of laboratory animals. Similar exposure of humans may occur from scattered radiation during dental radiography. Although it is insufficient to produce such genetic changes in the case of pregnant dental patients, any possibility can be excluded by strict adherence to all the required safeguards.
- Every radiograph must not only be necessary but also of diagnostic value. There should be no need for retakes because of faulty technique or processing. Retakes mean unnecessary additional exposure of patients and staff. To ensure perfect results the films must be in good condition, taken correctly, processed carefully and mounted properly.
- X-ray sets should be disconnected from their electricity supply when not in use.
- The amount of stray radiation received by staff can be checked by means of a film badge. This is an intraoral film which is worn at waist level for up to 3 months. It is then processed to indicate whether an excessive dosage is being received. If so, expert advice must be sought immediately to trace and eliminate the cause. Staff working in rooms adjacent to the surgery should also wear badges as X-rays can pass through walls.

Film badges are called personal monitoring dosimeters and details of suppliers are available from the Radiation Protection Division (RPD) of the Health Protection Agency or a local medical physics

department. The RPD will process the badges, notify the dosage received and can arrange appropriate investigation if it is too high.

Principles of dental radiography

As stated previously, there are many sound clinical reasons for dental radiographs to be taken in the dental workplace, and their use is particularly invaluable as a diagnostic tool in dentistry. However, to avoid their indiscriminate use, guidelines have been drawn up for the safe prescription of dental radiographs in dental practice, as follows, and must be adhered to by all.

- A history and a clinical examination must be performed before any radiograph is taken.
- Only new patients with clear evidence of some dental disease should have full-mouth radiographs taken.
- Regularly attending child patients in the mixed dentition stage who have orthodontic problems developing can be radiographed as necessary.
- Recall patients with a low caries risk should be radiographed no more frequently than every 18 months.
- Those with a moderate caries risk should be radiographed every 12 months.
- Those with a high caries risk should be radiographed at 6-monthly intervals, gradually reducing this rate as the caries is brought under control.
- Patients exhibiting evidence of periodontal disease can have selective radiographs taken of problem areas, as necessary.
- Edentulous patients should only have selective radiographs taken if there are any clinically suspicious areas (such as retained roots or hard tissue lesions).

Types of views used in dental radiography

Various types of film are used in dental radiography, depending on the reason for taking the dental image, but all are either those taken

within the oral cavity – *intraoral films* – or those taken outside the oral cavity – *extraoral films*.

Intraoral films

Intraoral films are supplied in child and adult size packets that contain the following (Figure 12.32):

- Plastic envelope to protect the contents from saliva contamination.
- Wrap-around black paper to prevent exposure of the film to light.
- Film, which is exposed to the ionising radiation and produces the dental image once processed or loaded onto the computer (digital imaging).
- Lead foil to prevent scatter of the ionising radiation past the film packet.
- Raised pimple marker on the film and packet side towards the X-ray tube, which is used to correctly determine the left and right side of the image produced (film is mounted with the pimple towards the observer).

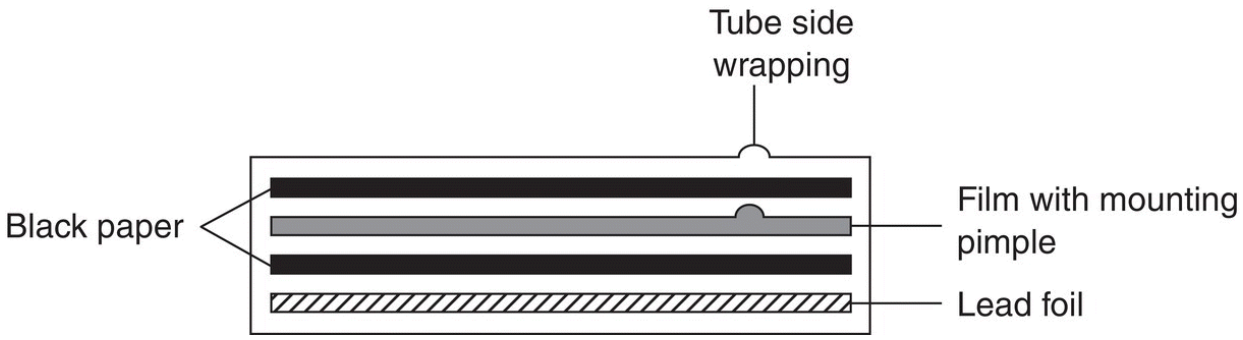

Figure 12.32 Contents of intraoral film packet.

The intraoral views that can be produced using these films are as follows:

- **Horizontal bite-wing** (Figure 12.33): show the posterior teeth in occlusion and are taken to view
  - interproximal areas and diagnose caries in these regions

- restoration overhangs in these areas
- recurrent caries beneath existing restorations
- occlusal caries.

- **Vertical bite-wing** (Figure 12.34): show an extended view of the posterior teeth, from midroot of the uppers to midroot of the lowers as a minimum, and are taken to view
  - periodontal bone levels of the posterior teeth
  - true periodontal pockets.
- **Periapical** (Figure 12.35) show one or two teeth in full length with their surrounding bone, and are taken to view the area and the teeth in close detail.
- **Anterior occlusal** (Figure 12.36): show a plane view of the anterior section of either the mandible or the maxilla, and are used especially to view the area for unerupted teeth, supernumerary teeth and cysts.

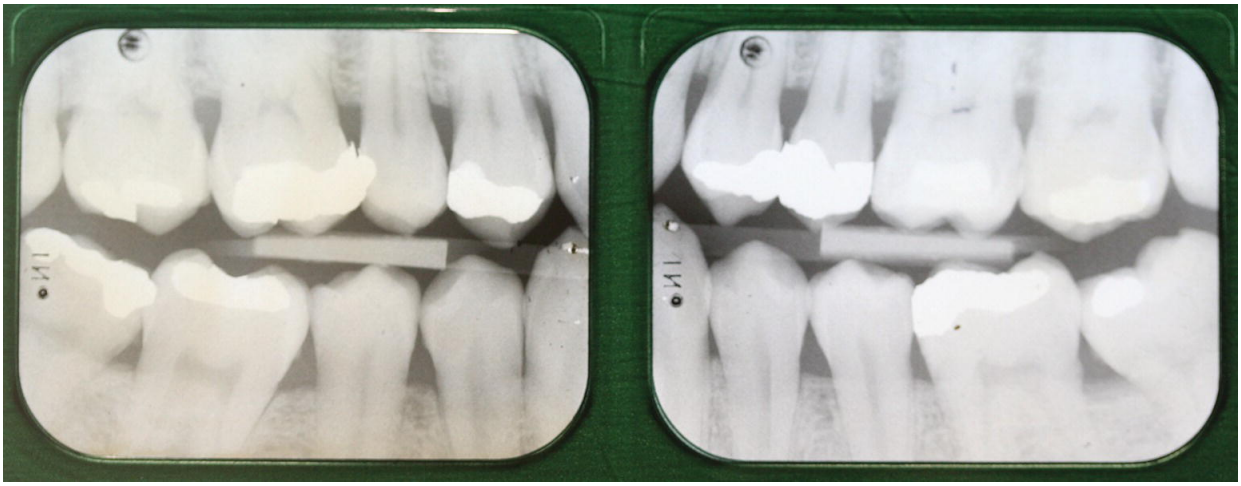

Figure 12.33 Horizontal bite-wing radiographs.

Figure 12.34 Vertical bite-wing radiograph showing bone levels.

Figure 12.35 Upper posterior periapical radiograph.

Figure 12.36 Anterior mandibular occlusal radiograph.

Extraoral films

Extraoral films are used to produce much larger images showing many structures, and are supplied in cassettes that contain the following (Figure 12.37):

- Cassette case that is loaded into special imaging machines for use.
- Intensifying screens in both sides of the cassette, to reduce the dose of radiation exposure required to produce a dental image.
- Film, of a type compatible with the intensifying screens, to produce the dental image once exposed and processed.
- Marker to correctly determine the left and right side of the image produced.

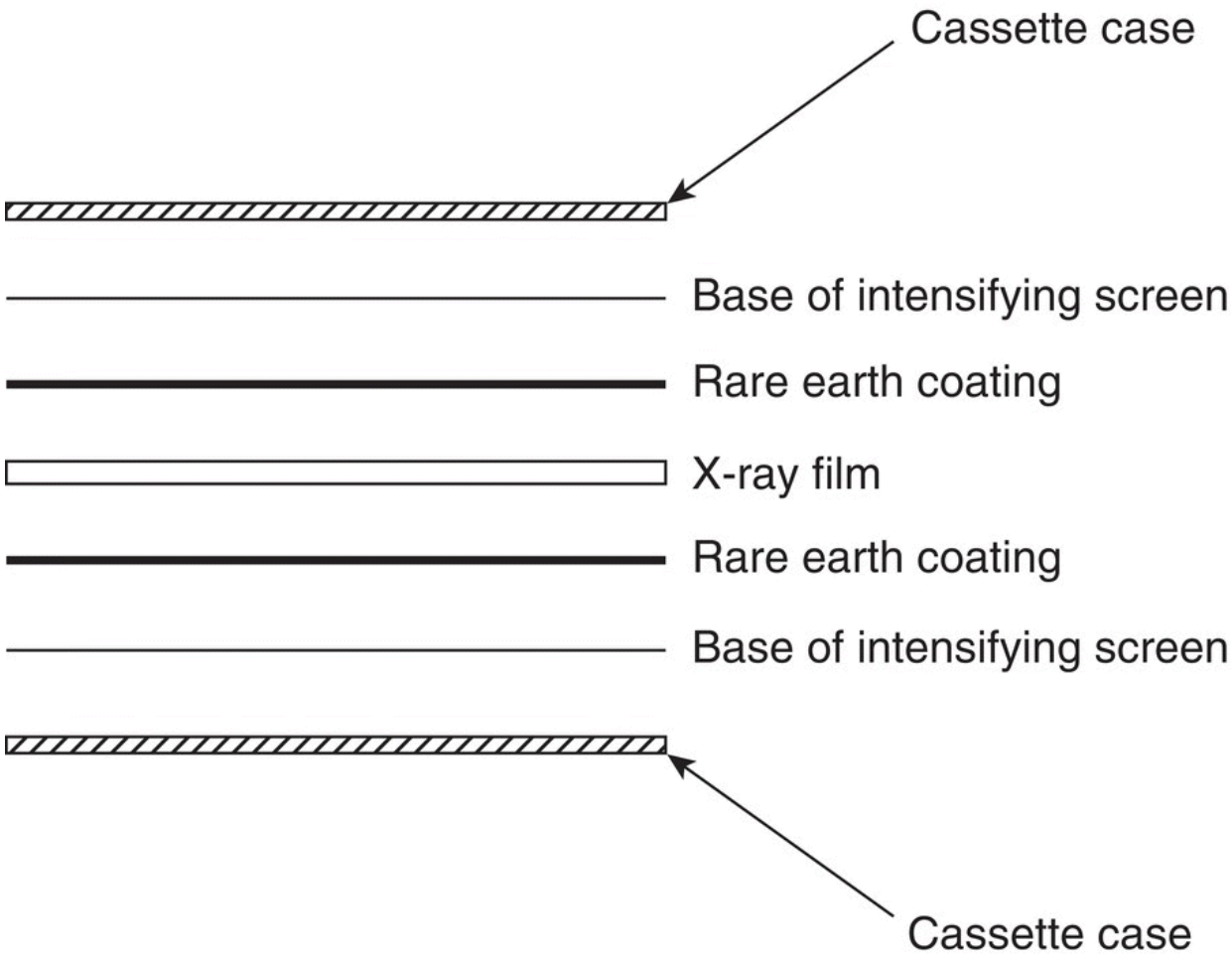

Figure 12.37 Contents of extraoral cassette.

Extraoral films are packed differently from intraoral films. The latter are individually packed in lightproof wrappers but extraoral film is not. Packets of extraoral film only contain unwrapped film and can only be opened in a darkroom. On removal from the packet in the darkroom, a film is placed immediately in the special lightproof container or *cassette*, which is then kept closed ready for use.

A typical cassette opens like a book and the film is placed in the middle. On each inside cover of the cassette there is a white plastic sheet called an *intensifying screen*, and the film is sandwiched between the two screens when the cassette is closed ready for use. The screens *fluoresce* on exposure to X-rays, and the brightness of the fluorescence creates the image on the film itself, rather than being produced by the actual X-ray beam. This allows the use of a reduced exposure time of X-rays, making the technique safer for the patient.

The extraoral views that can be produced using these films are the following:

- **Dental panoramic tomograph (DPT)** (Figure 12.38): shows both jaws in full and their surrounding bony anatomy, and is taken for orthodontic and wisdom tooth assessments, as well as to help diagnose pathology and jaw fractures.
- **Lateral oblique**: shows the posterior portion of one side of the mandible, including the ramus and angle and the lower molar teeth, and is an alternative to a DPT to view the position of unerupted third molar teeth (it is used infrequently now, as the image produced on a well-aligned DPT is far superior).
- **Lateral skull radiograph** (Figure 12.39): this is a view of the side of the head, taken in a specialised machine called a *cephalostat* (which may be present as an attachment to a DPT machine or as a stand-alone device), and is used to monitor jaw growth and determine orthognathic surgery techniques in complicated orthodontic cases where the patient has a severe skeletal discrepancy as well as malocclusion of the teeth.

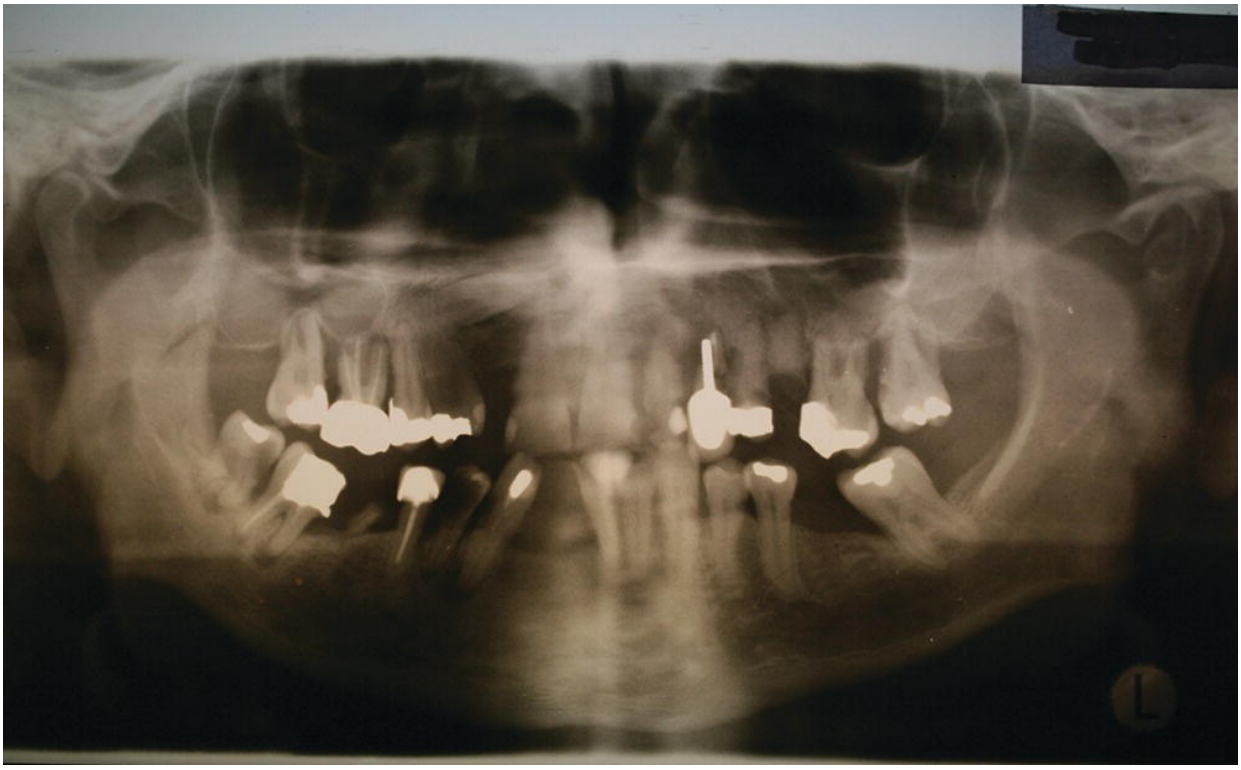

Figure 12.38 Dental panoramic tomograph.


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Figure 12.39 Lateral skull radiograph.

When DPTs initially became widely available to the dental profession, they were called ‘orthopan-tomographs’ and referred to as OPGs or OPTs; these abbreviations are still in current use in some areas.

Radiographic techniques

Any dental image is produced by the correct placing of the film on the far side of the area to be exposed from the X-ray machine. In other words, the radiation beam passes from the machine through the area to be exposed and then hits the film inside either the plastic envelope or the cassette.

Intraoral films are held in the correct position by the use of film-holder devices where possible, as shown in Figures 12.40 and 12.41. These are correctly loaded with the film packet (pimple towards the tube head) and placed inside the oral cavity for the patient to bite on so that the radiograph can be produced (Figure 12.42). If a digital imaging technique is used, the film is replaced by a special sensor that is positioned in exactly the same way, but instead of an exposed film being produced which is then chemically processed, the digital image is transmitted directly to a computer where it can be viewed immediately (see later).

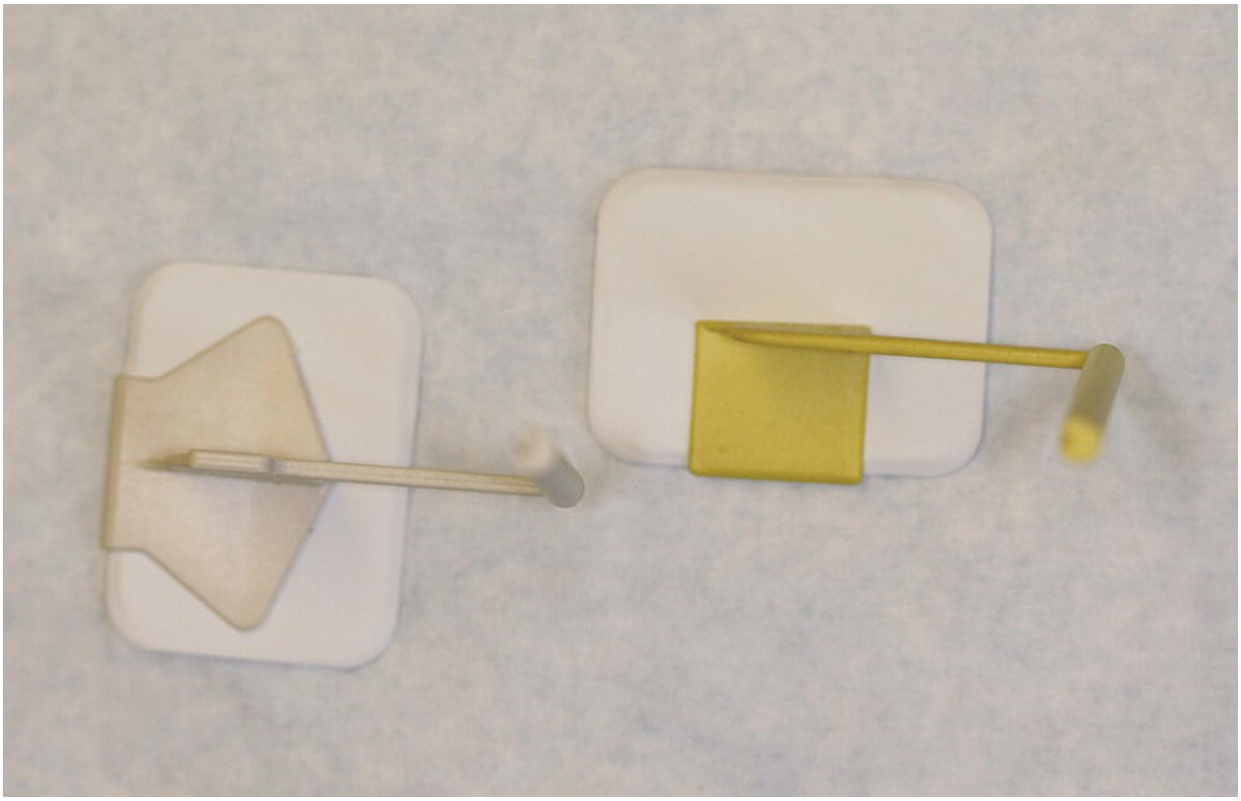


Figure 12.40 Vertical and horizontal bite-wing holders – loaded.

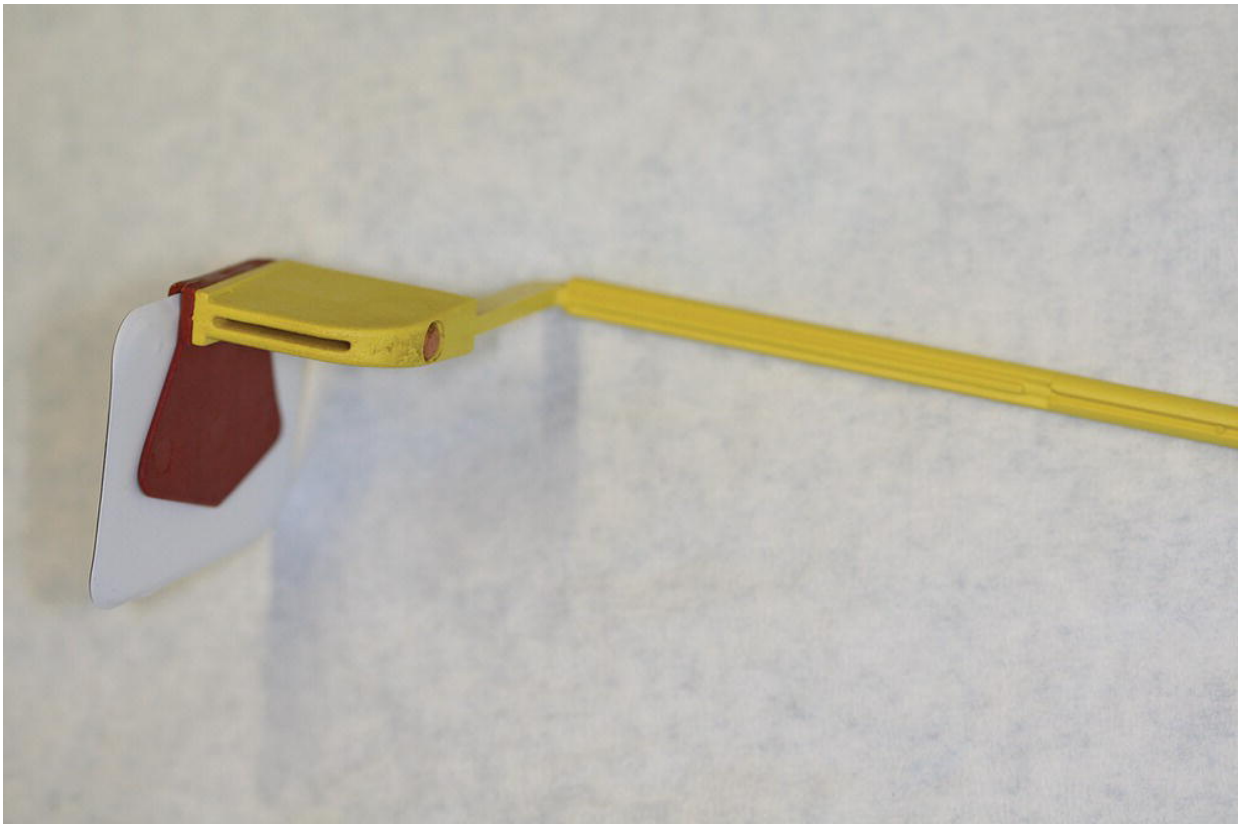


Figure 12.41 Posterior periapical holder – loaded.

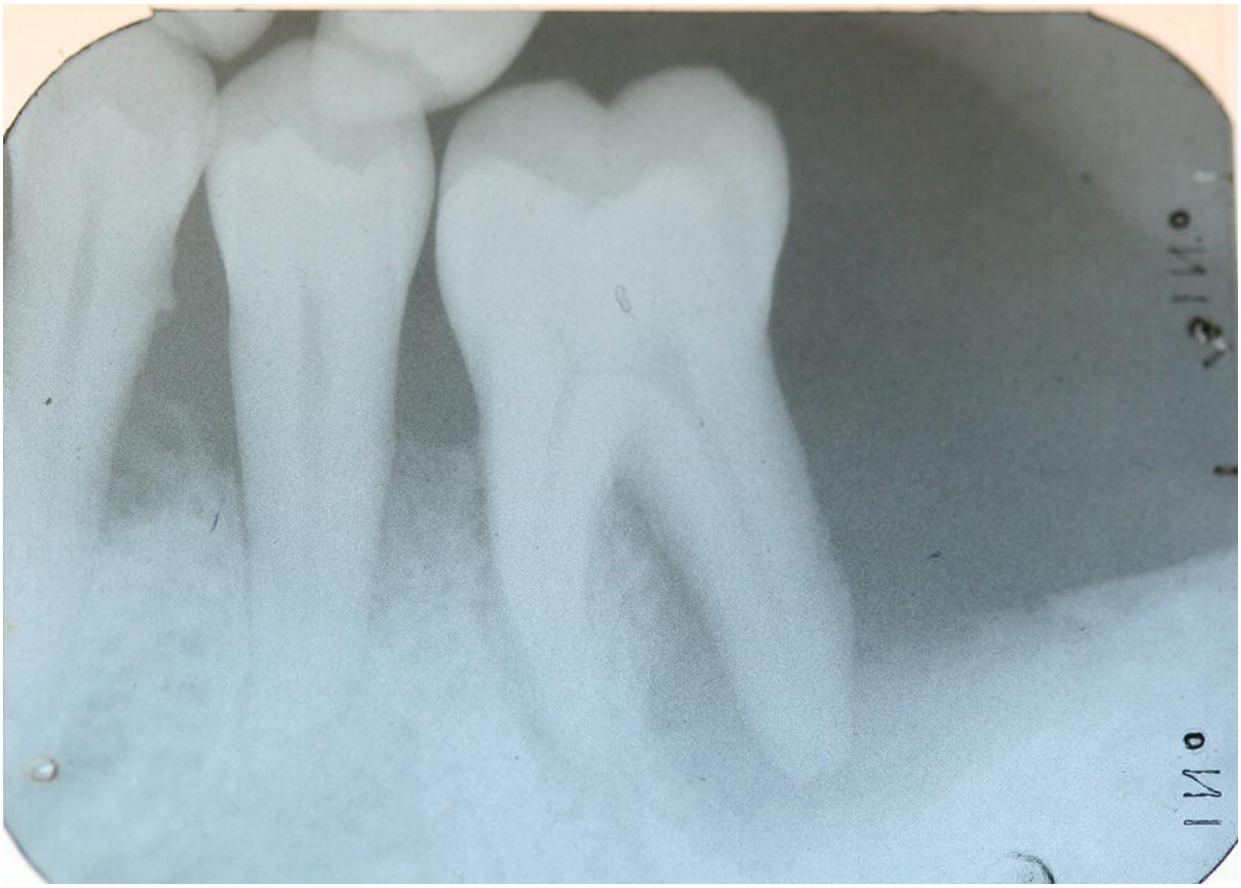


Figure 12.42 Posterior periapical radiograph.

Intraoral films can be exposed in one of two angulations, depending on which is the best technique for the given clinical situation. They are called the *paralleling* technique and the *bisecting angle* technique, and wherever possible the paralleling technique is used with the aid of film holders.

The paralleling technique holds the film exactly parallel to the long axis of the tooth being exposed, so that the image produced is exactly the same size as the actual tooth (Figure 12.43). This is especially important during endodontic procedures, when the correct diagnostic length of the tooth has to be determined to ensure accurate root filling of the canal.

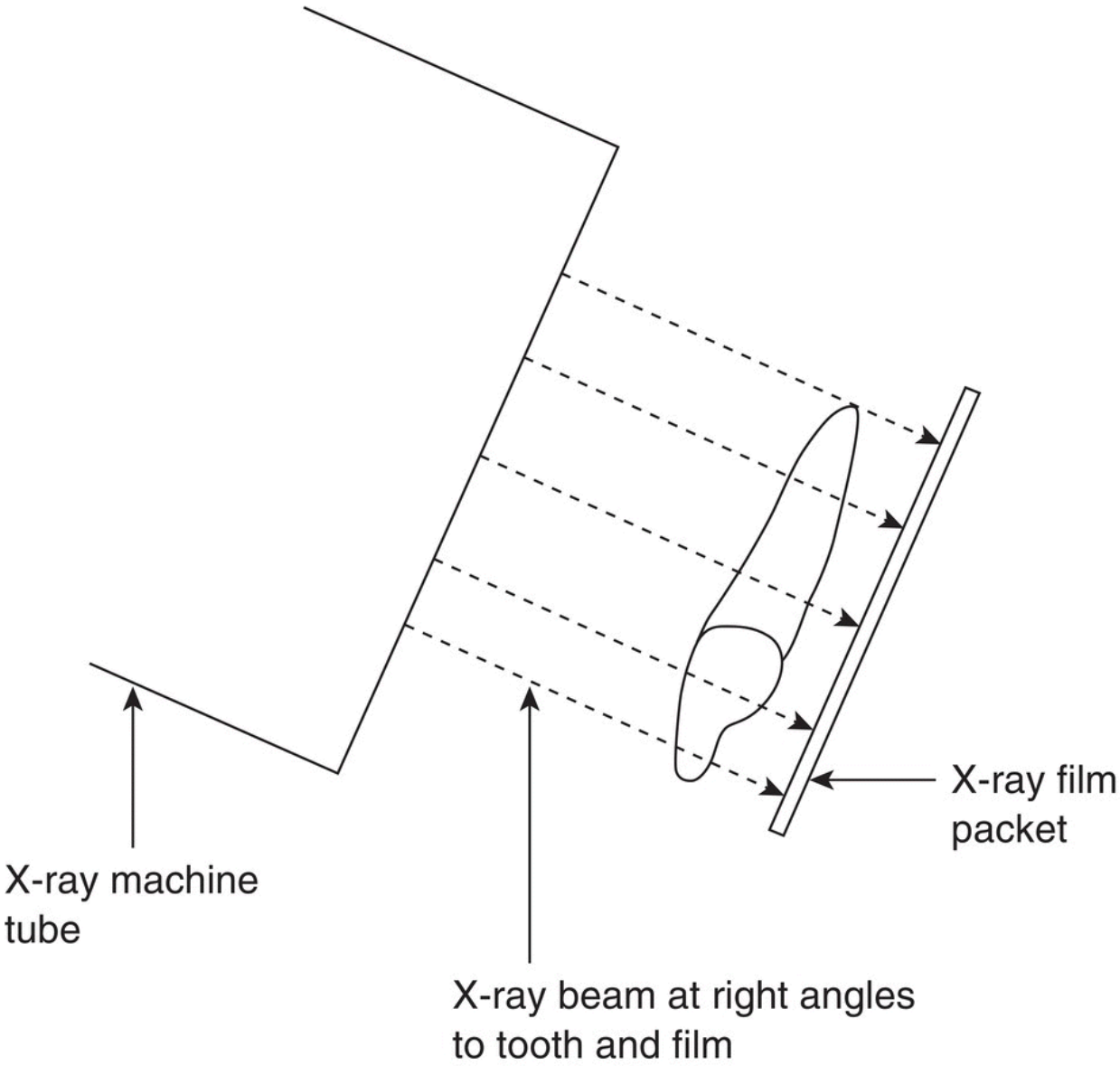


Figure 12.43 Paralleling technique.

Sometimes the film cannot be placed parallel to the tooth, because of the size restriction of the patient's mouth. In this situation the bisecting angle technique is used. The film is placed intraorally and the angulation of the long axis of the tooth against the film is determined by the operator. This angle is then halved (bisected) and the collimator of the tube head is angled to be at right angles to it (Figure 12.44), before the film is exposed.

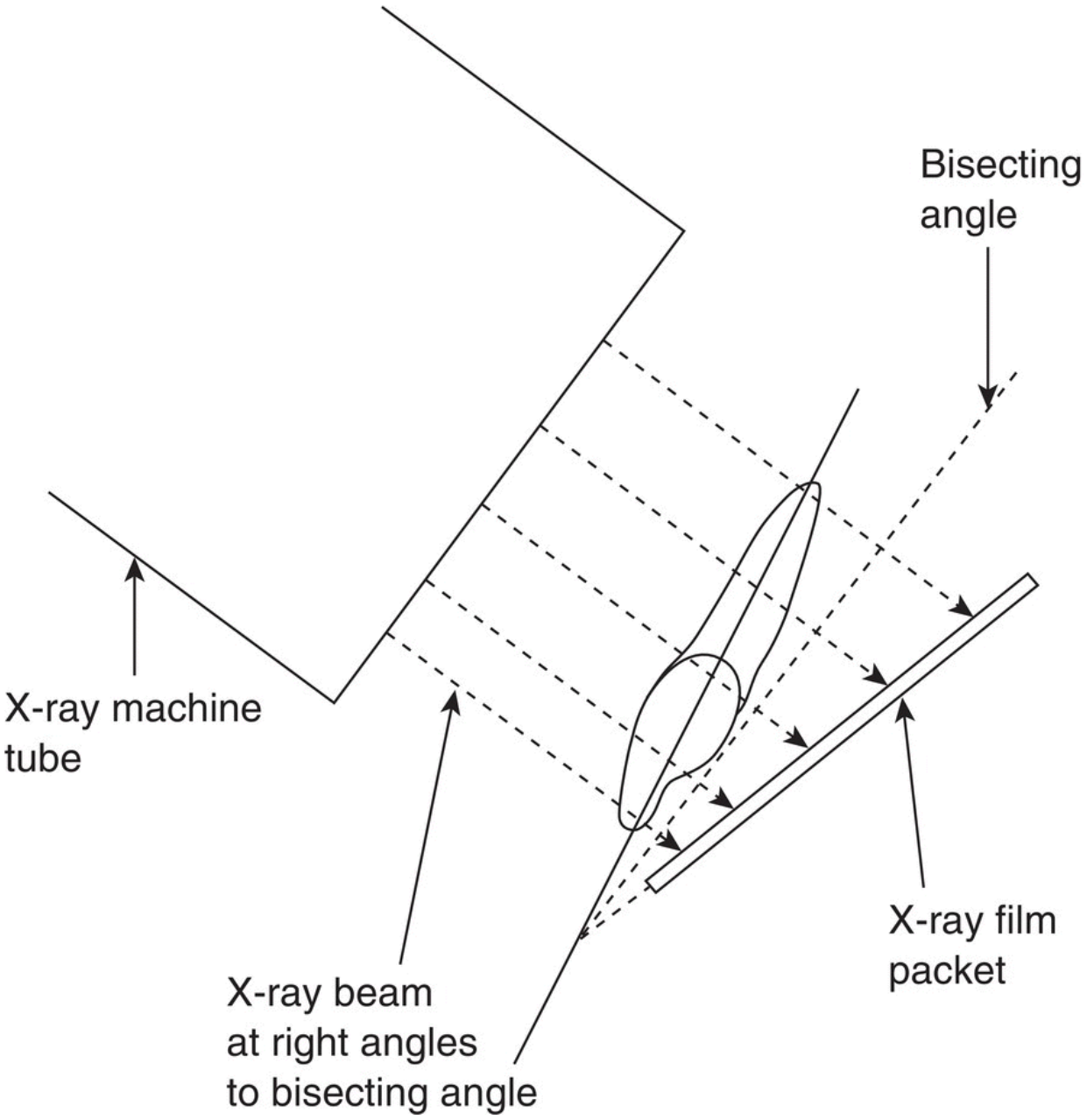


Figure 12.44 Bisecting angle technique.

Anterior occlusal views are produced using the bisecting angle technique, with the patient holding the actual film packet between the teeth anteriorly, as illustrated in Figure 12.45.

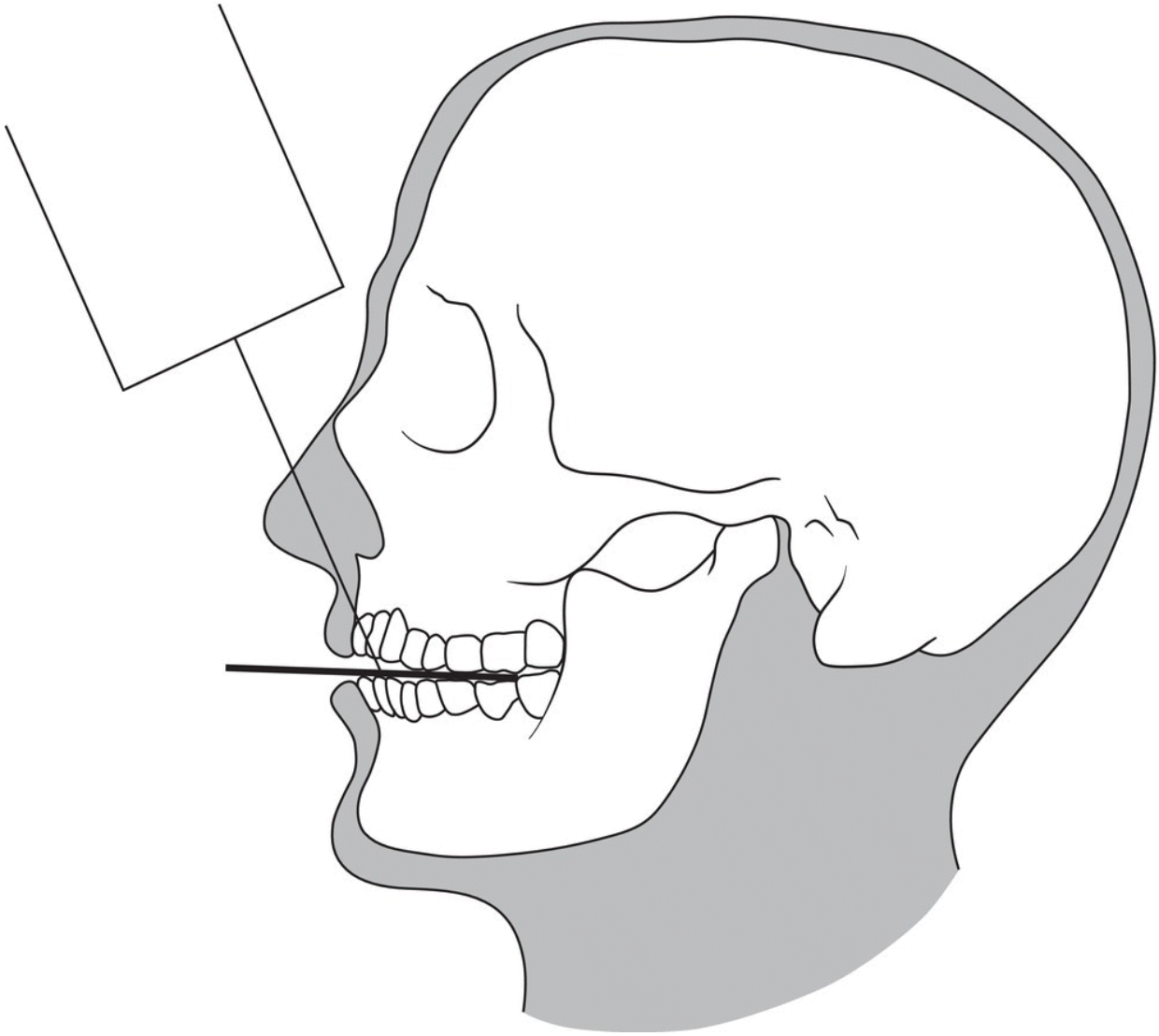


Figure 12.45 Maxillary anterior occlusal position.

Source: Smith, N.J.D. (1989) *Dental Radiography*, 2nd edn, Blackwell Scientific Publications, Oxford. Reproduced with permission of John Wiley and Sons.

Lateral oblique cassettes are held in position by the patient's hand, on the far side of the head from the radiation machine and angled so that the X-ray beam passes up through the angle of the jaw on that side, so that the third molar teeth on that side only are exposed (Figure 12.46).

Figure 12.46 Lateral oblique position.

Extraoral DPT film cassettes are loaded into their special radiation machines, and then the patient is accurately placed within the machine and the cassette is revolved around their head during the exposure process (Figure 12.47). Both types of extraoral film are processed in the same way as intraoral films, either manually or by the use of an automatic processing machine, as described later.

Figure 12.47 DPT machine with patient positioned.

Digital radiography

Conventional X-ray techniques rely on the use of a chemically coated plastic film being exposed to the X-ray beam, and then processed in a darkroom or an automatic processor, using special chemicals to produce the image permanently onto the film.

Digital radiography avoids the use of both the chemically coated plastic film and the need for processing it, as the X-ray beam is fired at a special sensor plate instead (Figure 12.48), which then relays the image directly to a computer screen on the surgery worktop (Figure 12.49). The reusable intraoral sensor plate is used instead of film and the radiation dose is far less than with ordinary film. It is a technique similar to the use of digital cameras and mobile phones to produce photographic images that can then be loaded onto the computer from a memory card, via email or from a scanner.

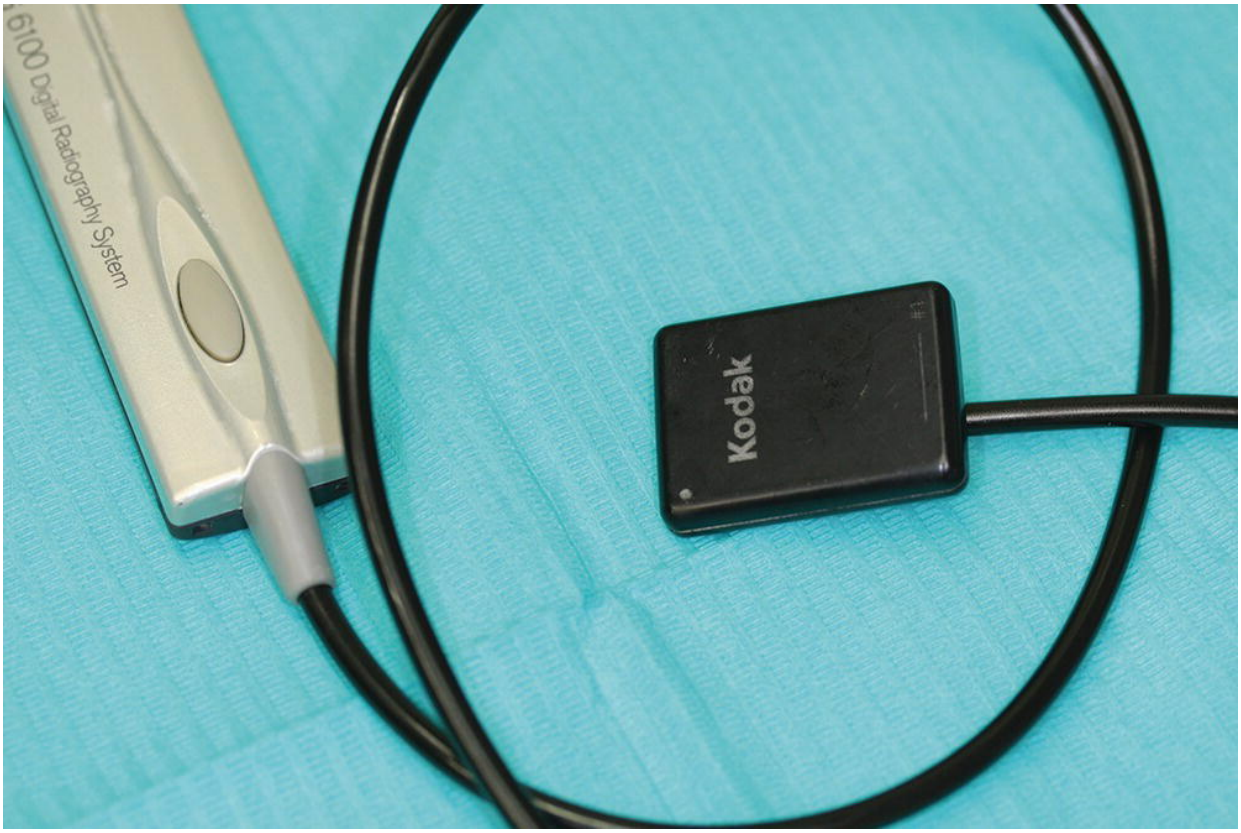


Figure 12.48 Digital sensor plate without protective sheath in place.

Figure 12.49 Digital image on computer screen.

The sensor plate is a similar size to whichever intraoral view is being taken: bite-wing, periapical or occlusal. It is placed within a single-use protective sheath and then positioned exactly the same in the patient's mouth, using holders so that a paralleling technique is possible. The plate is connected directly to the computer via a USB cable, and the image produced is visible on the screen within seconds.

Extraoral digital views can also be taken with specialised DPT machines, or with three-dimensional scanning machines (Figure 12.50) with or without a DPT facility incorporated. The three-dimensional scans produced (Figure 12.51) are particularly useful in the field of implantology, where the correct positioning of implants can be determined.

Figure 12.50 Example of three-dimensional scanning machine with DPT facility.

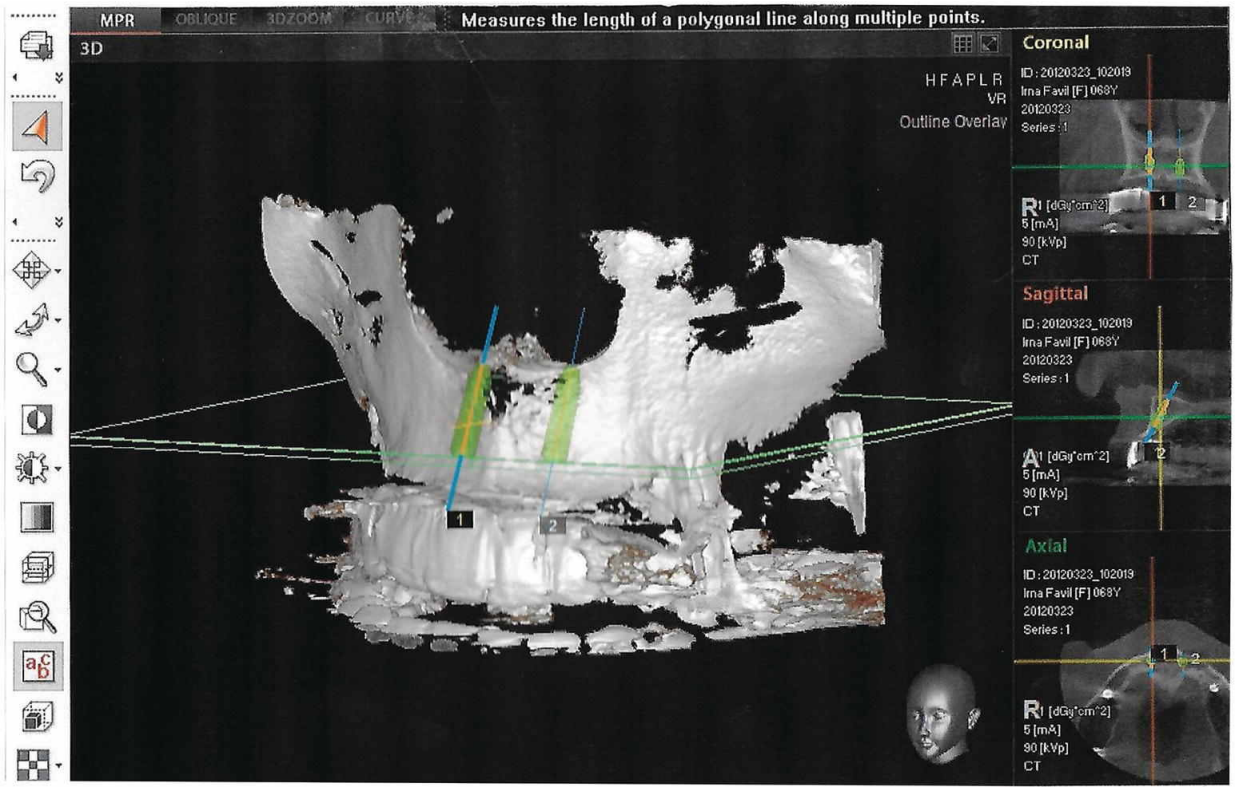


Figure 12.51 Three-dimensional digital scan of maxilla.

The digital image produced on the computer screen can be treated in the same way as digital photographs from a camera.

- Stored on the computer hard drive or transferred onto a storage device (disc or flash drive).
- Printed onto paper and stored as a hard copy in the patient's record card.
- Sent via email to be viewed by other colleagues.

However, as with digital photographs, the image can be adjusted and edited on the computer screen, and this raises issues in dentolegal situations where an image can be enhanced to make a clinical case look better than it actually was or the image selectively deleted so that poor-quality treatment is not so apparent. Fortunately, computer

experts would be able to detect that alterations had been made by examining the hard drive of the computer.

Digital radiographic techniques are now popular but have not fully superseded conventional techniques in the dental workplace, and many still rely on X-ray films that have been processed either manually or with an automatic processor, such as a Velopex machine. The advantages and disadvantages of digital radiographs are shown below.

Advantages

- Financial savings of not having to buy film packets and processing chemicals and equipment.
- Avoidance of health and safety issues surrounding COSHH and the handling of the processing chemicals.
- Help towards achieving ALARA/ALARP as the use of the sensor always ensures a lower dose of radiation than if conventional film is used.
- The image is produced in seconds at the chairside, rather than several minutes in the processing area.
- The patient is able to view the magnified image on the computer screen, at the chairside and with the dentist.
- The magnified image can give greater clarity in some instances.
- The same sensor can be used repeatedly, as long as adequate infection control techniques (such as single-use sheaths) are in place to avoid cross-infection.

Disadvantages

- The issue of adequate infection control to avoid cross-infection, although there should be no instance where single-use sheaths are not used.
- Financial implications of buying the computer with suitable specifications for use with the digital radiography software, the computer software itself (including any updates), and the sensor plates and their attachments.

- Financial implications of buying the specialised scanner machine, with or without the DPT facility.
- The ability to alter the image without detection raises dentolegal concerns in complaint and fraud cases, unless an expert is employed to examine the computer hard drive.

Formation of the conventional image

An intraoral X-ray film packet contains a celluloid film coated with light-sensitive silver bromide salts in an emulsion, surrounded by black paper to protect it from unwanted light and enclosed in a waterproof plastic packet. On one side of the film is a lead foil which prevents the emulsion coat being exposed twice, by absorbing scattered radiation during the actual exposure to X-rays.

The passage of the X-rays through the tissue causes the energy release discussed earlier, and an exact pattern of the tissue is produced within the chemicals on the film itself, as a *latent* (hidden) image, with radiopaque tissues causing the most energy release and therefore a clearer (white) image. Unless a digital imaging technique is used, the latent image can only be seen on the film by the use of special chemicals to make it visible during the processing procedure, in much the same way that conventional photographs from a camera are developed before being able to be viewed as prints.

Film processing

As discussed above, intraoral digital images are transmitted directly to the computer and can be viewed within seconds on the computer screen. All other films require chemical processing to convert the latent image to a visible image for viewing, and this can be done using an automatic processing machine (such as a Velopex machine) or by manual processing, with the film being passed through the chemical tanks by hand and in the correct sequence.

Automatic processing

The machine consists of a base containing the chemical and water tanks, with a conveyor belt style of rollers that carry the film through the machine during processing (Figure 12.52). These are all beneath a

removable, light-tight lid which has hand entry ports so that the film packet or cassette can be put into the light-tight environment before being opened. If the film is exposed to visible light before being processed, the image will be permanently lost.

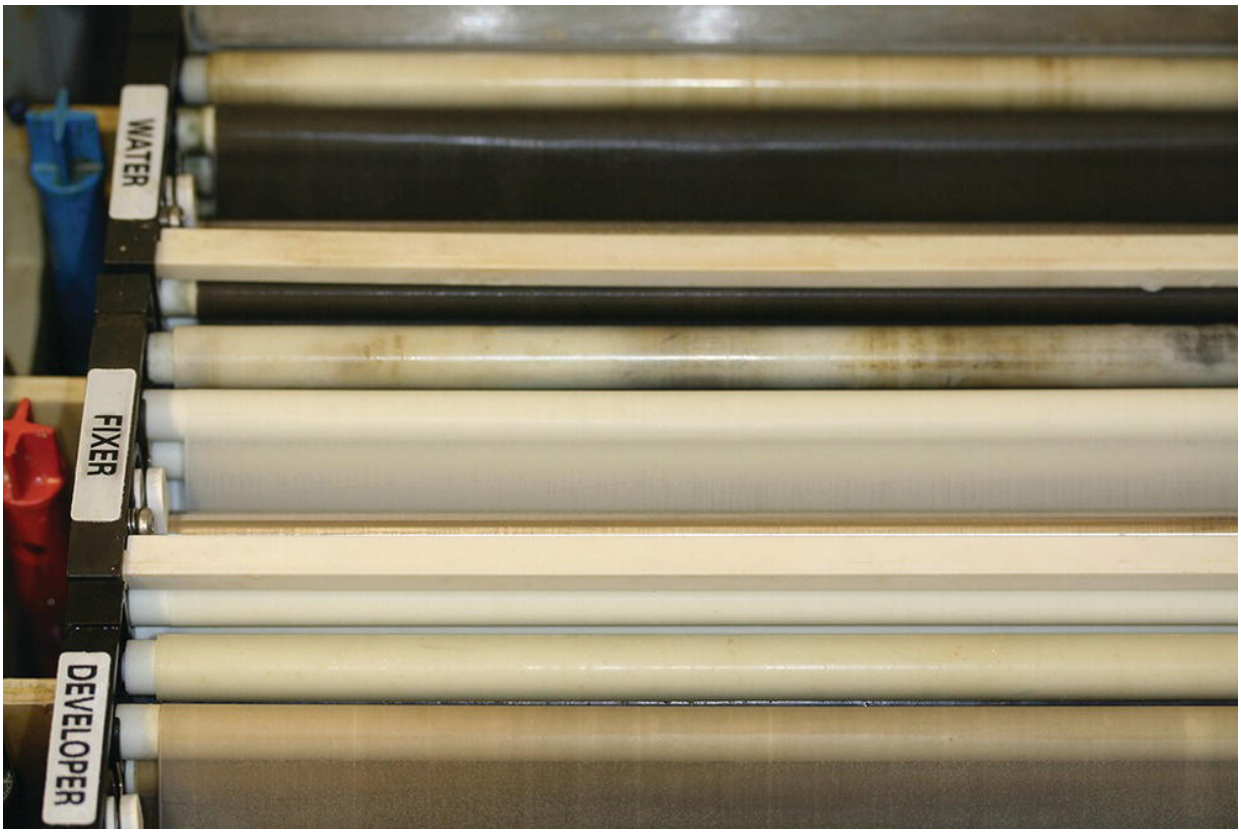


Figure 12.52 Velopex processing machine: internal detail.

The procedure of automatic processing is as follows:

- Observe the warning light system to check that the chemical and water levels are adequate, and that the temperature is correct for processing (Figure 12.53).
- When the temperature and fluid levels are correct, the warning light(s) will go out and the machine is ready for use.
- Intraoral film packets are taken into the machine through the hand ports, while wearing clean gloves.
- Extraoral cassettes are placed into this section by lifting and replacing the lid, and then can be opened and handled via the hand ports.

- The rollers become operational once the processing start button is pressed or automatically when the film is placed at the entrance port.
- The film packet is carefully opened and the plastic envelope, black paper and lead foil are all dropped to the base of the tank, for removal later.
- The film is then held by its sides only, as finger marks on the surface will damage the image.
- The film is carefully inserted into the entrance to the rollers, and it will be gently tugged into the machine as the rollers turn, to be processed.
- Once the film has passed through the machine, been processed and dried, it will reappear at the delivery port and can be safely handled and viewed.

Figure 12.53 Velopex machine and control panel.

Manual processing

Although the vast majority of dental workplaces use automatic processing machines or digital radiography techniques, it is important for the dental nurse to know about the manual processing technique, so that it can be carried out safely and effectively whenever necessary.

Manual processing follows the same procedure as that occurring in an automatic processor, but is carried out by hand and in a darkroom, a light-tight lockable room containing the processing chemicals and water tanks, which sit in a main water tank that is heated and maintained in the correct temperature range of 18–22 °C. Alternatively, self-enclosed worktop designs are also available for use with intraoral films only, where small, lidded fluid pots at room temperature are arranged within the unit as for the conventional darkroom layout, and accessed via hand ports (Figure 12.54).

Figure 12.54 Self-enclosed manual processing unit.

In the conventional darkroom set-up, four tanks will be present (Figure 12.55).

- **Lidded developing tank**: containing the alkaline developing fluid that produces the initial **latent image**; the lid is only removed during processing as the solution will deteriorate in air.
- The image is still unstable in visible light at this point.

- **First water tank**: to wash off the developing solution after the correct developing time, using tap water.
- **Fixing tank**: containing the acid fixing solution which permanently fixes the image onto the celluloid film, so that it can be viewed in visible light without deterioration.
- **Second water tank**: to wash off the fixing solution after the suitable fixing time, again using tap water.

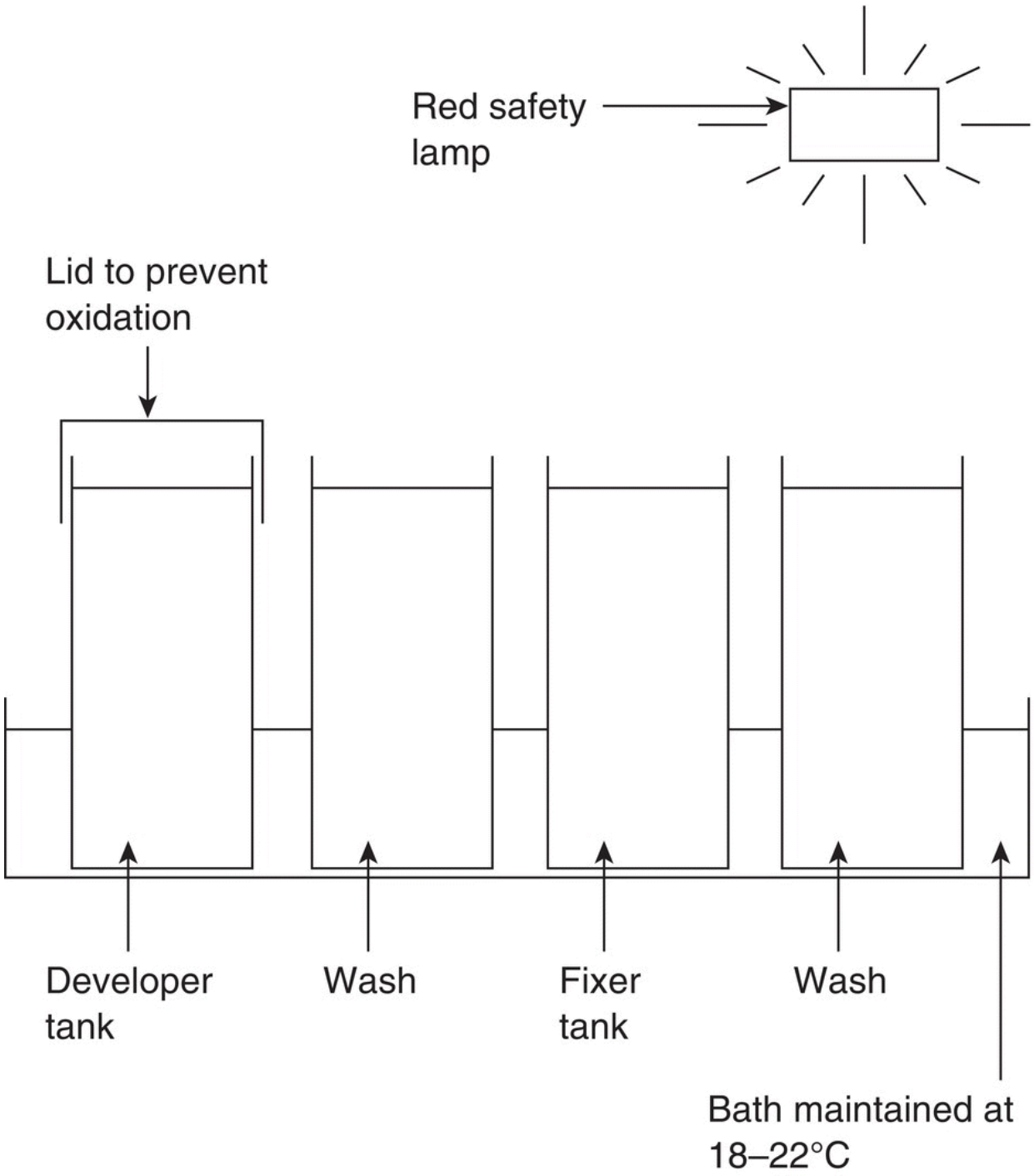


Figure 12.55 Darkroom layout.

Some vision is required within the room, so an orange or red *safe light* will be present under which the processing can be carried out without exposing the film to actual visible light, thereby ruining the image. The room must be lockable from within so that the door cannot be opened by anyone else, as this would result in the

accidental exposure of the film to light and the destruction of the image before it has been fully processed.

The procedure of manual processing is as follows:

- Check that the chemical and water levels are adequate.
- Check the temperature of the solutions, and determine the developing and fixing times required from the chemical manufacturers' guidelines.
- Check that a timing clock and suitable film hangers are available in the room.
- Wipe surfaces dry of any previously spilt chemicals or water, if necessary.
- Lock the door and switch off all lights except the safe light.
- Open the film packet or cassette, locate the film and clip it to one of the hangers available, carefully handling the film by its edges only, to avoid spoiling it with fingerprints.
- Remove the developer lid, immerse the hanger in the solution so that the film is completely covered by the solution, and start the timer.
- When the timer sounds, remove the hanger and film and immerse in the first water tank, agitating the hanger to ensure thorough washing occurs.
- Shake off excess water, then fully immerse the hanger and film in the fixer solution, and start the timer.
- Replace the developer lid to prevent the solution being weakened by exposure to air, which would allow oxidation to occur.
- When the timer sounds, remove the hanger and film and immerse in the second water tank, agitating the hanger to ensure thorough washing occurs.
- Switch on the ordinary light.
- Shake off excess water and dry the film: a slow-running hairdryer is suitable for this, as the radiograph must not be dried too quickly.

Once dry, the films can be correctly mounted as necessary and returned to the dentist for viewing.

Mounting and viewing films

Once the films have been successfully processed, they will be viewed by the dentist so that diagnoses can be made and treatment plans formulated. Ideally, a light box and magnifier will be available for viewing the films (Figure 12.56), but it is imperative that they are mounted and positioned correctly, otherwise the left teeth will be viewed as the right, and vice versa.

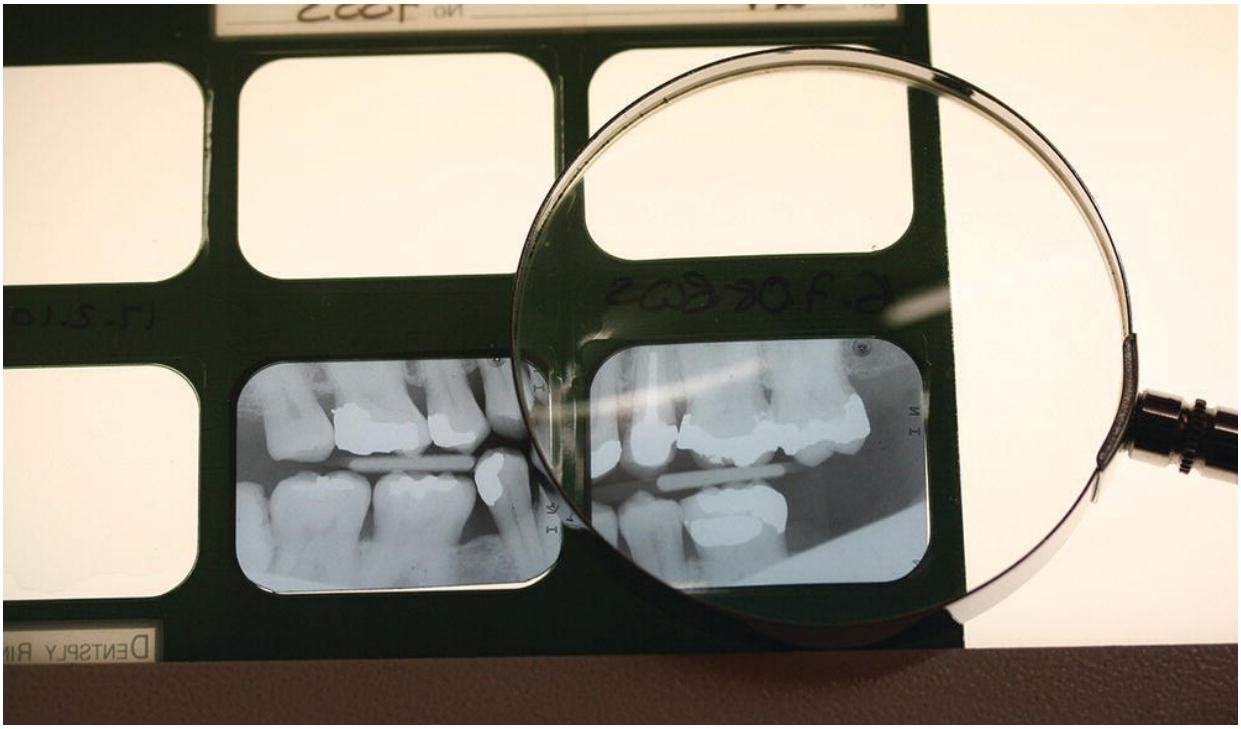


Figure 12.56 Viewing screen with magnifier.

Extraoral cassettes are marked with an 'L' to indicate the patient's left side and unless the cassette has been placed upside down in the machine, the film is easily orientated on the viewer so that it is viewed as if looking at the patient from the front (see Figure 12.38).

Various plastic envelope designs are available to mount all types of intraoral films nowadays, but they must be loaded correctly by the dental nurse first. All intraoral films have a raised pimple in one corner which must be facing out to view the film correctly, and not back to front. It is irrelevant which corner of the film the pimple

appears in, but it must face out towards the person viewing the radiograph.

Also, the dental nurse should use their knowledge of oral anatomy to check themselves: molar teeth are posterior to all other teeth so correct mounting of bite-wing films, for instance, should result in the molar teeth appearing on the outer side of both films, with their pimples palpable in one corner (see Figure 12.33). Upper periapical films should be mounted with the roots above the crowns of the teeth, as they are in the patient's maxilla (Figure 12.57), and so on.

Figure 12.57 Periapical radiograph, correctly orientated with the roots above the crowns.

Dental workplaces are likely to use one of the various different methods of patient identification and storage of films, and the dental nurse has to be aware of the methods in use in their workplace and use them appropriately. These may include any of the following:

- Digital images will be stored on computer or downloaded onto disks.
- Intraoral films may be mounted in plastic envelopes, with patient identification details written in indelible ink.
- These may be stored within each patient's record card and filed.
- If clinical notes are computerised, there may be a separate filing system used exclusively for films.
- Extraoral films may be too large to store within the record cards, so may also have their own exclusive filing system.

Whichever system is used, all films must be marked with the patient's identification details (e.g. name, computer number), the date the image was taken, and a note of the view used, before being stored or filed.

Care of processing equipment and film packets

One of a dental nurse's many duties will be to care for all processing equipment, once trained adequately to do so. This is a vital role with regard to patient safety, since poorly maintained equipment will lead to poor-quality radiographs that may need to be retaken, causing unnecessary X-ray exposure for the patient. And as stated previously, there is no safe level of X-ray exposure – each one could cause cell damage. The following list summarises the points that should be included in any care and maintenance protocol.

- Ensure adequate training in processing techniques has been given.
- Always carry out the preprocessing checks correctly.

- Always wear suitable PPE when handling all processing chemicals, as they are toxic if used inappropriately.
- Follow the surgery policy on topping up and changing spent solutions; normally all will require full replacement on a monthly basis, if not earlier.
- Dispose of all waste solutions as **hazardous chemical waste**, under the health and safety policy (see Chapter 4).
- Follow the training given and the manufacturer's guidelines on cleaning the processing area or the automatic processor, to avoid film contamination.
- This is especially important with regard to the roller system in automatic machines, as films can stick to dirty rollers and their images will be destroyed.
- Be aware of the correct functioning of the equipment, so that failures can be recognised, the equipment switched off safely and the matter reported to the necessary person for repair.

In addition, poor-quality or unreadable radiographs will be produced if old film stock is used or if the stock has not been stored correctly. Films can still deteriorate before their expiry date if stored in hot or damp places, or if they are kept too near an X-ray set.

Unexposed film packets must be stored as follows:

- Away from all sources of radiation.
- Away from all heat sources, and ideally at room temperature.
- Away from all liquids that may penetrate the packets and destroy the films before use.
- In stock rotation, so that older films are in front of newer films and therefore used first.

If an expiry date is given on a packet of film it should not be used beyond that date. Any remaining films should be discarded, as old film will not expose correctly and the image produced will be of poor quality. Film in poor condition from any of these causes will give a radiograph of poor quality which may have to be retaken.

Exposure faults

Although many practices have abandoned manual processing in favour of automatic methods, it is still necessary for all dental nurses to understand what happens to a film during exposure and processing. This will help to run QA systems that will trace any causes of error and prevent the need for retakes.

Faults that occur during exposure are the responsibility of the operator taking the view.

Any part of a film exposed to X-rays or white light is turned black and opaque by developer. The remaining unexposed part is still sensitive to light and appears green and opaque. Fixer dissolves away the unexposed green part, leaving it completely transparent and no longer sensitive to light. Some common faults that occur during exposure are listed in Table 12.3, some of which are shown in Figure 12.58.

Table 12.3 Some common faults that occur during exposure.

Fault	Reasons
Elongation of image (Figure 12.58a)	Collimator angulation is too shallow, producing a long image
Foreshortening of image (Figure 12.58b)	Collimator angulation is too steep, producing a squat image
Coning (Figure 12.58c)	Collimator angulation is not central to the film, so film is only partly exposed
Blurred image	Patient or collimator moved during exposure
Transparent film or faint image with overlying pattern (Figure 12.58d)	Film placed the wrong way around to the collimator for exposure, with the lead foil pattern superimposed onto the film; this may not always appear as the traditional 'herringbone' pattern
Fogged film	Exposed to light before X-ray exposure (this may occur with extraoral films, as they are being loaded into the cassette)
Blank film	X-ray machine not switched on, although this is unlikely to happen with modern machines, as they have exposure lights and audio signals installed

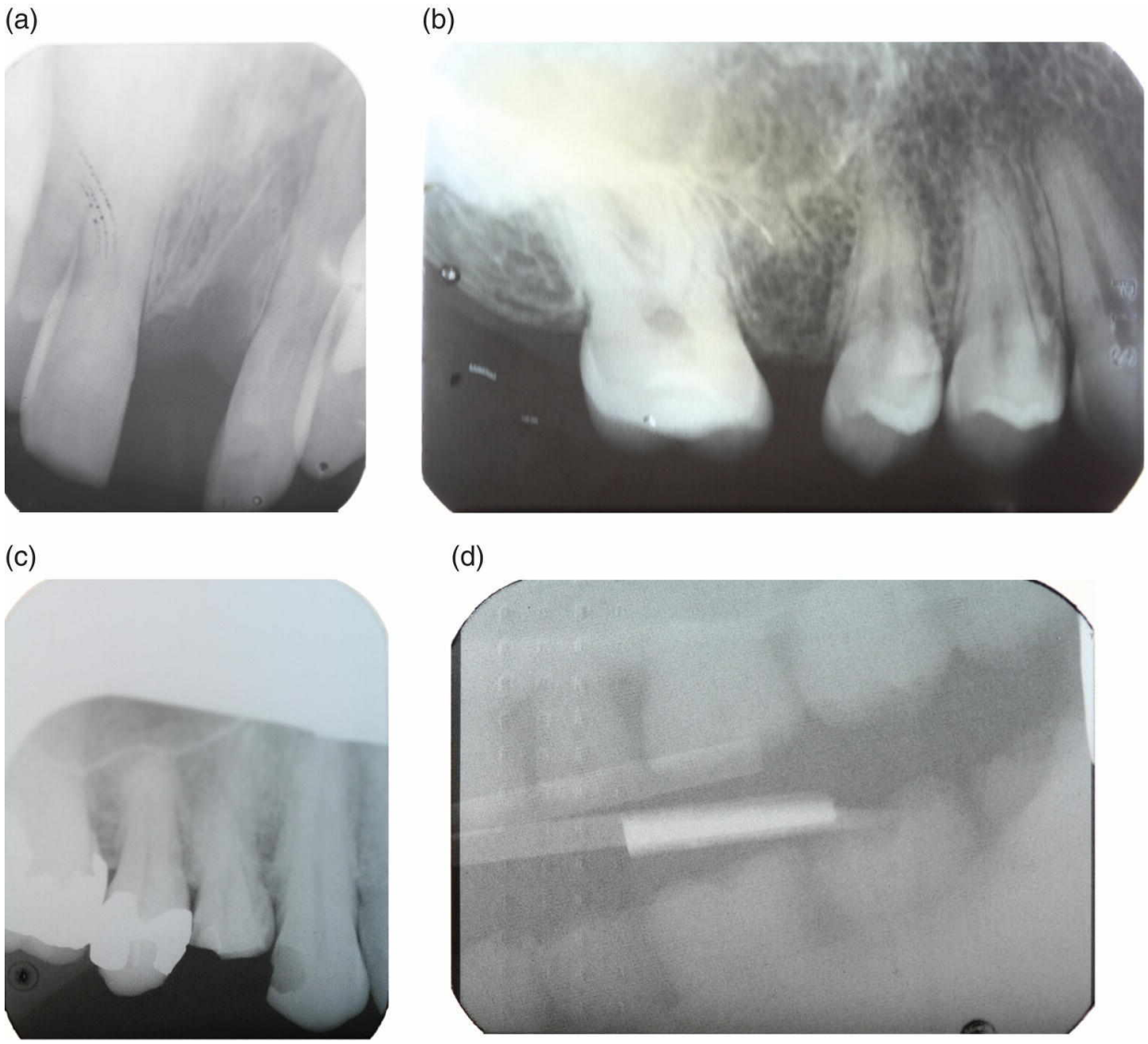


Figure 12.58 Radiograph exposure faults. (a) Elongation. (b) Foreshortening. (c) Coning. (d) Reversed film.

Handling faults

Faults can also occur due to poor handling technique or poor preparation of the processing equipment; these are both the responsibility of the dental nurse tasked with processing the exposed film. All these faults are avoidable by adequate training and by following procedures accurately. Some common handling faults are listed in Table 12.4, some of which are shown in Figure 12.59.

Table 12.4 Some common handling faults.

Faults	Reasons
Scratches or fingerprints (Figure 12.59a)	Catching the film on the tank side during immersion Not holding the film by the edges
Blank spots (Figure 12.59b)	Film splashed with fixer before developing
Black line across film	Film bent or folded during processing
Brown or green stains	Inadequate fixing due to old solution
Crazed pattern on film (Figure 12.59c)	Film dried too quickly over a strong heat source
Presence of crystals on film (Figure 12.59d)	Insufficient washing after fixing

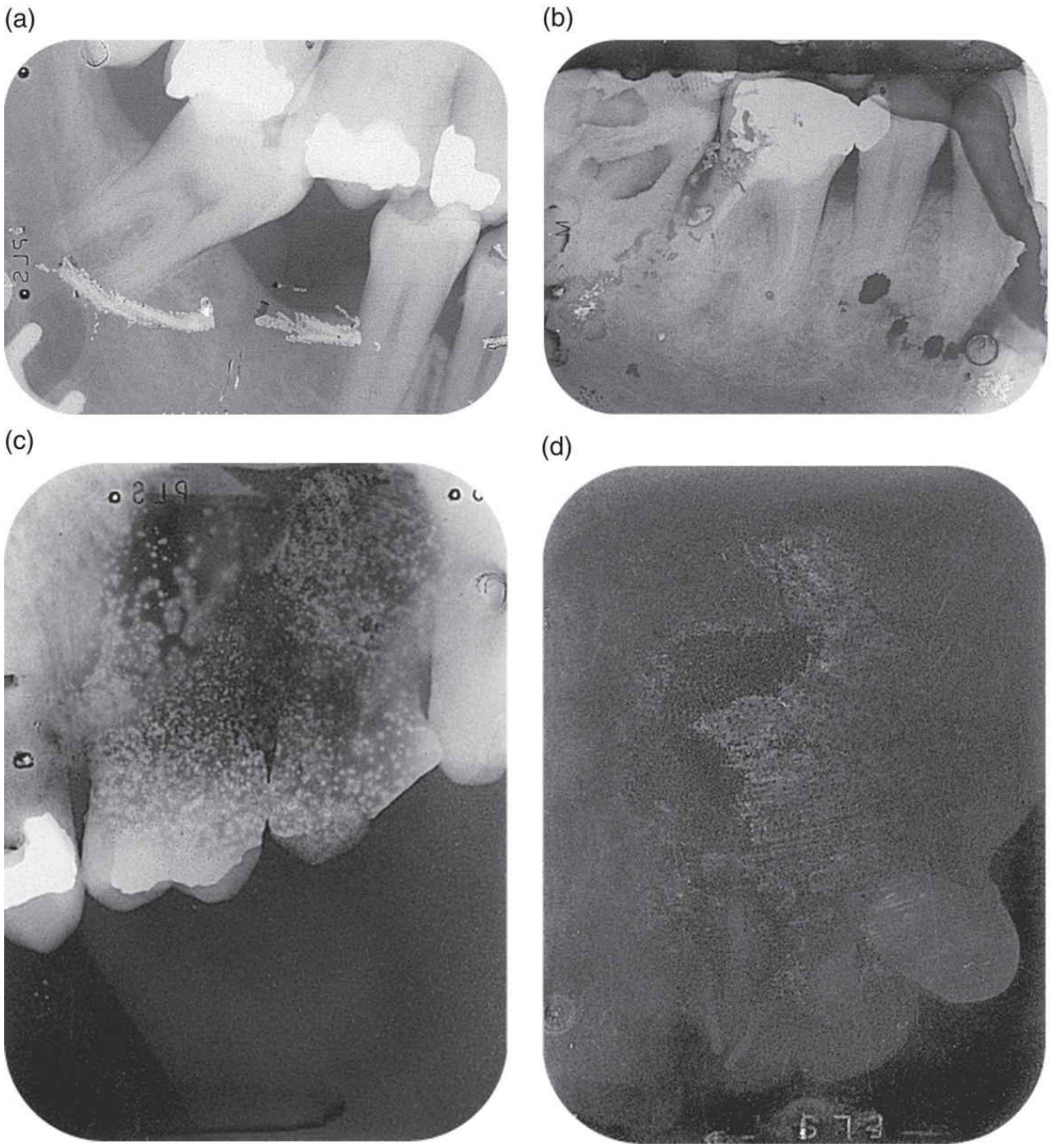


Figure 12.59 Radiograph handling faults. (a) Scratched. (b) Splashed. (c) Crazed. (d) Insufficient washing.

Processing faults

Poor-quality radiographs can also be produced due to equipment preparation faults, and especially by lack of solution preparation and maintenance of the automatic processor. As the majority of film

processing will be undertaken by the dental nurse in the workplace, knowledge of the faults, their occurrence and avoidance, and correct processing techniques should be basic topics of study and understanding for every dental nurse.

Some common processing faults are listed in Table 12.5, some of which are shown in Figure 12.60.

Table 12.5 Some common processing faults.

Faults	Reasons
Dark film (Figure 12.60a)	Developer solution too concentrated Developer solution temperature too high Overdeveloped
Blank film (Figure 12.60b)	Film placed in fixer solution before developer solution, so the image is destroyed
Partly blank film	Film partially immersed in developer solution
Fogged film (Figure 12.60c)	Processing room or machine is not light-tight, so the film is exposed to light before processing
Faint image (Figure 12.60d)	Developer solution too weak Developer solution temperature too low Underdeveloped
Fading image	Inadequate fixing time so image is not permanently held on the film
Loss of film	Film stuck in roller system due to poor cleaning and maintenance of automatic processor
Visible artefacts	Film contaminated with solution spillages, in cassettes or on work surfaces

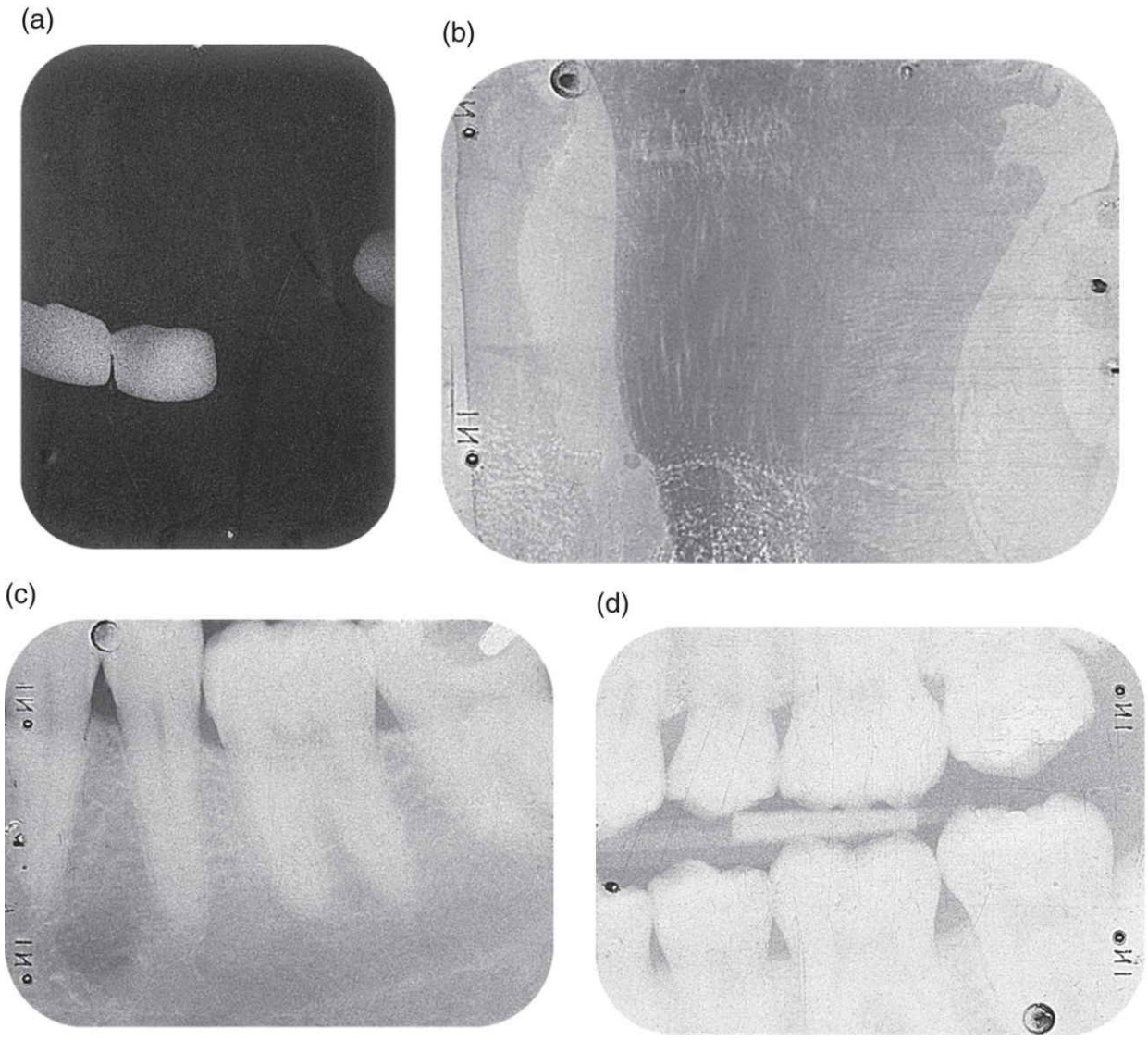


Figure 12.60 Radiograph processing faults. (a) Dark film. (b) Blank film. (c) Fogged film. (d) Faint film.

Every radiograph must not only be clinically justified but also of diagnostic value, so that an accurate diagnosis can be made and treatment planned accordingly. There should be no need for retakes because of faulty exposure or handling techniques, or poor processing skills. Retakes mean unnecessary additional exposure of patients and staff to X-rays. To ensure perfect results, the films must be in good condition, exposed correctly, processed carefully and mounted properly.

Quality assurance of films

As discussed earlier, the faults described previously are avoidable. However, the dental team may not realise that a recurring problem exists unless radiographs are regularly checked for quality, and this is especially so in large multi-dentist surgeries. A processing fault may affect the radiographs of several dentists but unless someone is analysing the radiographs from all surgeries, it can easily be overlooked. This is the purpose of a QA system, in which *all* radiographs are analysed and scored according to a universal system of quality so that commonly occurring problems will be identified.

The running of a QA system of radiographs is a very important task that is often allocated to the dental nurse, and has been described in detail previously.

Conclusion

For each patient who attends the dental workplace, an oral health assessment will guide the dentist, therapist or hygienist towards diagnosing the presence of an oral disease, and help to formulate a treatment plan where necessary or to refer on for specialist tests and treatment in some cases. Not every patient will have to undergo every assessment method described, and the assessor will use their professional knowledge and discretion in each case to determine the assessment, diagnosis and treatment planning required. The role of the dental nurse is to understand the need for the various assessments, and to be able to assist the assessor and patient while they are carried out, as well as to accurately record all the findings in each case.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

13
Oral Health Promotion and Disease Prevention

Key learning points

A **factual knowledge** of

- the role of bacterial plaque in dental disease

A **working knowledge** of

- the methods available to control bacterial plaque
- dietary advice to control caries incidence
- the use of fluoride in caries prevention
- the modification of risk factors to control periodontal disease
- the use of communication skills in oral health evaluation, motivation and promotion
- the effect of general health on oral health

A **factual awareness** of

- the genetic predisposition to periodontal disease

As discussed in Chapter 11, the main oral diseases of concern to the dental team are the following:

- **Dental caries**: the bacterial infection of the mineralised tissues of the tooth.
- **Gingivitis**: the inflammation of the gingival tissues at the neck of the tooth.
- **Periodontitis**: the inflammation of the supporting structures of the tooth.
- **Oral cancer**: the malignancy specific to the oral cavity that presents as squamous cell carcinoma (this accounts for 90% of oral cancers, although others do occur).

A huge part of the day-to-day work of the dental team is to educate patients in the risk factors of these four diseases: the behaviours, habits and actions that make the likelihood of one or more of them occurring at some point in the patient's mouth. Patient education should enable the avoidance of their initial onset or help to avoid their recurrence, once treatment has resolved any diagnosed disease that was present.

The success of this dental education depends on various factors, listed below, some of which are outside the control of the dental team.

- **Communication skills**: irrespective of how important the advice is to the patient, if it is delivered in a way that the patient cannot understand, it will not be followed.
- **Age group**: the style of communication and the advice to be given will vary between age groups, and these groups are generally divided into:
    - adults
    - young people
    - children.
- **Patient motivation**: despite the best attempts by the dental team, some patients are simply uninterested in their own oral health, and are unwilling to participate in efforts to assist them in achieving good oral health.
- **Mental capacity:** in an ageing population where natural teeth are being retained well into old age, at the same time as an increase in occurrence of health conditions which affect the mental functions of these older patients such as the dementias, the understanding and retention of information can be poor enough to prevent oral hygiene instructions from being followed.
- **General health**: some medical and physical conditions will affect the likelihood of oral disease development in some patients, while other conditions will affect the patient's ability to carry out effective oral hygiene methods.

All these factors and their influence on the patient's standard of oral health will be discussed here, but throughout and in following

chapters it will be seen that the old adage holds true: '*Prevention is better than cure*'. Self-help by patients, supported by the robust oral health efforts of the dental team, is much easier to achieve and obviously better than suffering the pain, misery and expense of dental disease and its necessary treatment.

Bacterial plaque as a risk factor in dental disease

As discussed in detail in Chapter 11, the presence of bacterial dental plaque is a prerequisite for the development of all three of the main dental diseases (dental caries, gingivitis and periodontitis), in addition to other causative factors as described below.

The causative factors of dental caries are as follows:

- A diet containing a high proportion of free sugars, a subdivision of extrinsic sugars which are not sourced from milk and which are loosely similar to those previously called 'non-milk extrinsic sugars' (NMEs).
- Poor oral hygiene allowing the accumulation of dental plaque and the bacteria it contains onto the tooth surface or around the margins of restorations.
- Stagnation areas of the teeth themselves such as occlusal fissures, overhanging restorations and abutments with dentures and orthodontic appliances. Even when oral hygiene efforts are carried out by the patient, these areas will always have the potential to allow plaque accumulation.
- The action of the bacteria within the plaque biofilm on the free sugars to produce acid, which demineralises the tooth structure and allows cavities to develop.

The causative factors of gingivitis and periodontitis are as follows:

- Poor oral hygiene which allows the accumulation of dental plaque, specifically in the gingival crevice and periodontal pockets, and on any pre-existing surface of tartar.
- The existence of stagnation areas, including the gingival crevice, which allows the plaque to accumulate specifically around the necks of the teeth against the gingiva.
- Failure to treat and eradicate the subsequent gingivitis allows inflammation of the periodontal supporting structures to occur, leading to periodontitis.

Dental plaque biofilm

This is the correct terminology in current use, but in general usage and hereafter it is simply referred to as plaque. As it plays such an important part in dental disease, its origin and effects should be clearly understood by all whose work involves dental treatment or oral health education.

Plaque is a thin transparent layer of saliva, oral debris (such as epithelial cells from the lining membranes of the oral cavity) and normal mouth bacteria that sticks to the tooth surface and can only be removed by cleaning. Once cleaned away, it is replaced within a few hours by a new deposit of plaque, and its presence in the mouth may be regarded as a natural occurrence. The harm it causes comes from food debris, which sticks to the plaque during meals and snacks and provides a plentiful supply of nourishment for its bacteria and other micro-organisms. They accordingly flourish, the plaque grows thicker, and caries and periodontal disease can begin to develop in the absence of good and regular oral hygiene efforts.

Which of the two diseases predominates depends on the following factors, but the plaque is the same entity whichever disease occurs – there is no difference between the plaque present in a carious cavity, an inflamed gingival area, or a periodontal pocket.

- The site of the plaque.
- The diet, and specifically the presence of free sugars.
- The age of the patient.

If the plaque is in contact with a tooth surface, caries will develop there unless the plaque is removed. If the plaque is in contact with the gingiva, gingivitis and then periodontitis will develop unless the plaque is removed.

Caries is mainly a disease of children and young adults whereas periodontal disease predominates in later life, although a specific type of aggressive periodontal disease can be found in younger patients, although it is uncommon. The difference in the usual age of disease onset is due to the rate at which the two diseases progress. Caries can cause loss of teeth within a few years whereas periodontal disease

may take decades to have the same effect. By the time periodontal disease has reached an advanced stage, the earlier onslaught of caries has already been overcome and is no longer a problem, as the teeth which were susceptible to caries have already been treated by exposure to fluoride, fissure sealing, filling or other restoration, or extraction.

Another reason explaining which disease predominates in each age group is the diet they tend to follow. Consumption of sweets and sugary food and drinks is probably far greater, and far less controlled, in children and young people, and their teeth are consequently much more vulnerable to caries. However, it must not be assumed that adults and older people are immune to caries. It still occurs if childhood patterns of unrestricted, indiscriminate consumption of sweets and foods containing free sugars persist. A typical example is the adult smoker who continually sucks mints after giving up the habit for health reasons, and then develops rampant caries affecting the buccal tooth surfaces, as the sugary mints dissolve and wash over the teeth.

The role of saliva in dental disease development

As discussed in Chapters 10 and 11, saliva is the watery secretion from the salivary glands that bathes the oral cavity to keep the tissues moist. It also protects against:

- caries by promoting remineralisation of early enamel caries, due to its mineral content and buffering effects
- periodontal disease by its cleansing and antibacterial properties, due to its antibody and white blood cell content, and antibacterial enzymes

and promotes overall health of the mouth by its lubricating and cleansing effects.

People suffering from the condition of xerostomia (or dry mouth) do not benefit from these effects and are accordingly at much greater risk of both caries and periodontal disease. This disorder is covered in greater detail later.

Prevention of dental disease

As indicated previously, caries occurs due to a combination of certain types of bacteria being present within dental plaque that use free sugars to produce acids that cause enamel demineralisation. There are therefore three main areas of caries prevention available to the patient and dental team.

- **Increase the tooth resistance to acid attack**: by incorporating fluoride into the enamel structure to make it stronger.
- **Modify the diet**: to include fewer cariogenic foods and drinks, and to reduce their frequency of intake.
- **Control the build-up of bacterial plaque**: carry out its regular removal from the teeth by using good oral hygiene techniques.

The main cause of periodontal disease is consistently poor oral hygiene, along with contributory factors such as smoking, and in some cases an unfortunate genetic predisposition to periodontal problems.

The prevention of periodontal disease can be achieved in most patients, whereas it can only be controlled in others.

- **Control the build-up of bacterial plaque**: carry out its regular removal from the gingivae and supporting tissues by using good oral hygiene techniques.
- **Modify the contributory factors**: by giving advice on smoking cessation, for instance.
- **Control the host response**: in patients predisposed to periodontal problems, by more frequent dental attendance for monitoring and evaluation, and intervention where necessary.

It is evident then that controlling the build-up of bacterial plaque is a common requirement in the prevention of both dental caries and periodontal disease (including gingivitis). Educating patients in how to successfully remove bacterial plaque, on a daily basis and for the

rest of their lives, is the most important aim of the dental team in helping their patients maintain a good standard of oral health.

Control of bacterial plaque

Plaque forms within hours on newly cleaned tooth surfaces, due to the action of oral bacteria on foods and oral debris. Unless removed from these areas, the plaque will allow dental caries to develop, while that formed around the gingival crevice will be involved in the onset of gingivitis and eventually periodontitis.

Controlling bacterial plaque on a daily basis is the main method by which patients can promote their oral health. It is the role of the dental team to ensure that patients are taught the correct oral hygiene methods suitable to them, and that they carry them out on a frequent enough basis to avoid damage to their oral health.

Plaque can be easily removed by the patient at home by carrying out a combination of the following oral hygiene techniques on a daily basis.

- **Toothbrushing**, using an effective technique and a recommended **toothpaste**.
- **Interdental cleaning**, using brushes or floss/tape.
- Using **suitable mouthwashes**.

Toothbrushing

Toothbrushing is the method used to remove supragingival plaque (that above the gum line) and food debris from the smooth surfaces of the teeth (the buccal, labial, lingual, palatal and occlusal surfaces), as well as the gingival crevice. Unless the patient has widely spaced teeth, the interdental areas will require special techniques of cleaning to remove plaque efficiently.

- Manual toothbrushes with a small head and multi-tufted medium nylon bristles are probably the most effective for the vast majority of patients.
- Good-quality, rechargeable, electric toothbrushes take the need for consistently good manual techniques away from the patient,

and are more likely to achieve prolonged high standards of oral hygiene (Figure 13.1).

- The brush is often rinsed to wet the bristles and a portion of the recommended toothpaste added (see below).
- Each dental arch is divided into three sections: left and right sides, and front.
- Side sections are subdivided into buccal, lingual and occlusal surfaces; front into labial and lingual.
- When instructing patients, these areas should be referred to in terms the patient can understand, such as ‘cheek side’, ‘tongue side’, ‘lip side’, and so on.
- This amounts to eight groups of surfaces in each jaw, and at least 5 seconds should be spent on each group.
- Egg timers or similar devices can give the patient an idea of how long the recommended 2-minute brushing cycle should last. Some electric brushes have a timer incorporated into their design so that patients are prompted to move to the next section when the brush ‘beeps’.
- The patient should be encouraged to develop their own start and end point within the oral cavity and then follow it systematically at each brushing session, so that a methodical routine is developed; so perhaps lower left side (all surfaces) followed by lower front (all surfaces) and then lower right side (all surfaces), before moving to the upper arch.
- Each area is brushed in turn and the mouth is then cleared by spitting out the toothpaste and oral debris.
- The patient should be instructed not to rinse the mouth out after spitting excess toothpaste away, as this removes the residual toothpaste and prevents its chemical constituents from continuing to act in the mouth; this is particularly important with fluoridated toothpastes.
- Parents will need to perform effective toothbrushing on children up to the age of around 8 years, to ensure that all plaque is removed and to teach the child how to brush correctly (Figure 13.2).

- Brushes should be rinsed afterwards and allowed to dry. They only have a limited life and need replacement every few months as the bristles curl down and render the brush ineffective (Figure 13.3).


Colgate
NEW
powered by OMRON
Unique Cleaning Action
for Healthier Teeth and Gums
DEVELOPED WITH DENTISTS
ProClinical™ C250
25,500 STROKES/MIN
Sonic Cleaning Action
2 Minute Timer
30 sec
30 Second Pacer
Travel Cap
RECHARGEABLE SONIC TOOTHBRUSH
powered by JAPANESE TECHNOLOGY
Colgate OMRON
OMRON
Colgate

Figure 13.1 Sonic style toothbrush.

Figure 13.2 Supervised child toothbrushing.

Figure 13.3 New and worn toothbrush: the curled bristles of the latter will remove very little plaque.

Toothpastes

A huge variety of toothpastes is available, from shops' own brands to specialised ones from oral health product suppliers, with a range of ingredients to fight all aspects of common oral disease. Individual recommendations should be given for any patient requesting advice from the dental team as to the most suitable product (Figure 13.4). This may vary from time to time as the patient may experience certain oral problems throughout life.

- Over 95% of toothpastes available in the UK contain **fluoride**, as sodium monofluorophosphate and sodium fluoride at 1450 ppm. These are suitable for use by both child and adult patients.
- **High fluoride** toothpastes contain between 2800 and 5000 ppm, for use by adult patients with an existing high caries rate or

an excessive risk of developing caries (Figure 13.5).

- Several other toothpastes contain ingredients specifically to slow down **calculus** formation.
- Many now contain the substance triclosan combined with zinc, which acts as an **antiseptic plaque suppressant**.
- Some toothpastes are specifically formulated to help **relieve sensitivity**, and contain ingredients such as arginine, NovaMin and stannous fluoride (Figure 13.6).
- Others are advertised as '**whitening' toothpastes** and remove surface tooth staining by the use of mild abrasives as micro-crystals, or by the use of biological enzyme systems.
- More recent developments have included toothpastes containing titanium dioxide and phosphosilicates, designed to help protect teeth against **acid erosion** and help repair enamel (Figure 13.7).


Colgate
Antibacterial & Fluoride Toothpaste
Total
ORIGINAL CARE
12 HOUR PROTECTION FOR A HEALTHIER MOUTH
19ml e
Colgate
Fluoride and Calcium Toothpaste
Maximum Cavity Protection
Fresh Mint
19ml e
plus SUGAR ACID NEUTRALISER
Directions for Use: Brush Twice Daily. Children of 6 years and younger: use a pea size amount for supervised brushing to minimise swallowing. In case of intake of fluoride from other sources consult a dentist or doctor. Uputstvo za upotrebu: Perite zube dvaputa
Oral-B
PRO-EXPERT
15ml e
PROFESSIONAL PROTECTION
WITH STANNOUS FLUORIDE COMPLEX. ORAL-B's BEST PROTECTION TECHNOLOGY
CLEAN MINT
Procter & Gamble UK, Weybridge, Surrey, KT13 0XP, UK. Made in Germany
Manufactured by: Procter & Gamble GmbH
Procter & Gamble Strasse 1, 64521 Gross-Gerau, Germany
stops stop and prev
eeding gums
CORSODYL®
ULTRA CLEAN
DAILY FLUORIDE TOOTHPASTE FOR HEALTHY GUMS & STRONG TEETH
gsk

Figure 13.4 Selection of toothpastes.

Figure 13.5 High-fluoride toothpaste.

Figure 13.6 Selection of sensitivity control toothpastes.

Figure 13.7 Selection of 'enamel repair' toothpastes.

Interdental cleaning

However good the toothbrushing technique, it is still impossible to clean interdental spaces perfectly with a toothbrush alone, unless a specialist electric brush is used. Consequently, the mesial and distal contact areas between adjoining teeth are more prone to developing caries and periodontal disease. To clean the interdental areas adequately, several oral health aids are available to assist patients to remove plaque that has formed here.

- **Dental floss** and **dental tape** are thread-like aids used to achieve interdental plaque removal; however, correct usage depends to some extent on the patient's manual dexterity and on receiving sound OHI (Figure 13.8).
- **Flossette-style** handles hold the length of floss in place for the patient so that they can floss with one hand, therefore making the

procedure less cumbersome, especially for posterior teeth where access is difficult for the majority of patients (Figure 13.9).

- **Interdental brushes** are a typical 'bottle-brush' design in a range of sizes, which are able to clean in various spaced interdental areas, as well as around the individual brackets of fixed orthodontic appliances (Figure 13.10).
- **Interspace brushes** have a small tuft of bristles which enables cleaning in wider interdental spaces, as well as around fixed orthodontic appliances (see Figure 11.28).
- **Woodsticks** (although they may also be plastic!) dislodge solid pieces of food debris from interproximal areas, as well massaging the gingival area. However, their use should be restricted to competent adults whenever possible, as they can easily be stuck into the gum and cause problems if used incorrectly.

Figure 13.8 Dental flosses and tapes.

Figure 13.9 Interdental flossettes.

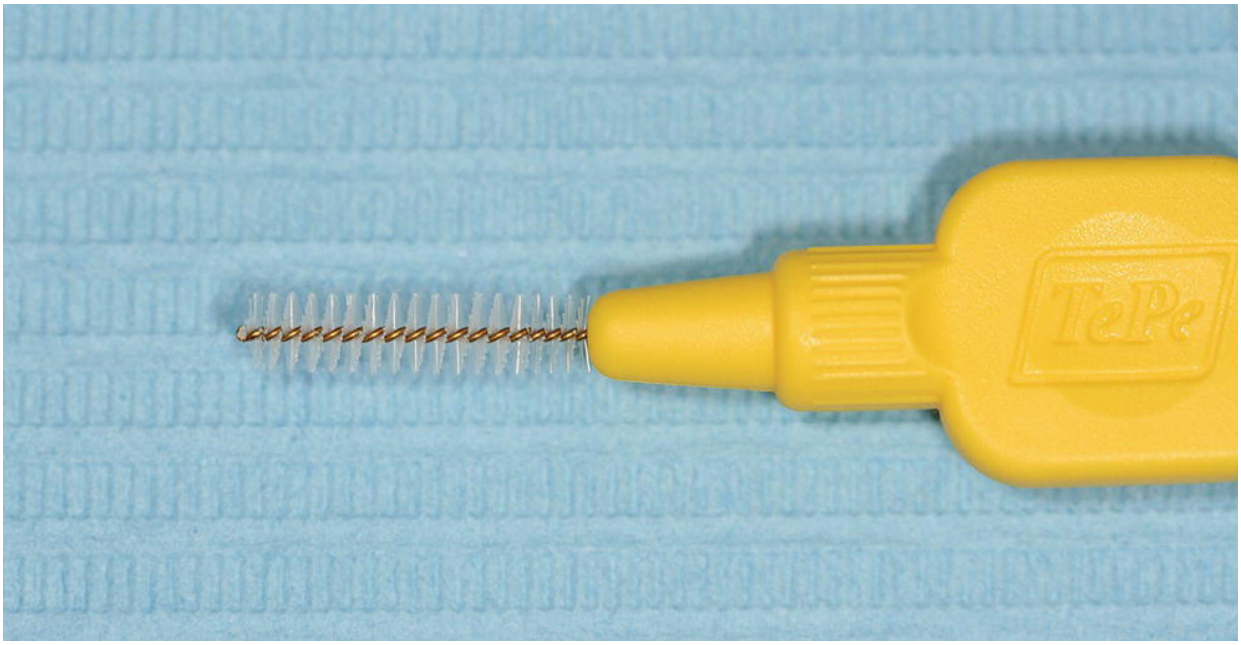


Figure 13.10 Interdental brush detail.

The aim of all these interdental aids is to dislodge food particles and accumulated plaque from the interdental areas of the teeth, so that the debris can be swallowed or removed from the oral cavity. As the plaque sticks to the tooth surface itself, the cleaning aids should be physically pulled across the mesial and distal tooth surfaces to remove this biofilm layer, so the majority of patients will require demonstrations in the correct technique by a member of the dental team. In particular, dental floss and tape needs to be 'wrapped around' the separate tooth surfaces to adequately clean them, and this requires a certain level of manual dexterity by the patient (see Figure 11.27).

Even when used correctly, woodsticks are the least effective method of interdental cleaning available, and other techniques should be recommended to the patient wherever possible.

Mouthwashes

A wide range of mouthwashes is currently available, ranging from shops' own brands to specialised products from dedicated oral health product suppliers (Figure 13.11). Each patient should have specific products recommended for use by the dental team, once their particular oral health needs have been assessed.

- General-use mouthwashes contain various ingredients to promote good oral hygiene, including:
  - **sodium fluoride** to provide topical fluoride application to the teeth
  - **triclosan**, a chemical that suppresses the formation of plaque in the oral cavity.
- Others contain substances such as potassium nitrate and are specialised for use on sensitive teeth (Figure 13.12).
- Some are used specifically in the presence of oral soft tissue inflammation as a first-aid measure or after oral surgery, and contain **hydrogen peroxide** which helps to eliminate anaerobic bacteria (Figure 13.13).
- Specialised mouthwashes are also available for patients suffering from both acute and chronic periodontal infections, and contain

chlorhexidine which is an **antiseptic plaque suppressant** (Figure 13.14).

Figure 13.11 Types of mouthwash.


NEW
ALCOHOL FREE MOUTHWASH
Colgate
with Fluoride
Sensitive Pro-Relief
FOR DAILY USE
Effective & Lasting Relief
clinically proven
RELIEF FROM THE PAIN OF SENSITIVE TEETH
PRO-ARGIN™
MOUTHWASH TECHNOLOGY
400 ml e

Figure 13.12 Pro-Relief mouthwash, which helps reduce tooth sensitivity to cold.


Colgate
PEROXYL®
Mouthwash
Hydrogen Peroxide
RELIEVES MINOR MOUTH AND GUM IRRITATIONS
Medicated mouthwash
MINT FLAVOUR
300 ml

Figure 13.13 Peroxyl mouthwash, which helps reduce soft tissue inflammation.


DAILY FLUORIDE MOUTHWASH FOR HEALTHY GUMS & STRONG TEETH
CORSODYL
DAILY MOUTHWASH
ALCOHOL FREE
COOL MINT
Helps protect healthy gums

Figure 13.14 Corsodyl daily mouthwash, which helps reduce periodontal inflammation.

Other methods of plaque removal

After eating a meal, toothbrushing may not always be possible until several hours later, by which time plaque will have formed and possibly started to cause damage. Obvious examples are after eating lunch at school or at work, or while out for a meal in the evening.

In these situations, loose food debris can be removed by using sugar-free chewing gum or finishing the meal with a *detergent food* and/or a piece of cheese. Detergent foods are raw, firm, fibrous fruits or vegetables, such as apples, pears, carrots and celery. By virtue of their tough fibrous consistency, they require much chewing and stimulate salivary flow, thereby helping to scour the teeth clean of food remnants. Although plaque is chemically unaffected by detergent foods, they can remove some of the food debris which nourishes all plaque bacteria and enables some of them to produce acid. Although cheese at the end of a meal has no direct detergent effect, it stimulates salivary flow, neutralises acid and enhances remineralisation of enamel, due to its calcium content. Hard cheeses are more beneficial than soft cheeses.

The excessive use of chewing gum should be discouraged in all patients where evidence of tooth surface loss due to attrition or bruxing appears, as its regular use will increase the amount of tooth wear that occurs. The use of chewing gum to aid tooth cleansing should be confined to immediately after a meal only, and not continually throughout the day. Effective cleansing will have occurred once the gum has lost its flavour (usually within 10 minutes), and it should then be disposed of responsibly in a bin.

Prevention of dental caries

Two other factors were noted previously with regard to preventing dental caries, and they will both be discussed here.

- **Increase the tooth resistance to acid attack**.
- **Modification of the diet**.

Increase the tooth resistance to acid attack

The outer layer of the tooth, the enamel, is made up of inorganic crystals of calcium hydroxyapatite arranged as prisms running from the amelodentinal junction to the tooth surface (see Chapter 10). It was discovered many years ago that the incorporation of fluoride into and onto the tooth structure resulted in the replacement of the hydroxyapatite crystals by *fluorapatite crystals*. This new chemical structure of the tooth was found to be much more resistant to the damage caused by the weak organic acids formed by plaque bacteria; in other words, the fluoride protected the teeth from developing caries so easily.

Fluoride is therefore the single most important salt in the battle against dental caries. It occurs naturally in the water in some areas, and is added artificially to water supplies in other areas during the process of water fluoridation, as an oral health measure to aid in the reduction of caries incidence.

Fluoride can be taken into the enamel structure by the direct application of various oral health products onto the teeth, called *topical fluoride application*, or by being taken internally with food and drink products, called *systemic fluoride application*.

Besides its action of reducing the solubility of enamel to acids, by the formation of fluorapatite, fluoride also has an inhibitory effect on the *feeding rate* of oral bacteria. This effect results in the production of lesser amounts of weak acids and polysaccharides to initiate the carious attack.

The protective effect of fluoride on the teeth is at its best after they have formed and recently erupted into the oral cavity, before any carious damage has begun. Many oral hygiene products containing

fluoride are now available, to allow their regular use by the general public throughout their lifetime, so that the protective effect of fluoride on the teeth is constantly 'topped up'.

Topical fluorides

These are administered externally to the tooth surface, either by the patient or the dental team, to provide a continual source of fluoride directly onto the enamel.

For use by the patient

- **Fluoride toothpastes** containing the current recommended dose for all patients over the age of 3 years of 1350–1500 ppm, with up to 5000 ppm in specialist high-fluoride products for use by adults at high risk of developing caries (see Figure 13.5).
- Children under the age of 3 years should use a toothpaste containing no less than 1000 ppm fluoride.
- Children up to the age of 8 years must be supervised during toothbrushing to ensure that a minimal amount of paste is used, so that if any is ingested it is unlikely to cause dental fluorosis, a condition of unsightly tooth mottling due to excessive consumption of fluoride.
- A minimum of twice-daily brushing is advised to achieve maximum benefits.
- Patients should be advised **not to rinse out** after brushing, as it washes the fluoride (and other chemicals) away and is therefore less effective.
- **Fluoride mouthwashes** for regular use by those with a high caries risk, and for those undergoing orthodontic treatment, where thorough debris removal is more difficult (Figure 13.15).
- **Dental floss** and tape impregnated with fluoride, for delivery directly to the interproximal areas.


Colgate
FLUORIGARD
FLUORIDE RINSE AF
Sodium Fluoride BP 0.05%w/w (225 ppm F⁻)
Alcohol Free
Daily Cavity Protection
Strengthens Tooth Enamel
Mint Flavour
500 ml
Colgate
FLUORIGARD
FLUORIDE RINSE AF
Alcohol Free
Daily Cavity Protection
Strengthens Tooth Enamel

Figure 13.15 Fluorigard mouthwash.

For use by the dental team

- **Fluoride varnish full mouth application**: administered at each examination appointment and is especially useful for patients with special needs and who are at high caries risk. The typical products used contain 22,600 ppm sodium fluoride.
  - Children with rampant caries, although lifestyle advice is also required.
  - Patients with medical conditions such as haemophilia and heart defects which would make tooth extraction dangerous.
  - Patients who are physically or mentally impaired and unable to achieve an adequate level of oral hygiene.
- The technique has one or two stages: (i) the removal of any gross plaque present when necessary, after which the teeth are washed and dried, and (ii) the varnish is applied to pits, fissures and interdental areas using a micro-brush. Patients are instructed not to brush, rinse, drink or eat for half an hour, and then to have only soft foods for the following 4 hours. The varnishes are pleasantly flavoured and the procedure is usually well tolerated.
- Current evidence suggests that this fluoride varnish application technique can reduce the incidence of caries in patients by 30–40%.
- **Fluoride varnish** (such as Duraphat products; Figure 13.16) applied to individual teeth showing areas of previous acid attack, or to roots exposed by gingival recession or periodontal surgery. Registered dental nurses can undergo extended duties training to enable them to carry out this procedure on patients, under the prescription of the dentist (see Chapter 18).
- **High-concentration fluoride toothpaste on prescription**: patients who are at high risk of developing caries due to a medical or disability condition, or who require a highly cariogenic diet or medication, may be prescribed high-concentration fluoride toothpaste for routine use. For patients aged 10 to 16 years, sodium fluoride 2800 ppm toothpaste is

available; for patients over 16 years, sodium fluoride 5000 ppm toothpaste is available. The latter is especially useful in patients with xerostomia (dry mouth) and in those where extensive gingival recession makes them prone to significant root caries.

Figure 13.16 Duraphat varnish, which can be used for full mouth applications or for individual teeth showing signs of localised carious damage.

Systemic fluorides

These products are supplied in a form to be ingested and then incorporated into the enamel structure within the body. However, the use of prescribed fluoride supplements (tablets and drops) relies on patient or parent compliance and there is always a risk of fluorosis in cases where instructions are not followed.

- **Fluoridated water supplies**: by the addition of the optimum concentration of **1 ppm** to drinking water. In England, the West

Midlands and parts of the North-east benefit most from artificial or natural water fluoridation.

- Naturally occurring fluoridated water supplies, in some parts of the UK and the rest of the world.
- Addition of fluoride to table salt, but this occurs in countries other than the UK.
- **Fluoride drops and tablets**: available on prescription for children, to be taken daily during the period of tooth development (up to 13 years). The doses required vary with the patient's age and the amount of fluoride in the local water supply.
- These fluoride supplements are usually reserved for those with medical or physical conditions which would make dental treatment difficult, or for those whose general health would suffer if caries occurred.

Water fluoridation is carried out as a public health measure in some areas of the UK (such as the West Midlands), where fluoride at the optimal level of 1 ppm is added to the local water supply, is ingested by the local population and absorbed from their digestive tracts so that it can be incorporated into the enamel structure of their teeth.

Public health surveys have consistently proved the benefit of water fluoridation, by comparing the number of *decayed, missing and filled teeth* (*dmf* count in primary teeth and *DMF* count in secondary teeth) in various populations. In areas where systemic fluoride is present at the 1 ppm concentration, the incidence of caries is reduced by 50% compared with areas where there is no water fluoridation. However, the technique has remained controversial as some opponents consider it to be a form of 'mass medication' of the population, carried out without necessarily having their approval as they can only avoid ingesting the drinking water by using bottled water instead.

In 2003, strategic health authorities were legally enabled to require water companies to fluoridate their supplies, but only if there was majority support from the local population after a period of consultation. To date, there has been no significant increase in exposure of the UK population to fluoridated water supplies.

Fissure sealing

Topical fluorides exert most of their effect on mesial and distal (proximal) surfaces of the teeth. Occlusal fissures and pits are just as vulnerable to caries but they are less well protected by fluorides, unless directly provided as a fluoride varnish application by the dental team. Fortunately, these areas can also receive extra, and even better, protection by the application of fissure sealants. These materials are supplied as flowable composite fillings or glass ionomer cements, which are used to seal the naturally occurring stagnation areas of pits and fissures, therefore preventing damage from acid attacks and avoiding the onset of dental caries.

Successful fissure sealing should make an occlusal surface safe from caries. Like topical fluoridation, it can be carried out by hygienists and therapists as well as dentists and is of major importance in preventive dentistry as it can produce a significant reduction in the most common disease of children, dental caries.

Enamel fluorosis

This is a condition which occurs when excessive fluoride is ingested during enamel formation. The teeth erupt with mottled white areas in the enamel surface which vary in severity but can be quite unsightly. Restorative techniques, such as veneers, are available to mask the areas but the condition can be prevented by ensuring that parents receive the correct advice regarding fluoride.

- Children below the age of 8 years should have toothbrushing supervised by an adult, to prevent ingestion of the toothpaste.
- The amount of toothpaste should be kept to a minimum and allowed just twice daily.
- The parents must ensure that children spit the toothpaste out after use, rather than swallow it.
- All fluoride supplements should only be prescribed as necessary and at the correct dosage, which is dependent on the local water fluoridation levels.
- The dental team must therefore have knowledge of any local water fluoridation levels.

Modification of the diet

The single most important modification to the diet to help reduce the incidence of dental caries is the reduction (or ideally the elimination) of free sugars (loosely the same as NMEs) and dietary acids from the daily food and drink intake. It cannot be emphasised too strongly that even if teeth are thoroughly cleaned after meals, caries will still occur if snacks containing free sugars and acidic drinks are taken between meals on a regular basis. This is because plaque persists in the inaccessible areas of fissures and tooth contact points after a meal, unless brushed away by the patient. Acid forms in this residual plaque within minutes of eating sugar, the pH of the oral environment is lowered, and the tooth enamel will be at risk of demineralisation until the pH balance is restored.

Then, as described in Chapter 11, a constant acid environment at the enamel surface allows demineralisation to proceed unchecked, and leaves insufficient time between intakes of sugar for the natural defence mechanism of remineralisation to occur. Although adequate toothbrushing and interdental cleaning twice daily may prevent supragingival periodontal disease, it cannot prevent caries unless accompanied by strict dietary discipline to eliminate free sugar snacks between meals.

If free sugar foods and acidic drinks (such as carbonated 'pops' and fizzy flavoured waters) are confined to mealtimes only, the acids involved are neutralised to some extent by the buffering action of saliva, and the extent of any demineralisation is reduced.

When giving dietary advice to patients, it helps if they are made aware of which food and drink products are safe or harmful, in relation to dental caries. This is especially important with what are known as 'hidden sugars' in foods – where free sugars have been artificially added to foods for taste and preservation purposes, very often in foods that patients would not expect to be harmful to their teeth.

A simple list of 'good' and 'bad' foods and drinks can then be used by the dental team when giving dietary advice to patients.

Good snacks (Figure 13.17) include:

- non-citrus fruit, such as apples, pears and peaches

- fibrous raw vegetables, such as carrots and celery
- unflavoured crisps (so simple ‘ready salted’ or ‘cheese and onion’ flavours)
- low-fat cheese
- unsweetened yoghurt.

Figure 13.17 Examples of good snacks.

Bad snacks (Figure 13.18) include:

- sweets and other confectionery
- biscuits and cakes
- carbonated drinks
- pure citrus fruit juices
- tea and coffee with sugar.

Figure 13.18 Examples of bad snacks.

Care should be taken with excessive intake of citrus fruits such as oranges, lemons, grapefruits and limes between meals.

Those foods containing 'hidden sugars' can be identified by carefully reading the contents label of each product, and include the following (Figure 13.19):

- Cooking sauces, especially those with a tomato base.
- Table sauces, including ketchup, mayonnaise, and some salad dressings.
- Flavoured crisps (such as 'prawn cocktail' and 'smokey bacon' flavours).
- Fruits tinned in syrup.

- Some tinned vegetables, including baked beans and sweetcorn.
- Some breakfast cereals.
- Jams, marmalades and chutneys.
- Some low-fat products, as sugar is often artificially added to improve their taste.
- Tinned fish and meat in tomato sauce.
- Soups.
- Savoury crackers and biscuits.
- Some processed ready meals.
- Energy drinks.
- Some health food breakfast bars.

Figure 13.19 Examples of hidden sugar foods (savoury marinade, soup, tinned oranges).

A universal system of clearly labelling food products so that contents such as hidden sugars and saturated fats are more readily identified is still under discussion by politicians and food manufacturers, involving information such as contents by percentage and/or a 'traffic light' content system. If enforced, bad snacks and unexpected sugar contents will be more obvious to the patient, and their ingestion can therefore be avoided or at least controlled more easily. Also of great importance, the foods which tend to be bad for teeth are also likely to be linked to weight gain and obesity, another health issue that seems to be spiraling out of control in the UK currently. So, the dental team can be instrumental in educating patients to look after their own oral health as well as their general health, by providing important information about food and healthy diets.

Although the incidence of caries is gradually reducing in this country, it remains a major health problem. It is most prevalent in younger age groups, and the main reason for a child in the UK to undergo a general anaesthetic is for dental extractions, so parental education and support by the dental team is imperative if oral health messages are to be successful. Sadly, the incidence of obesity in both children and adults in the UK is currently rising.

What is a healthy diet?

As long ago as 2001, the Food Standards Agency issued advice on what constituted a healthy diet, in the publication *The Balance of Good Health*. It developed the 'Eatwell Guide' (Figure 13.20) to help advise the public on what constitutes a healthy balanced diet, by dividing a standard food plate into thirds and indicating the amounts of food products that should come from each food group. It is important to note that a healthy diet for humans includes foods from all food groups: proteins, carbohydrates, and fats, as well as vitamins, minerals and water. Over recent years various 'healthy weight-loss diets' have been proposed, where followers have been advised to have such as a carbohydrate-free diet or a low-protein diet, for example.

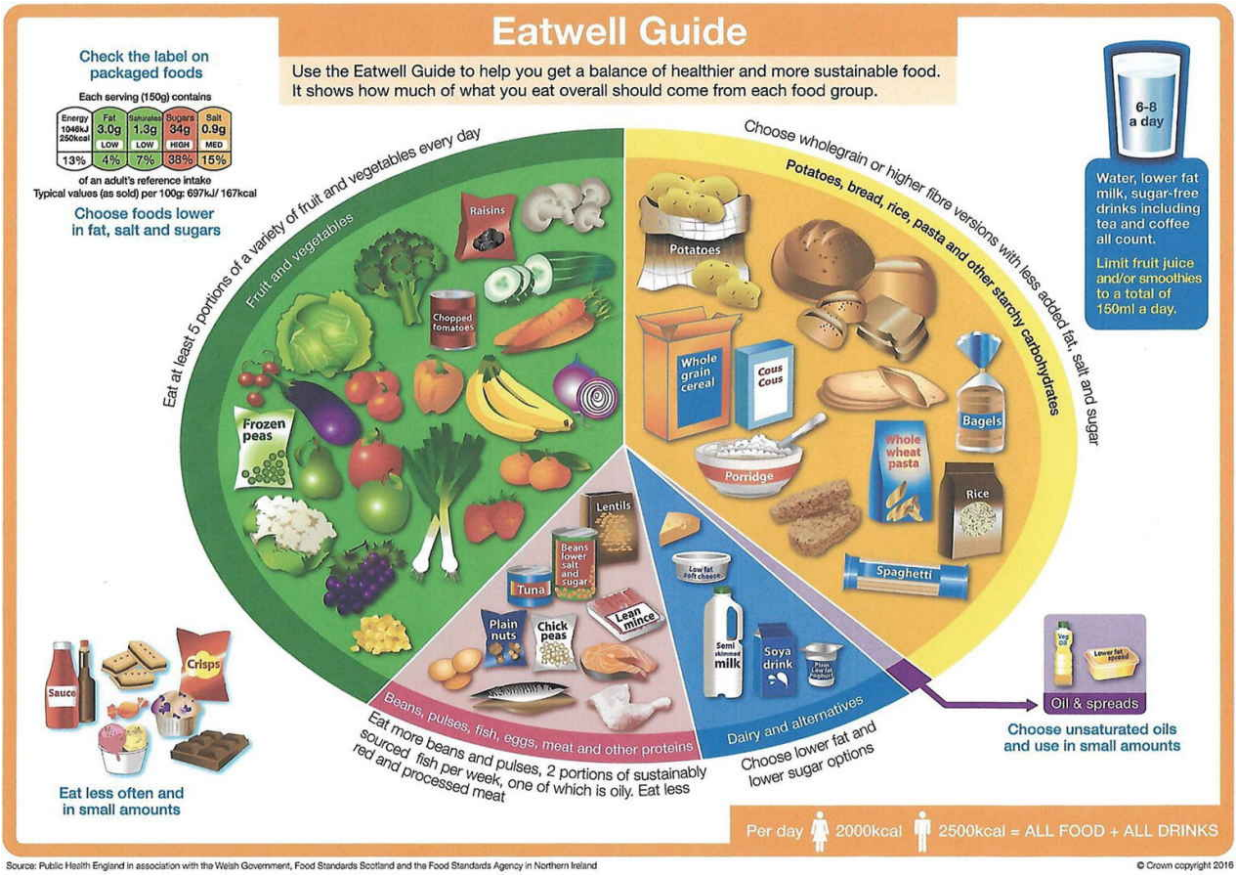


Figure 13.20 Food Standards Agency Eatwell Guide.

The 'Eatwell Guide' clearly indicates that a healthy balanced diet should be made up as follows, with portion sizes being varied to reflect the level of activity of the person involved.

- One-third of the plate made up of starchy carbohydrates (not sugars):
  - Bread (preferably wholemeal)
  - Rice or pasta (in any of its forms: shapes, spaghetti, tagliatelle, etc.)
  - Potatoes (preferably boiled, mashed or baked, rather than fried or roasted)
  - Other starchy foods, such as sweet potatoes.
- One-third of the plate made up of fruit and vegetables:

    - Ideally whole fruit or with minimal cooking, such as passata or stewed fruit
    - Ideally fresh and raw or lightly steamed vegetables, to maintain their maximum content of fibre, vitamins and minerals
    - Lightly boiled vegetables otherwise
    - If roasted, then in olive oil or rapeseed oil rather than in animal fats, such as lard or dripping.
- One-third of the plate made up of proteins, fats and sugars:
    - Meat, preferably white rather than red for a lower fat content (so chicken, pork, etc. rather than beef)
    - Fish, especially oily fish such as salmon, tuna and mackerel
    - Eggs, nuts, beans and other pulses
    - Milk and other dairy foods, ideally as reduced-fat or low-fat alternatives
    - Minimal amount of foods and drinks which are high in fats and/or sugars.

Humans are omnivores, a mammalian species whose digestive system has developed so that they can gain nutrition from both animal and vegetable food substances; as opposed to carnivores (such as lions, dogs and cats, who eat only animal-derived food substances) and herbivores (such as cows, sheep and rabbits, who eat only vegetable-derived food substances). Vegetarians follow a diet which excludes the flesh of animals, while vegans follow a stricter diet containing no animal products whatsoever; both groups therefore must use alternative sources of protein and fats to eat healthily.

Useful dietary advice that the dental team can give to their adult patients, in relation to maintaining good oral and general health and avoiding dental caries and obesity, is well described in the Department of Health publication *Delivering Better Oral Health: An Evidence-based Toolkit for Prevention* (2nd edn 2009; 3rd edn 2014) (Figure 13.21). In particular, the 'key facts and messages' contained in this toolkit explain the reasons behind the health advice given, and therefore give patients the information they need to enable them to

make healthier choices when considering their diet, as summarised below. Specific dietary advice for infants and young children is available at www.eatwell.gov.uk.

Key fact 1: portion sizes must be linked to the level of physical activity of the person. Someone with a sedentary occupation (such as an office worker) or a retired person is unlikely to require the same size portions of food as someone with a physically demanding job, such as a tree surgeon. Obviously, any sporting hobbies and pastimes must also be taken into account when considering this point.

Key fact 2: a healthy diet consists of a range of foods from each food group, rather than from just one or two of the food groups; our bodies need intakes from all food groups to function correctly.

Key message 1: starchy carbohydrates should make up 33% of each meal. They give a sense of digestive fullness which should reduce the desire to 'nibble' or 'graze' between meals, and they provide energy, certain nutrients, and fibre in the diet.

Key message 2: everyone should be eating at least five to seven portions of fruit and vegetables every day to reduce their risk of heart disease and some cancers. Current advice is to have a combination of colours of fruit and vegetables (Figure 13.22), as each colour group provides different vitamins, minerals, nutrients and fibre for the body, and to have as many portions raw or as minimally cooked/processed as possible.

Key message 3: two portions of fish, especially oily species such as salmon and sardines, should be consumed weekly, as they are a good source of low-fat protein, unsaturated fats, and specific vitamins and minerals which are required for good health.

Key message 4: limit the fat content of the diet to unsaturated fat sources, such as vegetable oils and spreads, nuts and pulses, and oily fish. Saturated fats can increase the levels of blood cholesterol and therefore the risk of heart disease, and should be avoided wherever possible. Sources include fatty meats and meat products, butter and some cheeses, lard and full fat milk, and cariogenic foods such as cakes, sweets, biscuits and pastries.

Key message 5: limit the amount of salt in the diet, to reduce the risk of high blood pressure developing, as this increases the risk of heart disease and stroke. Most processed foods contain salt, so home cooking and especially the use of alternative salt products (Figure 13.23) can significantly reduce the amount of salt in the diet.

Key message 6: drink at least 1 litre of water or other fluids each day to avoid dehydration, as this state prevents the body systems from functioning correctly.

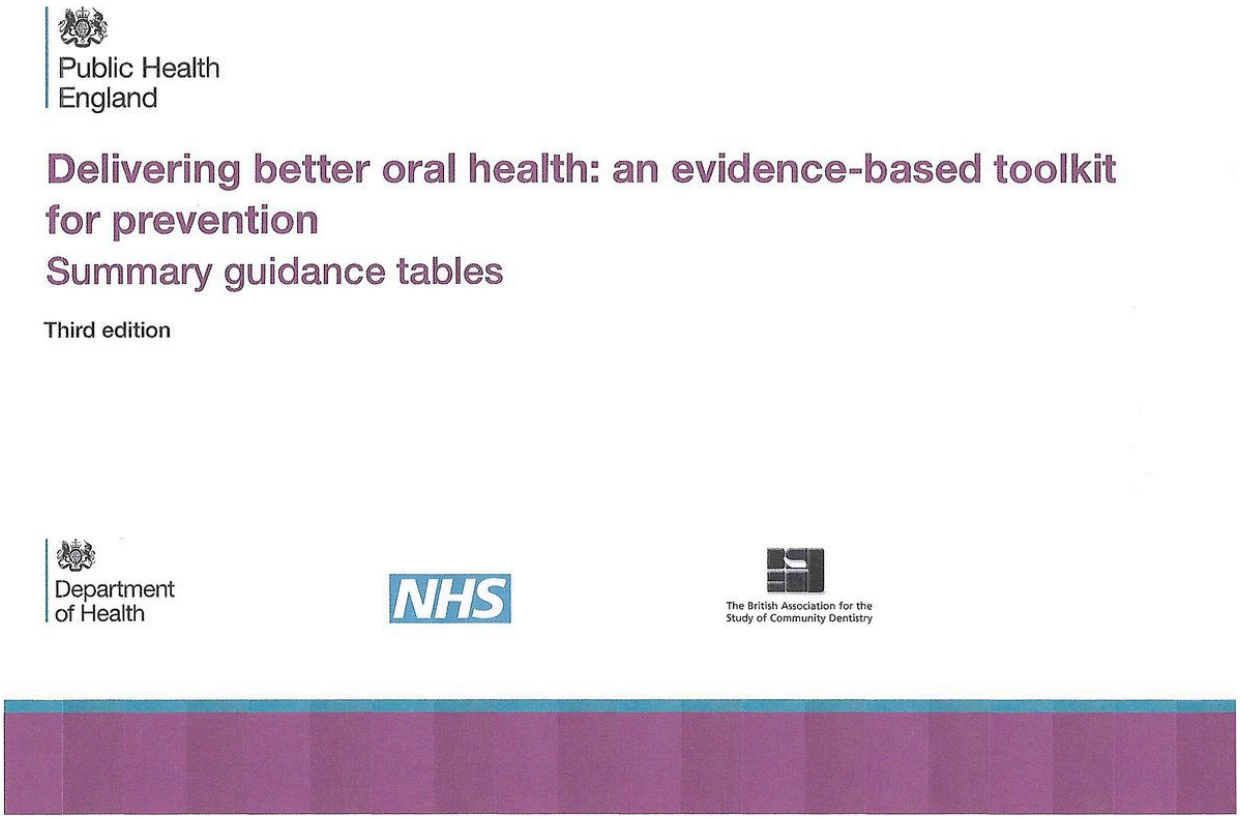


Figure 13.21 Department of Health's *Delivering better oral health* publication.

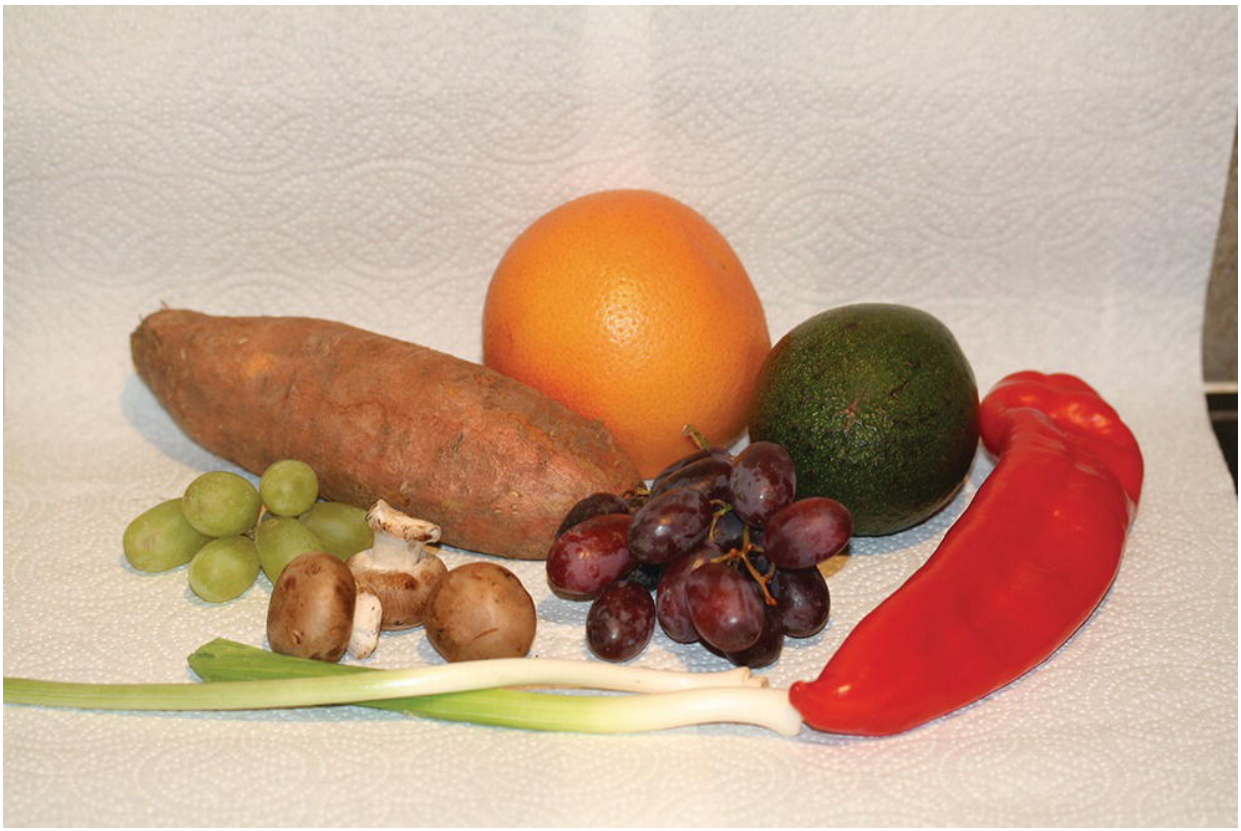


Figure 13.22 Fruit and vegetable colour groups.


LO
SALT
Original
66% LESS SODIUM
than regular table, sea and rock salts
all the same great taste

Figure 13.23 Example of alternative salt product.

Many patients believe that they do have a healthy balanced diet, and it is often only when the above points are discussed with the dental team in relation to their oral health that many of the key facts and messages are realised. A key method used by the team of determining the source of cariogenic foods/drinks in patients who repeatedly present with new cavities is to have them complete a diet sheet (Figure 13.24). When completed truthfully by the patient, the entries on the sheet can often provide evidence of hidden sugars consumption, unhealthy 'grazing' activities, and the consumption of an unbalanced diet. The dental team are then in a prime position to advise the patient on issues related to their general health and well-being, as well as how to improve their oral health.

Oral hygiene instruction and promotion session with the dental nurse.

Tuesday	Food or drink	Oral hygiene
6am	Cereal with sugar, orange juice	
7am		Tooth brushing, fluoride tooth paste
8am		
9am		
10am	Biscuit, coffee with 2 sugars	
11am		
12pm	Pizza, chocolate muffin, diet coke	
1pm		Chewing gum, not sugar free
2pm		
3pm	Diet coke, chocolate biscuit	
4pm		
5pm	Cheese and onion crisps	Chewing gum, not sugar free
6pm		
7pm	Chicken burger and chips with side salad, glass of white wine	
8pm	Glass of white wine	
9pm	Glass of white wine	Tooth brushing, fluoride tooth paste and general use mouthwash
10pm		
11pm	Glass of diet lemonade	
12am		

Figure 13.24 Example of a diet sheet.

In summary, the following dietary advice should be given to patients with the aim of reducing their experience of dental caries, and with the additional benefit of guiding them towards a healthy balanced diet and therefore of enjoying good general health too.

- Eat a healthy balanced diet with foods of low cariogenic (caries-causing) potential.
- Follow the ‘good snacks’ list given previously.
- Be aware of the extent of ‘hidden sugars’ in foods and drinks.
- Limit any cariogenic foods to mealtimes, so that they can be neutralised by the increased flow of saliva that occurs while

chewing.

- Avoid or control carbonated drinks and confine fruit juices to mealtimes only.
- Use diet sheets to determine if any hidden sugars are being taken, as well as to determine the balance of the diet.
- Advise mothers on the damage caused by using cariogenic drinks in baby feeders.
- Parents should be encouraged to request sugar-free medicines for their children whenever possible.

Prevention of periodontal disease

Two other factors were mentioned previously with regard to preventing periodontal disease, and they will both be discussed here.

- **Modify the contributory factors**.
- **Control the host response**.

Modify the contributory factors

The contributory factors to be discussed do not, in themselves, cause periodontal disease, which is due to the presence of consistently poor levels of oral hygiene by the patient. The contributory factors just exacerbate (make worse) the periodontal disease that is already in existence – they aggravate it so that the extent of the disease is worse than it would be otherwise and/or it progresses more easily and quickly than it would do otherwise.

The most common contributory factors include the following:

- Smoking.
- Unbalanced masticatory stress: such as when teeth have erupted out of alignment (especially when proclined, as with upper incisors) and normal chewing actions put force on them in an abnormal direction.
- Excessive masticatory stress: such as when several posterior teeth are missing and the patient then 'nibbles' with their anterior teeth only, resulting in excessive chewing force on them.
- Hormonal imbalance that affects the reaction of gingival tissues to normal events such as plaque build-up, the usual examples being pregnancy and puberty.
- Open lip posture that allows the gingival tissues to dry out readily, such as occurs in various malocclusions or in patients who routinely breathe through their mouth rather than their nose (this may be a habit, or due to conditions such as having large adenoid glands).

- A history of radiotherapy treatment for cancer in the head and neck region will result in reduced saliva flow (as the salivary glands are damaged by the treatment), so that plaque is able to build up more easily (these patients also tend to experience a higher rate of dental caries).
- Certain medical conditions that alter the patient's ability to fight infection or to heal when attacked by pathogens; these patients are referred to as being *immunocompromised*.
    - Diabetes.
    - Leukaemia and other blood disorders.
    - Vitamin C deficiency.
    - AIDS.
- Certain medicines that affect the normal reaction of the gingival tissues to the presence of plaque, often resulting in an overgrowth of tissue which makes plaque removal more difficult for the patient. The resultant tissue overgrowth is called *gingival hyperplasia*.
    - Phenytoin (Epanutin) used in the control of epilepsy.
    - Antihypertensive agents, such as nifedipine.
    - Immunosuppressant drugs to prevent transplant rejection, such as ciclosporin.
    - Cytotoxic drugs used to treat various cancers.
- Certain medicines affect saliva production so that the patient suffers from xerostomia (dry mouth), resulting in loss of the natural cleansing effect of the saliva and a greater build-up of plaque.
    - Diuretics used to treat various heart conditions.
    - Some antidepressants.
    - Some antihypertensive medicines.
- Plaque retention factors that allow an increased local build-up of plaque and/or prevent its ready removal by normal oral hygiene methods.

- Tooth crowding in malocclusion.
- Unopposed teeth in one arch, so that there is no normal contact and self-cleansing action by friction of food or other teeth.
- Iatrogenic factors: those created by the dentist, including overhanging restorations, poor marginal fit of crowns, poorly designed dentures, etc.

Of this large list of contributory factors, the most obvious and relatively easiest ones for the dental team to overcome are those due to masticatory stress and those due to localised plaque retention factors. Restorative dental treatments to restore the occlusion are discussed in detail in Chapters 15 and 16.

Of the remainder, patients can be informed of the effect of their various medications on their oral health and advised to discuss them with their doctor, who will be able to determine if alternative medications are available. Those patients suffering from medication-induced gingival hyperplasia can undergo a simple gingivectomy procedure to remove the excess tissue, so aiding plaque removal in the affected areas.

Little can be done for those patients suffering from hormonal imbalances and the various medical conditions that are an issue, except to ensure that they attend regularly for oral health assessment and treatment, and that the relevant oral hygiene messages are reinforced at each attendance.

As smoking has such a huge detrimental effect on both general and oral health, many patients are likely to have been given smoking cessation advice on numerous occasions by other healthcare workers besides the dental team. However, the team should still use every attendance by the patient as an opportunity to reinforce the health benefits of stopping smoking, and inform them of the various techniques that are currently available on referral to the excellent NHS Stop Smoking Service. Some patients are unlikely to be receptive to this advice, and the dental team are only likely to be involved in giving brief advice anyway, but it should still be delivered at least once a year. Completion of a medical history form or updating the

information already held on it is the ideal time to determine the smoking status of every patient.

- Current smoker: if so, of which tobacco product, for how long and how many per day?
- Ex-smoker: if so, as above, when did they stop, and what has prompted them to stop smoking?
- Never smoked: congratulate, and determine if they are exposed to passive smoking on a regular basis, such as from a partner, parent, etc.

All tobacco users should be advised of the value of stopping smoking (whether they are receptive to the advice or not) and the risks to their oral and general health of continuing. The advice given should be concise and personalised to their situation, using leaflets and printed information where necessary (see Figure 7.10). Those who are interested in the advice given and are motivated to try to stop their habit should be referred to the local NHS Stop Smoking Service. Dental treatment is one of the few areas of the NHS where many patients are expected to pay for their health services, and while it may be an unusual tactic, the cost of dental treatment may be highlighted as an additional good reason for advising those patients who smoke to give up, especially where it can be shown that smoking has contributed to their treatment costs. The dentist should advise and lead the team in this technique, as skilful communication methods are required to ensure that the patient is helpfully advised and supported, rather than insulted and humiliated.

Control the host response

Some patients are prone to suffering from periodontal problems, often for genetic reasons. No matter how thorough their oral hygiene efforts become with help and support from the dental team, and even in the absence of any contributory factors, they may still go on to develop periodontal disease. As their genetic predisposition cannot be altered, the development of periodontal disease is inevitable over time. These patients will require a high level of support and maintenance by the dental team to ensure that their disease does not

spiral out of control and result in the loss of multiple teeth that could have been saved.

These patients may therefore require interventional dental treatment on a regular basis.

- Any calculus that has built up must be removed by **scaling** and **subgingival debridement**, by a suitable member of the dental team (see Chapter 11).
- Advice should be given on suitable oral health products that act specifically to control calculus formation and improve gingival health, in particular the use of:
  - toothpastes containing **triclosan** and **zinc citrate**
  - mouthwashes containing **chlorhexidine**.
- Patients taking drugs that result in the development of **gingival hyperplasia** may require the overgrown tissue to be surgically removed as a gingivectomy procedure, thereby eliminating these plaque retention areas.
- Once debrided, the periodontal pockets may have an antibiotic gel (Figure 13.25) inserted as an alternative to repeated courses of systemic antibiotics, in an effort to eradicate the bacteria involved in the disease process.
- Alternatively, a PerioChip (Figure 13.26) can be inserted into the debrided pocket to provide a slow-release delivery of chlorhexidine directly in the problem area.
- Areas of persistent periodontal infection that fail to respond to treatment may require the **extraction** of the individual tooth involved, to remove the associated periodontal pockets as a source of the anaerobic bacteria.
- Patients who require a high level of periodontal maintenance are best referred to a **periodontal specialist** for their treatment.

Figure 13.25 Examples of periodontal pocket treatments.

Figure 13.26 PerioChip to provide slow-release delivery of chlorhexidine within the pocket.

Effective oral hygiene instruction

Communication skills

Good communication between the dental team and patients is crucial if they are to take an active role in managing their own oral health. Not only is it a necessity if any consent given for treatment is to be valid (see Chapter 3), but it will also lead to greater understanding between all parties, especially if the patient is unsure about treatment options or even refuses to have treatment as advised by the dentist.

An open relationship must exist at all times so that the patient feels they can ask for advice, query options given or explain why they do not wish to have certain treatments. All of this depends on the dental team showing good communication skills, and this is especially important for the dental nurse as patients often prefer to discuss matters with them rather than with the dentist.

Communicating means 'to give or exchange information' and this can be done both verbally and non-verbally.

- **Talking**: either directly with the patient face to face, or by telephone.
- **Written explanations**: which reiterate any verbal information given.
- **Information leaflets or posters**: which can be read and then discussed as necessary.
- **Body language**: which can be open and friendly, or defensive and stand-offish.
- **Eye contact**: maintaining eye contact shows attentiveness, while breaking eye contact indicates that the patient is being dismissed by the listener.
- **Facial expressions**: again, these can be friendly or not.
- **Body position**: sitting to listen to the patient is more attentive than standing, especially if the body position of the listener is turned away from the speaker. Many dental surgeries are designed so that the dental chair faces away from the computer

workstation area, and this inevitably leads to a staff member being positioned behind and out of sight of the patient while in the chair. All efforts should be made to avoid speaking to the patient while sitting in this position, and the staff member should move to be in front of the patient and talk face to face.

- **Touching**: this is sometimes used to reinforce points, although it is not acceptable in some situations and with some patients, and should only be used where there is a friendly and well-established rapport between the patient and the team member.

A friendly staff member will obviously appear more approachable to patients than one who seems unfriendly, but often an unfriendly demeanour occurs without the staff member realising it. When unexpected situations arise, such as an equipment failure or a very busy appointments session, staff can seem abrupt, harried or even dismissive towards patients as they try to deal with the unexpected work situation.

Continuing to carry out tasks while being spoken to, especially if eye contact is not maintained, can appear extremely rude and dismissive to patients. On the other hand, standing too close to a patient ('invading their personal space') or making inappropriate physical contact may be construed as threatening or offensive by the patient. Some individuals have naturally good communication skills, but for other dental staff a training course or in-house experiential learning, by following the lead of good communicators, is vital in the development of their own skills. There are many providers of very good 'communication skills' CPD events in the UK nowadays, and all dental team members should access a suitable course at least once in their 5-year CPD cycle.

Communicating with ethnic groups

In our modern, multiracial society there are bound to be patients whose first language is not English, and communicating with them will present severe problems for the dental team in some circumstances, so wherever possible an adult family member or friend should be encouraged to attend and act as an interpreter. Full communication can then occur so that the patient is fully aware of the

state of their oral health, and is fully informed of all risks and benefits before undergoing any dental procedure.

Valid consent cannot be given for treatment if the patient does not understand the language being spoken, and the relevant points have not been translated for them. The NHS issues patient information leaflets in various languages and it would be advisable for practices with a large ethnic minority patient base to have them to hand. They are available for free and can be delivered directly to the workplace.

Dental staff should also be aware of any cultural differences between ethnic groups, and accept and deal with them in an appropriate manner. Religious beliefs may prevent oral examination and dental treatment at certain times, and these facts should be accommodated and handled sympathetically as far as possible, rather than being seen as an unnecessary hindrance to the running of the practice.

Religion probably plays the most important role in the differences encountered amongst many ethnic groups, both in their culture and in their daily lives, including their diet and eating habits. Several points of interest for dental staff around these cultural differences are summarised below.

Hindus

- Many are vegetarian, some vegan, and they take no beef in their diet.
- Fasting days for religious reasons are common.
- Their diet tends to be very high in saturated fats, and is often expensive.

Sikhs

- They eat more dairy products than other ethnic groups.
- They are often vegetarian.
- If meats are eaten, they tend to avoid beef and pork.

Moslems

- They have strict food laws, even including the methods used for animal slaughter.
- They avoid both alcohol and pork.
- They abide by Ramadan, a period of fasting during daylight hours for one month per year.
- They tend to eat a diet rich in fish.

All Asian groups tend to breastfeed their babies for up to 2 years, and sugar is routinely added to feeds, especially as milk-based additions that are therefore cariogenic and have low nutritional value.

All these issues are of relevance to both the oral and general health of these patient groups, but are unlikely to be altered because of their religious basis. The dental team must accept this and respect the wishes of each patient, while also advising them of the likely consequences to their oral (and general) health.

Patient evaluation and motivation in relation to age group

Each patient's knowledge and skills in relation to their own oral health are evaluated by adequate communication with them, and the aim of good communication is to identify their level of motivation. If this is poor, what constitutes the actual problems for them: what is preventing them from achieving and then maintaining a good standard of oral health?

During consideration of the issues, all the following points need to be looked at and taken into account.

- Do they just need direct advice, help and support to adequately achieve good oral health, such as one-to-one oral hygiene instruction with a member of the dental team?
- Are factors involved which prevent them from achieving good oral health, such as a disability or a diet- or habit-related problem?
- Are they simply uninterested in their oral health or are they unaware that they have a problem?

- Are general health factors involved which either exacerbate or actually cause the oral health problem?
- Is a serious general health problem present which overrides their oral health problems?

Following the evaluation of each patient, their individual problems will have been identified and help can then be given by the dental team to aid the patient in achieving a better standard of oral health.

Any risk factors identified during the evaluation need to be discussed with the patient. These risk factors will vary, depending on the age group of the patient involved, and tend to be influenced by complex social attitudes and outside pressures.

Adults

- Smoking and drinking habits should be discussed in relation to oral health, but in a non-judgemental manner. Information should be given on the links between these risk factors and both the general and oral health problems associated with them, especially periodontal disease and oral cancer.
- Some patients may require referral to their dental or medical practitioner for individual advice on aids to stop smoking, such as nicotine patches and nicotine substitutes, and this is easier to arrange nowadays with the free NHS smoking cessation schemes available.
- Similarly, excessive alcohol intake should be discussed in relation to oral cancer and general health problems, but it is the patient's choice whether to act on the advice given.
- Diet should be discussed in detail, using accurate diet sheets completed by the patient to identify any hidden dietary problems if necessary, such as a high free sugars intake or frequent snacking episodes.
- The patient's diet should be assessed in relation to any general health effects.

Young people

This group of patients will require a quite different approach to support and motivation in relation to their oral health, for the following reasons:

- They have a different outlook on life and different priorities in their lives from adults; events that are important to adults are often of less concern to young people, and vice versa.
- They are likely to have little, if any, experience of long-term oral and general health problems and will therefore require some convincing that a problem actually exists.
- They are likely to require evidence for the existence of an oral health problem from the dental team, rather than just accepting their word for it, so the use of disclosing agents to stain bacterial plaque on their own teeth is often an invaluable aid in this situation.
- Some young people may be experimenting with alcohol and tobacco usage because of peer pressure, and this may already be having an effect on their oral health (and ultimately on their general health).
- Some may not wish to accept responsibility for maintaining their own oral health yet, and prefer to rely on their parents for this.
- Parental influence will be greater for some young people than others.
- Parental support will differ similarly, but is therefore of great importance. Well-motivated parents tend to instil their attitudes and beliefs into their youngsters.

Children

The oral health of this group depends very much on parental influence and support, especially for the younger patients. Parents who have little interest in their own oral and general health are unlikely to instil their children with high levels of interest and motivation, although exceptions do occur.

- Wherever possible, parents should be included in their child's oral health education, and their support should be gained at an

early stage.

- The oral health messages given by the dental team can then be reinforced at home by the parent, and will usually revolve around brushing techniques and dietary advice.
- A suitable vocabulary should be established for each child. If it is aimed too high they are unlikely to understand, but if too low they will be insulted by being treated childishly.
- A friendly, non-threatening approach is required so that their trust is gained.
- Ideally, the child should not be threatened by phrases such as 'if you don't brush your teeth you'll have to have a needle', as this will cause them to associate dental visits with fear and pain. Unfortunately, the team may sometimes find that this has already been threatened by a parent.
- The patient should also feel comfortable when asking questions, so the oral health team should maintain an open, frank manner with each child.
- Oral health messages need to be fun so that the interest of the child is maintained. Consequently, the use of games, drawings and competitions should be considered wherever possible.
- Again, the use of disclosing agents (either tablets or liquids) should be encouraged, both by the dental team and at home, to stain the bacterial plaque and make its removal easier.

Motivation can be thought of as the act of persuading people to do something for their own benefit. When there is a lack of motivation by patients to take an interest in their oral health, it needs to be established whether this is due to lack of knowledge, lack of interest or because of the presence of previously unrealised risk factors. Once these points have been understood, priorities and goals can be set for each patient and the role of the dental team can be established.

Having established the different groups requiring oral health advice and the factors that can affect their motivation in relation to both their oral and general health, the various methods available to the dental team to improve that motivation can be considered in detail for each patient. Using this information, a plan of action can be

developed in relation to the relevant oral and general health advice that is to be delivered, and how the various oral health messages should be communicated, especially in relation to caries and periodontal disease.

Successful communication with *adult patients* can be achieved in various ways.

- The use of specific oral health leaflets from dental suppliers.
- One-to-one discussions of relevant oral health issues with a member of the dental team, in a non-patronising manner.
- The non-use of dental jargon unless it is appropriate, but without condescension.
- The adoption of an attentive manner, so that the patient's own difficulties and problems relating to their oral health maintenance are listened to and understood.
- Any queries raised need answering at a level that the patient will understand, and may require referral to another member of the dental team by less experienced staff members.
- Eye contact should be maintained with the patient during the discussions, to ensure the correct level of attention is given.
- Reflective replies to their queries and concerns should be given, which relate to the patient's individual experiences.

The more mature *young people* can be approached in a similar fashion, but less mature patients will require an individual approach aimed at their level of understanding. Pubescent teenagers may even take offence at the implication that they have a 'dirty' mouth, and act quite negatively during attempts to discuss their oral health issues. This tends to be especially so for male teenagers.

A young person with a 'rebellious' nature will be determined not to make efforts to improve their oral health, enjoying the shock that this has on both the dental team and their parents. Thankfully, most tend to grow out of this phase as they mature.

Oral health messages can be communicated to this group as follows:

- The use of relevant leaflets and dental literature, many of which are specifically aimed at this age group.
- Definitely a one-to-one approach to give oral health messages for those members of this age group who are easily embarrassed.
- Some will tend to react better in small groups, especially with similarly aged siblings or friends.
- Authority and control of the situation need to be maintained by the dental team throughout the session, but in a friendly manner.
- The dental team should never lose patience with these individuals, no matter how obstreperous they become.
- Good patient management by the dental team at this age should produce attentive and responsible adults in the future.

Children tend to respond best to a group approach when learning new information, but their interest in a subject can soon be lost or they can be easily distracted. Consequently, short interactive sessions are best, with plenty of opportunities for individual involvement by the children.

- The use of disclosing tablets to show the presence and position of bacterial plaque.
- Supervise individual attempts at toothbrushing, to determine how to improve plaque removal.
- Develop relevant games to play, especially any involving current TV or film characters.
- Encourage parental involvement in the oral health sessions wherever possible, as the parents need to maintain and promote the oral health messages at home.

Having received all the available oral health advice given by the dental team, the patient should now be able to determine whether they are motivated and willing to improve their oral health.

A gentle and tactful reminder of the reasons why good oral health should be a personal goal for the patient can be given at this stage.

- To avoid the embarrassment of having halitosis (bad breath).
- To avoid the embarrassment and pain of having carious teeth.
- To avoid tooth loss due to periodontal disease or caries.
- To avoid the need for fixed or removable prostheses, and their expense.

A written note of the specific advice and instructions given should be kept in the patient's records, including details of any oral hygiene products recommended for use (Figure 13.27). This can be referred to in future appointments and discussed and updated as necessary.

PATIENT OHI SESSION NOTES

PATIENT	Melanie Chew
DATE	14th October 2017
OHI GIVEN BY	TE
ORAL HEALTH PROBLEMS	Lingual visible tartar lower incisors Localised inflammation UR1,2,3 and LR2,3,4 areas Several interdental areas with soft debris accumulation especially posterior teeth Often misses brushing session as short of time Several new cavities in last few years, although previous diet discussions revealed no obvious issues – so poor cleaning technique likely Localised gingivitis only due to poor technique
ADVICE: TECHNIQUE	Must brush twice daily as a minimum otherwise soft debris hardens and becomes impossible to remove, and must brush all tooth surfaces Pt right – handed, so less effective brushing on right side – demo given today
ADVICE: TOOTHBRUSH	Change to sonic (electric) toothbrush for more efficient debris removal at each brushing, rather than persist with worn-out manual brush
ADVICE: TOOTHPASTE	Cavities are the issue rather than perio, so good-quality long-acting toothpaste such as Colgate Total recommended for prolonged tooth protection, or Colgate Cavity Protect
ADVICE: MOUTHWASH	Tooth protection from caries required so advise any of following for regular use (30 mins after brushing): Listerine (Zero or Cool Mint) Fluorigard
ADVICE: OTHER ITEMS	Needs to carry out interdental cleaning, especially if continuing with manual brush Ideally use interdental brushes (demo given today) or dental tape (demo given today)
REVIEW DATE	April 2018 at recall

Figure 13.27 Example of oral hygiene advice and instruction sheet.

Review of patient progress

The patient will need to be seen on a regular basis to determine whether progress with their oral hygiene has been made or not. The dental team's success or failure in promoting and maintaining oral health depends on an understanding of the determinants of oral health issues.

- Social factors.
- Environmental factors.
- Economic factors.
- Patient's knowledge.
- Patient's skills.

Oral health education should aim to modify any damaging behaviour, rather than unrealistically trying to reverse this behaviour, and oral health educators need to have an understanding of why any damaging behaviour occurs. In particular, the effects of being in a low socioeconomic group need to be understood by the dental team, as many of these patients are entitled to free dental care under the NHS, and yet they often exhibit the worst standards of oral health. Some of the reasons identified for this anomaly are as follows:

- They are the group of patients least likely to attend for regular dental examinations, so there is little advice and preventive input from the dental team.
- Their associated poor diet, usually high in carbohydrates, predisposes them to general poor health.
- The high rate of smoking and alcohol use in this group tends to predispose them to periodontal disease and oral cancer.
- Dental ignorance, often compounded by low self-esteem, prevents their own oral health from being a high priority.
- Their high carbohydrate input tends to be related to the expected high caries incidence, and early tooth loss.

- Some of these patients feel intimidated by professionals, and are least likely to seek dental advice, especially in relation to information regarding lifestyle changes.
- Some people may also have difficulty understanding oral health advice, and this highlights the need for the dental team to develop good communication skills that can be adapted for various patients and situations as necessary.

Studies indicate that patients in lower socioeconomic groups tend to have poorer general health overall, and advice given by the dental team must be sympathetic to this, as it is often related to the financial situation of these patients in particular. All oral and general health advice should be given sympathetically and targeted at realistic outcomes. For example, parents in these groups tend to use sweets for their children as treats, or even bribes, because sweets are often cheaper to buy than books, toys or other presents. The finances of these families cannot be changed, so it would be totally unrealistic to try to stop the parents buying sweets for their children under these circumstances, and the delivery of the oral health advice and its promotion would fail. It would be more sensible in these circumstances to educate the parents to restrict sweets consumption to mealtimes, so that the frequency of acid attacks on their children's teeth is minimised, and hopefully their caries experience will be reduced or even eradicated.

Similarly, it would be unrealistic to expect older smokers to give up their nicotine habit without lots of encouragement and support from a smoking cessation scheme, as nicotine is addictive and the longer the patient has smoked, usually the harder they will find it to stop. Advice about current aids to help to stop smoking, such as nicotine patches or chewing gum, can be given, or a referral to the local NHS Stop Smoking Service.

Teenage smokers may be easier to re-educate, as they often only smoke to appear socially acceptable to their friends or because of peer pressure. Advice regarding the overall damage to health caused by smoking, given in an informed but friendly manner, is often the first step in their re-education.

With all the information collated with regard to the level of the patient's oral health at their assessment, the extent of their known risk factors for oral disease and their level of motivation to improve their oral health, the dental team is able to determine the outcome of their oral health promotion efforts on each patient at their review appointment. The outcome will fall into one of the following categories:

- Has progress been made, resulting in a higher standard of oral hygiene?
- Has the original oral hygiene status been maintained, but with no improvement?
- Has the oral hygiene status deteriorated, such that more damage has occurred?

When progress has been made, the patient should be congratulated and encouraged to maintain this raised standard of oral hygiene. Children can be given stickers, badges or certificates, all of which are available from oral hygiene product distributors. Many computer programs are available that can be used to design and print out certificates exclusive to the dental practice.

It should be remembered that oral health promotion is a long-term process, so regular monitoring will still be required for some time, although if the higher standard of oral hygiene becomes consistent, then review appointment intervals can be gradually lengthened.

When the oral health status has been maintained but not improved, the patient should still be congratulated on the fact that there has been no relapse, and they should be encouraged to try harder still before the next review, with advice tailored to areas where achievable results are possible.

These patients tend to have considered the financial and emotional costs and benefits to themselves of changing their oral hygiene status, and decided that the costs outweigh the benefits at the present time. All is not lost, as this decision may be transitory, due say to a particularly stressful period in their lives at the current time, so they feel unable or unwilling to attempt change now. Once this period is

over, however, they may be receptive to further attempts by the dental team to promote oral health.

If patients feel that the goals set by the dental team are not achievable, or are unrealistic for now, they should be reviewed regularly and supported until they feel able to try again.

The patients who have undergone deterioration in their oral health may need referral to the dentist or hygienist for specialist input and reinforcement. However, reflection still needs to determine whether the goals set were completely unrealistic and unachievable for that particular patient. If so, then new ones will need to be discussed and agreed upon with the dental team.

Alternatively, and frustrating though it is, some patients really do not wish to change their lifestyle, nor do they accept the consequences to their oral health that may occur. Regular monitoring and review are all that the dental team can hope to achieve for these patients, although they should stay alert to any indication by the patient that they are willing to try again at any time.

The patient's right to choose not to accept the oral health advice given by the dental team should be respected and accepted by all.

With regard to oral health assessment recall intervals, these depend on various factors for each patient as shown below, and current guidelines issued by NICE are used to determine the appropriate recall frequency in each case (Figure 13.28).

NICE National Institute for Health and Care Excellence

NICE guideline

Dental checks: intervals between oral health reviews

Clinical guideline

Published: 27 October 2004
nice.org.uk/guidance/cg19

Figure 13.28 NICE guidelines for dental recall.

Effect of general health on oral health

It is essential that patients understand that their oral health is not a separate issue from their general health, as the two are very much linked. The dietary and lifestyle advice that the dental team give to ensure good oral health will also be relevant to maintaining an overall high level of general health, if the patient chooses to follow that advice. This is particularly so in relation to diet, dental caries and obesity, as well as smoking, periodontal disease and oral cancer.

There are numerous medically related examples of the links between oral health and general health.

- Several chronic diseases have the **same risk factors** as oral diseases.
    - **Smoking** and other tobacco habits are associated with heart and respiratory disease, periodontal disease, and cancers such as oral cancer.
    - Diets high in **free sugars** and those containing many processed meals are linked to dental caries, obesity and an increased risk of heart disease.
    - **Excessive alcohol consumption** is associated with liver disease, periodontal disease, dental trauma (due to falls) and several cancers, including oral cancer.
    - **Eating disorders**, such as anorexia nervosa and bulimia, are associated with general ill health and acid erosion of the enamel of teeth, respectively.
    - **People with diabetes** suffer from poor wound healing generally, which also affects the oral soft tissues and makes the patients prone to postoperative complications, as well as to a higher incidence of oral infections (including periodontal infections).
- Certain commonly prescribed medicines have the unwanted side-effect of **reducing saliva flow**, which makes dental caries more likely to occur.
    - Some antihypertensives.

    - Some antidepressants.
- Some medical conditions may also result in a reduced salivary flow, such as Sjögren's syndrome.
- Other medicines have the unwanted side-effect of causing gingival overgrowth – **gingival hyperplasia** – which makes effective oral hygiene techniques more difficult.
    - Phenytoin: used to prevent epileptic fits.
    - Nifedipine: used to control heart problems.
    - Ciclosporin: used in some autoimmune conditions, as well as to prevent organ rejection after transplant.

In addition to the above, the effects of patient disability (physical or mental) as well as old age have a huge influence with regard to oral health advice and promotion, and oral disease prevention.

Patients with disabilities

Disability comes in many forms, and can be either mental or physical in its effect on the patient. Mentally disabled patients range from those with minor learning disabilities, through the elderly suffering from various forms of senile dementia (such as Alzheimer's disease), to those with congenital problems such as Down's syndrome. With the increase in life expectancy of the UK population, dementia has become one of the most common neurological disorders in those over 65 years of age, and all dental workplaces will have patients who suffer from one of its forms, whether diagnosed or not. Many sufferers are still likely to attend a general dental practice for their dental treatment, where the oral healthcare of this increasingly large group of patients is particularly challenging for the dental team (discussed in more detail below).

Some other patients with disabilities have significant problems associated with learning and socialising with others, due to inherited disorders such as Down's syndrome, autism and Asperger's syndrome, or acquired but permanent disorders following severe head injury. Those with mild impairment are likely to access dental treatment via general practice, while the more severe cases are likely to be referred for specialist dental care in community special needs clinics.

The dental care of these patients can be very demanding and time-consuming for the dental team, but also challenging and rewarding, and those dental nurses with a particular interest in this area are advised to consider the post-registration qualification of Special Care Dental Nursing, run by the NEBDN.

Often (but not always, as with autistic patients), those with some learning disabilities may exhibit a reduced level of general intelligence which presents the following problems to the dental team.

- They have a short attention span, so explaining treatment plans and gaining valid consent is often difficult.
- Poor memory retention means that information and advice has to be repeated many times.

- Reduced level of understanding may cause problems in gaining the trust of the patient before dental treatment can be provided.
- Careful explanations of treatment must be given, in basic and non-threatening terms.
- The link between diet, oral hygiene and dental disease is often impossible to explain satisfactorily, making co-operation in the management of their oral health very difficult.
- Some dental staff may slip into a type of 'baby talk' while communicating with these patients, and that is particularly offensive to those with acquired learning disabilities.

Those who have physical disabilities make up a wide-ranging group, from those who are paralysed and wheelchair bound, through those with visual or auditory impairments, to those who have acquired medical conditions which affect the level of dental care they are able to receive. Again, the more severely disabled patients tend to be treated in specialist units rather than general dental practice, the latter being able to accommodate the milder cases to varying levels of efficiency. Some of the more common problems that these patients present to the dental team are as follows:

- Hearing-impaired patients often rely on hearing aids or lip reading to understand when being spoken to, so the lowering of PPE masks and speaking face to face are very important in communicating with them.
- Visually impaired patients like to touch and feel, or listen to the sound of, dental equipment before it is used on them, and the dental team should accede to these requests at all times.
- Some physical disabilities will require the patient to be treated in downstairs surgeries only, with wheelchair access available.
- Any disabilities causing variations in muscle tone may restrict the ability of the patient to sit comfortably in the dental chair, and may also require the use of muscle relaxants to achieve adequate access to the oral cavity.
- Stroke victims may have difficulty communicating if their speech ability has been affected, and may rely on family members or

carers to make themselves understood.

- Arthritic patients, and those with upper limb deformities (such as thalidomide victims or those with dwarfism), may find adequate oral hygiene impossible to achieve without special adaptations to toothbrushes, etc.

The dental team has a vital role to play in assisting disabled patients in the dental workplace, not only in adapting the level of oral health promotion given but also in the oral hygiene techniques that they teach. Effective oral hygiene measures may require adaptations to oral health products, such as adapting a toothbrush handle so that it can be gripped more firmly by an arthritic patient. The oral health of the patient may even be the responsibility of a carer, and it is vital that they also attend the evaluation, support and review appointments with the patient, so that they have the necessary access to the dental team.

Angled toothbrushes, or even children's sizes rather than adult size, can make access to the teeth so much easier, either for the patient themselves or their carer. Good-quality rechargeable electric toothbrushes, when used correctly, can ensure a good standard of oral hygiene, although battery-operated designs are not particularly recommended as they can lose their charge with time and become quite inefficient at plaque control.

Several floss holders are now available to allow efficient interdental cleaning; indeed, even manually dextrous patients may find these less cumbersome than the traditional method of wrapping floss around the fingers (see Chapter 11).

Patients with dementia

The commonest, and most well-known, forms of dementia are Alzheimer's disease and vascular dementia, which account for over 60% and almost 20%, respectively, of the diagnosed incidence of dementia in the UK. There are other forms of dementia too, but they are all progressive neurological conditions affecting the brain that impact on the patient's ability to remember, understand, communicate and reason – they become cognitively impaired. The speed with which a patient's dementia progresses is very individual,

and can be affected by other medical issues as well as by their home environment, their level of support from others, some medications, and whether they have actually been assessed and diagnosed with dementia. Much useful and important information about dementia of relevance to the dental team is available in the excellent 2017 publication from the FGDP, *Dementia-Friendly Dentistry: Good Practice Guidelines* (www.fgdp.org.uk) (Figure 13.29). The salient points are summarised below, and another very useful resource for information and advice for the dental team, patients and their carers is available at www.alzheimers.org.uk.

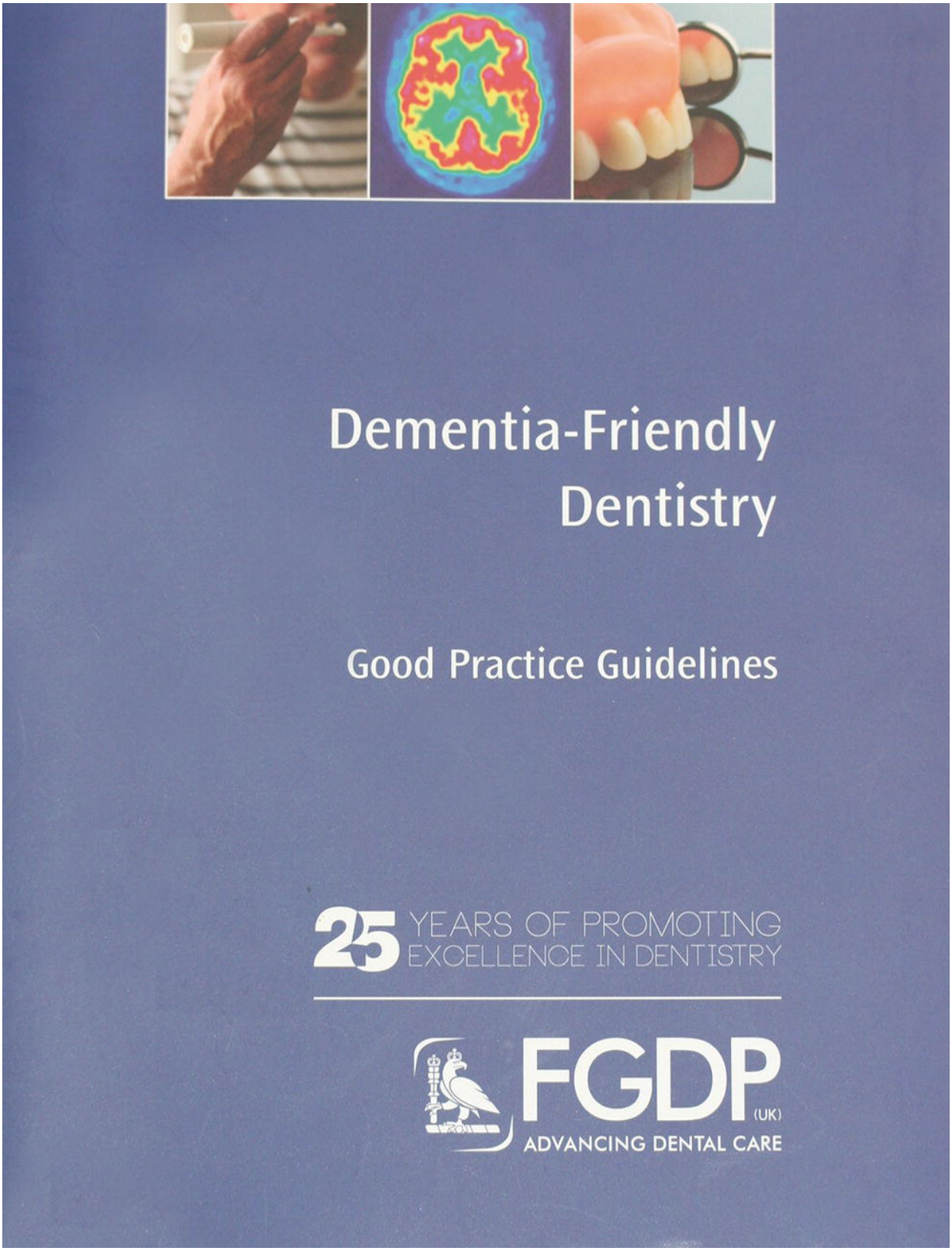


Figure 13.29 FGDP publication *Dementia-Friendly Dentistry*.

Implications for the dental team

In general dental practice, it is often the case that a patient and their family attend for routine oral healthcare for many years to the same dental team; indeed, it may be the dental team who first notice a change in a patient's abilities and behaviours and suspect the possibility of the onset of dementia. A tactful request by the team for permission to write to the patient's GP describing their observations and concerns, and suggesting that the patient is reviewed medically, may help the patient to be assessed and diagnosed with dementia. Where there are concerns over the patient's mental capacity in these situations, issues of patient confidentiality and consent must follow the GDC's *Standards for the Dental Team* and the code of practice set out in the Mental Capacity Act.

Once a diagnosis of dementia has been made, the dental team are an important part of the multidisciplinary approach to the health and social care needs of the patient, for as long as the patient is able to attend the practice. As they become more cognitively impaired, the patient may have to access future oral healthcare via carers in a nursing home, or via special care dental services in the community or in hospital. Until then, the long-term oral healthcare for the patient provided by the practice should be based on the following guidelines, issued by the British Society of Gerodontology and available at www.gerodontology.com.

- Continue to reinforce oral hygiene techniques specific to the patient, as they usually comply with, and continue to carry out, oral health routines that have been advised previously by the dental team.
- Actively use preventive measures where appropriate to minimise the extent of any dental disease, as soon as possible. So with dentate patients, change to a high-fluoride toothpaste, carry out fluoride applications regularly, and so on.
- Complete any necessary dental interventions as soon as possible, before the patient's condition deteriorates and they are unable to understand that treatment is required.
    - Replace any restorations that are being kept under observation and which are likely to need replacement in

future.
    - Remove any likely sources of future pain and/or infection by endodontic treatment or extraction.
    - Consider providing simple crowns on stable, heavily restored teeth at an earlier stage, where they are likely to be required in future anyway.
    - Provide dentures as soon as possible, where required.
    - Replace any existing dentures when necessary using a 'copy denture' technique so that the patient is used to their design and fit (see Chapter 16).
- Have all dentures marked with a patient identifier, and cleaned regularly at the practice to avoid the build-up of tartar on their surfaces.
- Provide regular reviews and professional cleaning regimes for dentate patients, to avoid the need for further interventions at a later stage of their condition.

The dental team also needs to be aware of the following points in relation to how the progression of the patient's dementia may affect them.

- The patient's manual dexterity will reduce with time, and they may become dependent on carers/family for adequate oral hygiene care at some point. If so, the correct techniques need to be shown to those involved.
- Likewise, the patient will experience increasing levels of fatigue and become unable to complete their usual oral hygiene regime adequately without help.
- The patient may eventually forget to carry out oral hygiene (and personal hygiene) techniques, and again carers/family need to be correctly instructed to take over these tasks.
- An electric toothbrush, or adaptations to the handle of the toothbrush, may eventually be required for the patient to be able to use it effectively.

- Some patients will experience increased levels of bruxism that may be related to their dementia medication, and signs of tooth surface loss or tooth damage should be actively assessed at each appointment. The provision of a gum shield may be required at some point.
- Bruxism may also indicate that the patient is in pain, and this needs to be investigated and treated as necessary by the dental team.
- Gradually, the patient may experience difficulty in chewing and may need to transfer to a softer diet (even puréed), and have assistance at every mealtime to ensure they do not choke.
    - They tire and stop chewing, holding food in their mouth for some time until prompted to swallow.
    - They forget to chew, or chew continuously without swallowing.
    - They avoid harder foods, although transferring to softer foods helps to prevent interdental food trapping in many patients.
- The patient may experience difficulty in swallowing (dysphagia) and can be at risk of choking, aspirating food or fluids (sucking them into the lungs), or experiencing dehydration, weight loss and malnutrition.
- Dehydration will make denture wearing uncomfortable, difficult or even impossible, and in dentate patients it will increase the risk of oral disease.
- The patient may lose their dentures and require replacements, or become intolerant of them. Again, a soft diet will help to prevent weight loss, physical weakness and malnutrition.

In summary, the dental team have an important role to play in providing good-quality oral healthcare to patients suffering from dementia, in assisting carers and family members to take over the patient's oral hygiene regime and ensuring that an adequate diet and fluids are taken, and to know when the time has come for specialist care to be instigated in the best interests of the patient.

Elderly patients

The number of people living longer is steadily increasing in the UK as medical treatment improves and healthier lifestyles predominate. A greater proportion of the population is now made up of those over the age of 70 years, the elderly. Dentally, as oral health has become understood and methods of maintaining good oral health have developed, these patients are also keeping their natural teeth for longer, but because of age-related changes to the oral tissues, their dental treatment is different in some aspects from those who are younger, and is classed separately as *gerodontology*.

The changes to the oral tissues with age, and their relevance to dentistry, are summarised below.

Skin

- Has less underlying fat and elasticity.
- This gives increased tissue fragility and the likelihood of soft tissue trauma and bruising postoperatively.

Bone

- Tends to be more brittle, especially in postmenopausal women who may have some degree of osteoporosis.
- The jaw bones are therefore at increased risk of fracture during extraction.
- In particular, elderly female patients who take bisphosphonates to counteract the debilitating effects of osteoporosis are likely to require referral for tooth extraction, as the risk of postoperative bone necrosis is high.
- The natural resorption of the jaw bones following tooth extraction makes denture retention more difficult to achieve.

Oral mucosa

- Is thinner and less elastic.
- It is therefore easier to traumatise during routine treatment.

- The ridge areas are less tolerant of bearing dentures, with discomfort and ulceration more likely.
- Gingival recession will be more pronounced, which increases the risk of root caries developing.

Salivary glands

- Undergo an alteration of the salivary components and volume, especially with certain drugs.
- More likely to suffer from a dry mouth (xerostomia).
- This leads to an increased caries rate, as the self-cleansing action of saliva is reduced.
- It may also cause problems with swallowing, speech and denture retention, as well as an increased incidence of localised periodontal conditions.

Teeth

- Undergo a gradual darkening in colour, making shade matching of anterior restoratives more difficult to achieve.
- Narrowing and sclerosis of the pulp chamber lead to difficulties in gaining access to the root canals during endodontic treatment.
- Have a reduced sensitivity.

Some of the reasons for these patients experiencing difficulties in accessing dental care are as follows:

- Immobility, or poor mobility, making regular attendance at a dental practice difficult or impossible.
- Poor mobility may restrict access to ground-floor surgeries only.
- Complicated medical problems, which may limit the dental treatments available to them.
- Complicated drug regimens, some of which may interact with dental anaesthesia and dental medicaments.

- Various degrees of senile dementia, which may make explanations of dental treatment difficult for them to understand or remember.
- Various degrees of visual impairment or hearing loss, which can again make explanations difficult.

Summary

Overall, there are many factors for the dental team to consider in relation to oral health advice and promotion, and oral disease prevention, but in summary the key points of global dental health education for all patients can be condensed into four simple messages.

- Reduce the frequency of consumption of food and drink containing free sugars, and avoid acid drinks.
- Maintain adequate oral hygiene measures, including brushing twice daily with fluoride toothpaste.
- Regular dental attendance at least once a year.
- Do not smoke.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

14
Pain and Anxiety Control

Key learning points

A **factual knowledge** of

- local anaesthetics in pain control

A **working knowledge** of

- local anaesthetic techniques in dentistry

A **factual awareness** of

- anxiety control techniques
- patient monitoring techniques

A **working understanding** of

- the role of the dental nurse during the use of anxiety control techniques

When a patient has dental disease, especially dental caries, the dental team will aim to treat and eradicate that disease by performing some type of dental (tooth) or soft tissue surgery on the patient.

- Restorative treatment performed directly on the tooth involved, by:
  - fillings
  - endodontics
  - fixed restorations (crown, veneer, inlay).
- Extraction of the tooth:
  - simple extraction
  - surgical extraction.

- Periodontal treatment involving the supporting structures of the tooth:
  - scaling and debridement
  - periodontal surgery.
- Other types of soft tissue surgery.

All these dental techniques are covered in later chapters.

As described in Chapters 9 and 10, the oral cavity has an excellent nerve supply to all areas and anyone who has suffered the misery of toothache or even minor mouth ulcers will vouch for just how well developed pain reception in this area can be. To carry out any oral or dental surgical treatments without some form of pain control would be acutely painful for the patient, and the majority of procedures are therefore usually carried out under a technique of *local anaesthesia*.

Local anaesthesia

The term ‘anaesthesia’ is defined as ‘the loss of all sensation’ but in dentistry when local anaesthetics are administered, they produce the loss of pain sensation only; the sensation of pressure can still be felt by the patient. Drugs used to produce the loss of pain sensation only would therefore be more correctly termed ‘local analgesics’.

Teeth and their support structures are particularly well innervated with a sensory nerve supply that responds to temperature, pressure and pain. Local anaesthetics must be given by injection before dental treatment begins, so that the patient is comfortable and pain-free throughout the procedure. As described in Chapter 5, all sensations felt by the body tissues are transmitted as electrical impulses along the length of the sensory neurones (nerve cells) to the brain, where the information is analysed and interpreted. Local anaesthetics act by blocking these electrical transmissions from the source of the stimulation (the tooth or its surroundings), so that the information that a painful procedure is being carried out does not reach the brain. The patient is conscious and fully aware of the treatment being carried out (unless they are sedated), but they feel no unpleasant or painful stimuli.

In addition, the sensations of hot and cold are also blocked as they would be interpreted as pain under these circumstances. The heat generated when a tooth is drilled with no cooling water spray is interpreted as pain by the brain, and similarly anyone with sensitive teeth will relate to the very uncomfortable sensation that occurs when cold drinks are taken.

The sensations of pressure and vibration will remain, so for example the patient will be aware of the pushing and wiggling sensations that occur during a tooth extraction procedure, but it should be completely painless if the local anaesthetic has been administered correctly.

Local anaesthetic drugs

Many local anaesthetics are now available for use in dentistry, and they are all supplied within glass or plastic cartridges for use in special dental syringes (Figure 14.1). The cartridges are available as either 2.2 mL or 1.8 mL sizes, and contain the following:

- **Anaesthetic**: to block the electrical nerve transmissions to the brain so that neither pain nor temperature changes can be felt.
- **Sterile water**: acts as a carrying solution for the other constituents, and makes up the bulk of the cartridge contents.
- **Buffering agents**: maintains the contents of the cartridge at a neutral pH, so they are neither acidic nor alkaline and do not irritate the soft tissues when they are injected.
- **Preservative**: to give an adequate shelf-life to the contents.
- **Vasoconstrictor**: present in some types of local anaesthetic (but not all), and acts to prolong the action of the anaesthetic by closing (constricting) local blood vessels so that the solution is not carried away so quickly in the bloodstream.

Figure 14.1 Local anaesthetic cartridges.

Both the anaesthetic agent and any vasoconstrictor present are classed as drugs, and are therefore subject to strict regulations with regard to their safe disposal. The topic of waste disposal is discussed in detail in Chapter 4, and used local anaesthetic cartridges are classified as infectious hazardous waste. Unused but out-of-date cartridges are classified as non-hazardous waste as a medicine, although broken cartridges should be disposed of as sharps waste under the infectious hazardous waste category.

The more common local anaesthetics currently in use in dentistry are as follows:

- **Lidocaine**: 2% lignocaine hydrochloride as the local anaesthetic with 1:80,000 adrenaline (epinephrine) as a vasoconstrictor (known as Lignospan and Xylocaine).
- **Articaine**: carticaine as the local anaesthetic with 1:100,000 adrenaline as a vasoconstrictor.
- **Citanest**: 3% prilocaine hydrochloride as the local anaesthetic, with 0.03 units/mL felypressin (Octapressin) as a vasoconstrictor.
- **Citanest plain**: 4% prilocaine hydrochloride as the local anaesthetic, with no vasoconstrictor present.
- **Mepivacaine**: 3% mepivacaine hydrochloride as the local anaesthetic, with no vasoconstrictor present (known as Scandonest).

Adrenaline (also called epinephrine) is the vasoconstrictor most commonly used in dental local anaesthetics, but it is a potent cardiac stimulant which increases the rate and depth of a patient's heartbeat generally. This explains its usefulness as an emergency drug in various situations, such as during anaphylaxis when the blood pressure falls to such low levels that the heart can stop beating (see Chapter 6). Unfortunately, it also means that dental local anaesthetics containing it are considered unsafe for use on patients with certain medical conditions.

- **Hypertension**: high blood pressure.
- **Cardiac disease**: poor functioning of the heart, whether due to valve defects or acquired problems such as coronary artery disease.
- **Hyperthyroidism**: an overactive thyroid gland, which tends to increase the overall metabolic rate of the patient, including the heart rate.

In addition, care should be taken with certain groups of patients or with those taking certain drugs.

- **Elderly patients**: as they may have complicated medical histories, be taking other drugs that could interact with adrenaline, have undiagnosed diseases, or simply may not be able to excrete drugs efficiently due to their age.
- **Hormone replacement therapy**: given to women to counteract the adverse effects of the menopause and prevent the development of osteoporosis (thinning of the bones), but which may produce hypertension as a side-effect.
- **Thyroxine**: a drug given to patients suffering from hypothyroidism (an underactive thyroid gland), which increases their overall metabolic rate, including the heart rate.

Theoretical risks are also said to exist with patients taking certain antidepressants, including tricyclics and monoamine oxidase inhibitors (MAOIs).

The use of local anaesthetics containing no vasoconstrictor is an alternative in these groups of patients, but then the analgesic action would wear off more quickly and there is more risk of haemorrhage during surgical procedures. Alternatively, they can be given 3% Citanest, the only contraindications to its use being *pregnancy*, as felypressin is a potent drug used to induce labour due to its contractive action on the muscles of the uterus.

Local anaesthetic equipment

The equipment required to administer the local anaesthetic consists of the cartridge itself, the syringe and needle, and sometimes a topical anaesthetic is used.

The anaesthetic cartridge is a glass or plastic tube sealed at one end with a thin rubber diaphragm and at the other with a rubber bung (Figure 14.2). A special syringe and needle are used with dental cartridges. When a cartridge is inserted in the syringe, a double-ended needle pierces the diaphragm. Solution is injected when the syringe plunger engages the rubber bung and pushes it down the tube. As some patients are now known to have an allergy to latex, the rubber bung and diaphragm have been replaced by plastic alternatives in some types of specialised cartridges.

Figure 14.2 Close-up of cartridge ends showing bung and diaphragm.

Various designs of local anaesthetic syringe are available, some being side-loading and some being breech-loading (from the back) (Figure 14.3). The majority of older style syringes are metallic so that they can be sterilised in an autoclave after each use, but many single-use disposable designs are also available, many of which comply with the Sharp Instruments in Healthcare Regulations 2013 (see Chapter 8) whereby they have a safety device in place to avoid inoculation injury during resheathing of the needle after use (Figure 14.4).

Figure 14.3 Breech-loading (open) and side-loading syringes.

Figure 14.4 Example of a 'safety' syringe.

The head of the plunger is adapted in some older style syringes so that the dentist can use an *aspirating technique* when administering the local anaesthetic, for patient safety reasons. The technique is designed to avoid the injection of the solution into a blood vessel, rather than around the nerve as is the essential position, and requires the plunger head to be designed to extend the bung without injecting, or to be able to screw into the bung so that it can be drawn back before injecting (Figure 14.5). So once the needle has been positioned and the plunger is either pressed slightly or drawn back, if a blood

vessel has been pierced then blood will flow visibly into the anaesthetic cartridge. The needle tip can then be repositioned, the cartridge aspirated to check again, and then the contents safely injected into the correct position around the nerve. Unfortunately, some of the new 'safety' syringes cannot be used with an aspirating technique.

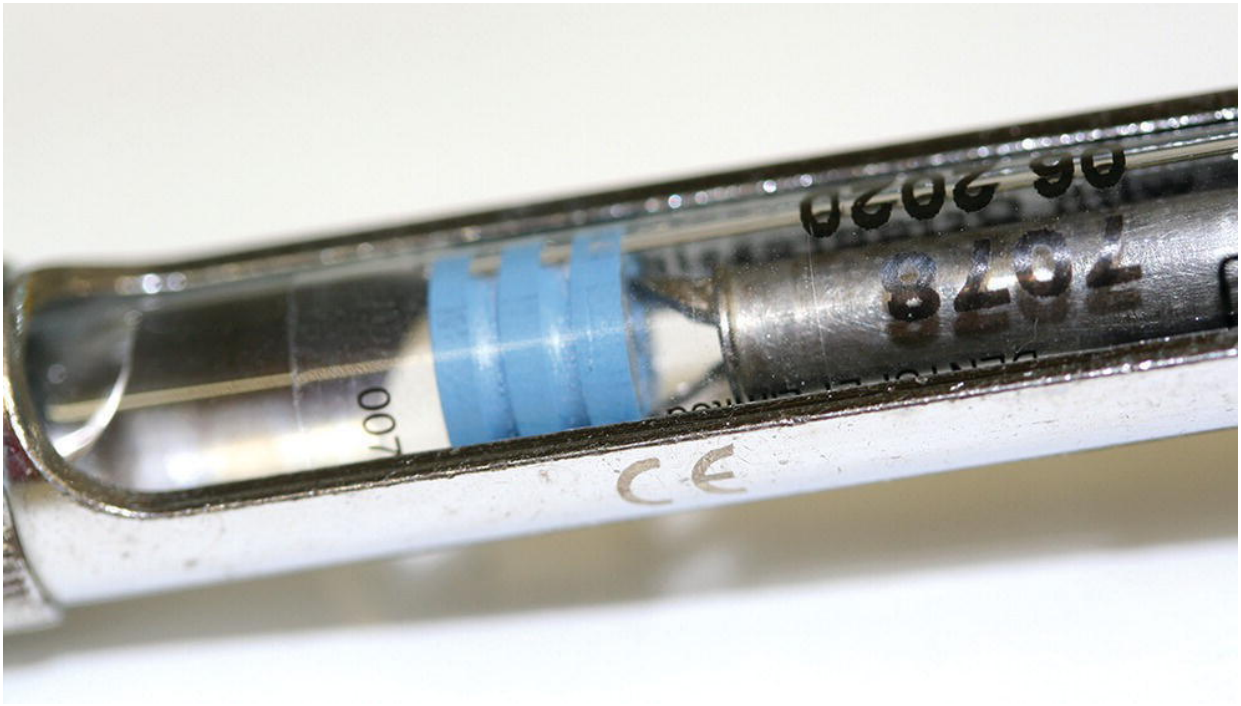


Figure 14.5 Screw-in style aspirating syringe plunger engaged in cartridge bung.

All syringes have a universal thread end for the needle to be positioned and attached. The needles are provided in various lengths and sizes, or gauges, depending on the type of injection to be given (Figure 14.6). Smaller sizes are less painful to use but are too fine to be used in some oral injection sites, especially where muscle tissue has to be penetrated to reach the target nerve.

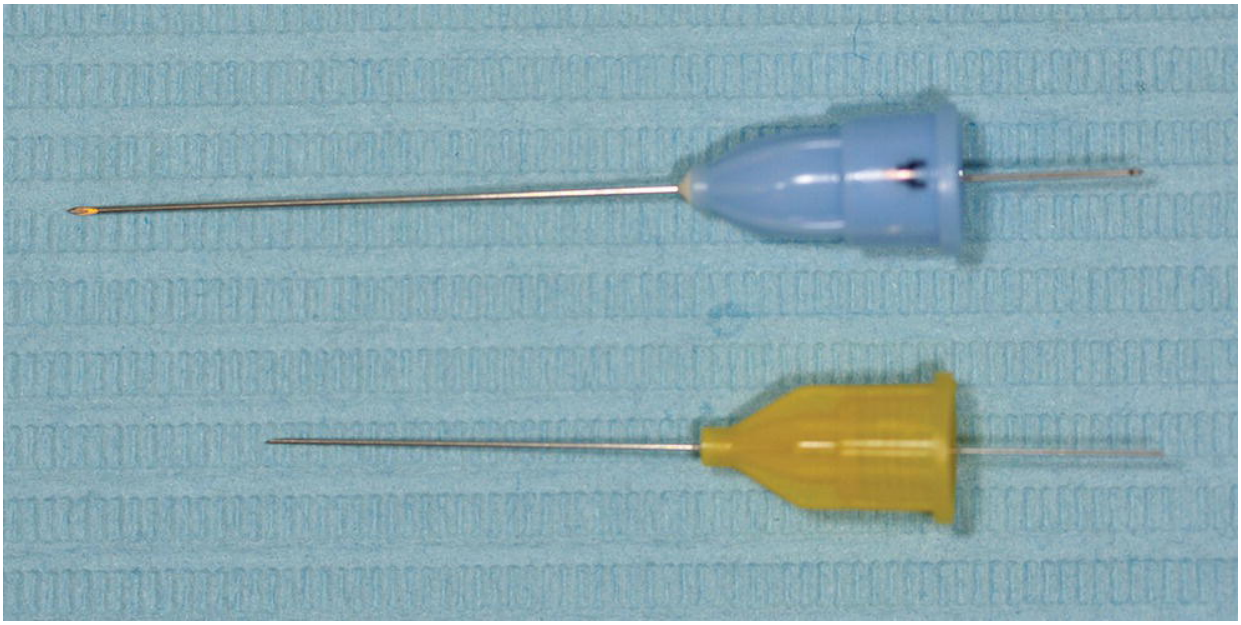


Figure 14.6 Local anaesthetic needles.

Topical anaesthetics are used on the surface of the oral mucous membrane to provide localised anaesthesia in that area, so that a syringe needle can be inserted painlessly and the local anaesthetic can be administered. They are supplied as a paste, solution or spray which is applied to the appropriate site a few minutes before an injection is given. Commonly used surface anaesthetics are 5% lidocaine paste (Figure 14.7) or 20% benzocaine.

Figure 14.7 Topical anaesthetic gel.

These products may also be used to minimise the discomfort of superficial scaling, fitting matrix bands and orthodontic bands, and for preventing stimulation of the gag reflex when taking impressions – benzocaine spray directed onto the oropharynx area is particularly useful in this situation.

Local anaesthetic administration techniques

Due to the variable anatomy of the jaws, the administration technique required to anaesthetise teeth is dependent on whether the relevant sensory nerve is deep within the bone or is superficial to the bone surface. Other techniques can be used to anaesthetise individual teeth and their surroundings only, without causing any soft tissue effects. Generally, there are four basic methods of administering a dental local anaesthetic (Figure 14.8).

- Nerve block.
- Local infiltration.
- Intraligamentary injection.

- Intraosseous injection.

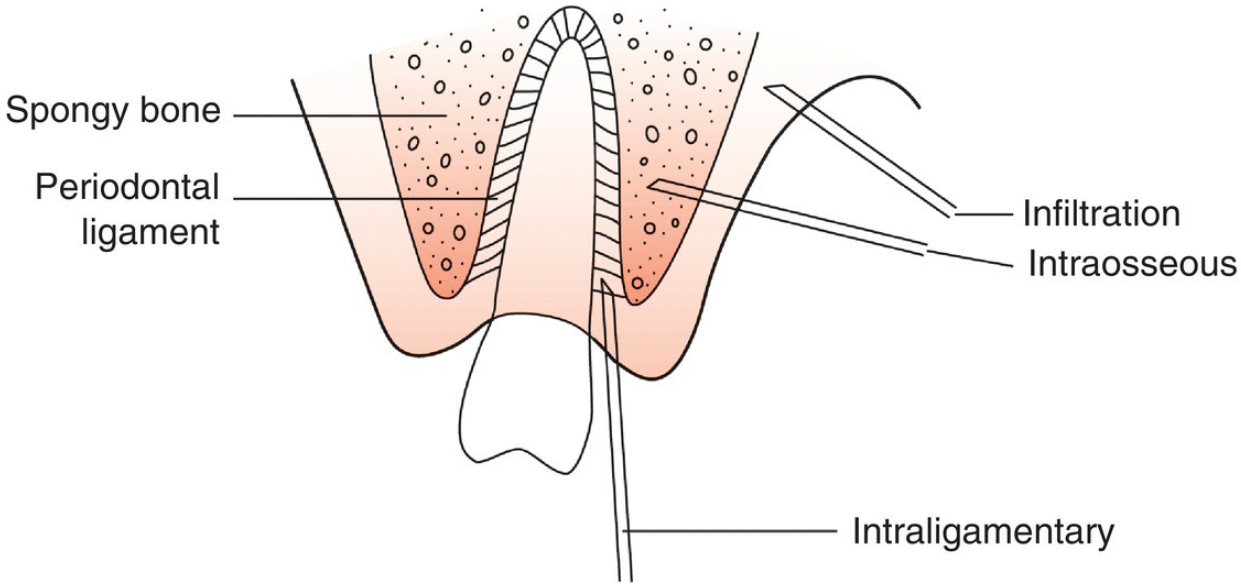


Figure 14.8 Three of the four types of injection technique.

See Chapter 9 for details of head and neck anatomy and cranial nerve distribution.

Nerve block

A nerve block is an injection which anaesthetises the nerve trunk (the main body of the nerve rather than its finer ends) as it runs in soft tissue, either before it enters the jaw bone or after it leaves it to reach the teeth and associated parts. Pain sensations from every part supplied by the nerve are blocked at the site of injection and cannot reach the brain. A nerve block is used when it is necessary to anaesthetise several teeth in one quadrant or where a local infiltration cannot work because the nerve ends are lying within bone.

The most common example of this type of injection is the *inferior dental block*. For this injection, the anaesthetic solution is injected over the mandibular foramen, on the inner surface of the ramus of the mandible (Figure 14.9). At this site the inferior dental and lingual nerves are so close to each other that both nerves are anaesthetised together. Thus it has the effect of anaesthetising all the lower teeth and lingual gum on the side of the injection, together with that half of the tongue as well. Furthermore, it anaesthetises the lower lip and buccal gum of the incisors, canine and premolars as these are

supplied by the mental branch of the inferior dental nerve. So once the patient confirms the numbness of the lower lip, the dentist knows that all the lower teeth on that side are numb too.

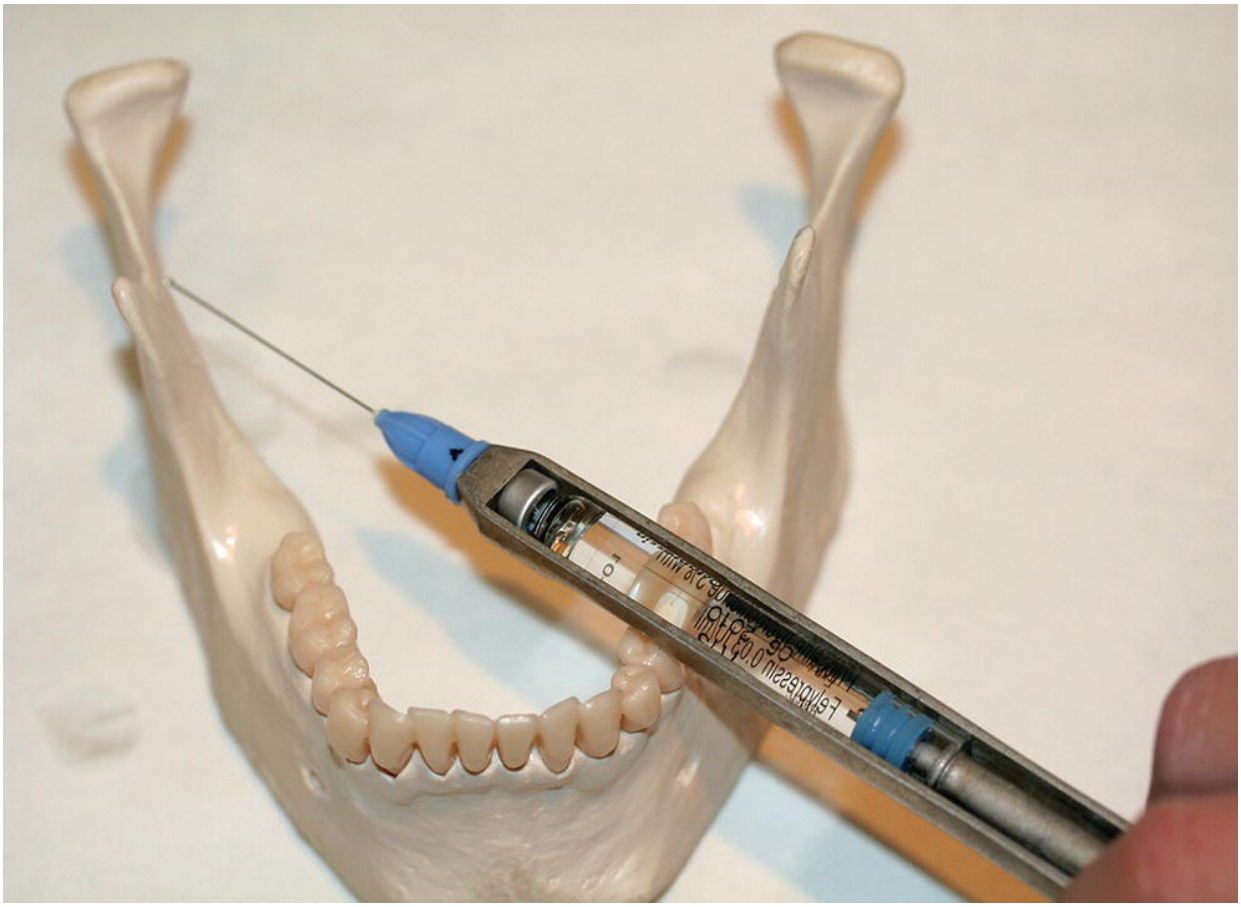


Figure 14.9 Inferior dental nerve block technique.

The only part unaffected by this injection is the buccal gum of the lower molars; this area of soft tissue is supplied by the long buccal nerve which is too far from the injection site to be affected. Again, the nerve supply of the oral cavity is covered in detail in Chapter 9.

Other nerve block injections that may be administered by the dentist are as follows:

- **Mental nerve block**: to anaesthetise the end portion only of the inferior dental nerve, as it leaves the mandible through the mental foramen, so that all but the molar teeth and their buccal or labial soft tissues are affected (Figure 14.10).

- **Posterior superior dental nerve block**: to anaesthetise this nerve before it enters the maxillary antrum, so that both the upper second and third molar teeth and their buccal gingivae are anaesthetised.

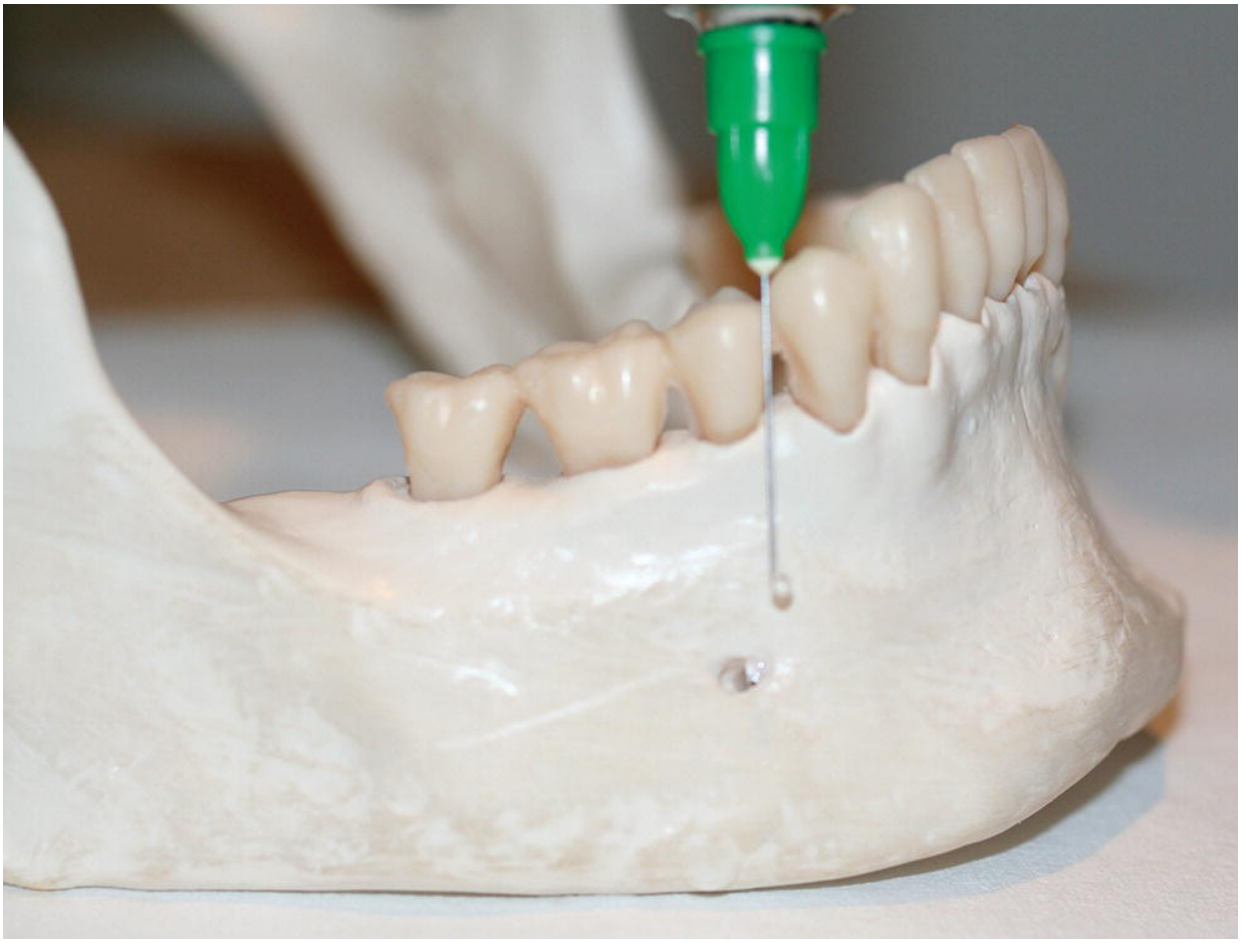


Figure 14.10 Mental nerve block technique.

The nerve block technique is useful in situations where an infection is present around a tooth requiring dental treatment, as it can be anaesthetised without risking the spread of the infection by placing the injection at a distance from the tooth involved.

As stated previously, the nerves tend to run as neurovascular bundles and an aspirating technique should be used during a block injection, to prevent the inadvertent placement of the cartridge contents into an adjacent blood vessel.

Local infiltration

A local infiltration injection is given over the apex of the tooth to be anaesthetised. The needle is inserted beneath the mucous membrane overlying the jaw bone. The anaesthetic soaks through pores in the bone and anaesthetises the nerves supplying the tooth and gum at the site of injection. Therefore, the difference between these two types of injection is that a nerve block applies the anaesthetic to the nerve trunk, whereas an infiltration applies it to the nerve endings.

A local infiltration injection can only be used where the compact bone is sufficiently thin and porous to allow the anaesthetic to penetrate into the inner spongy bone. Thus it is usually effective for all upper teeth, and for the lower incisor teeth. However, the compact bone overlying the mandibular premolars and molars is too thick and an inferior dental block or a mental block, respectively, is necessary for these. A local infiltration can always be used to anaesthetise the local gingivae only, as will be required for procedures such as extractions, where both the tooth and all its related gingivae require anaesthetising for the procedure to be carried out painlessly.

Intraligamentary injection

The intraligamentary injection technique tends to be used in conjunction with either an infiltration or a nerve block, to produce deeper anaesthesia around hypersensitive teeth. Various specialised syringes are available, which hold the smaller 1.8-mL anaesthetic cartridge within a protective plastic sheath (Figure 14.11). The force required to administer the cartridge contents is considerable, so a ratchet design of plunger is used to maintain the pressure, and the plastic sheath prevents injury if a glass cartridge shatters during use, as sometimes happens.

Figure 14.11 Ligmaject syringe with ratchet style plunger.

The anaesthetic is administered into the periodontal ligament of the tooth, and the surrounding gingivae can be seen to blanch as it takes effect. The technique is especially useful when a nerve block has failed to produce sufficient anaethesia of the tooth, but it cannot be used in the presence of gingival infection unless the tooth is being extracted. The force required for administration may also cause some postoperative soreness for the patient, and they should be advised of this at the time.

Intraosseous injection

An intraosseous injection is given directly through the outer cortical plate of the jaw and into the spongy bone between two teeth. A few drops of anaesthetic are first injected into the overlying gum to permit painless drilling of a small hole through the compact bone, to allow access for a needle to be inserted directly into the spongy bone (Figure 14.12).

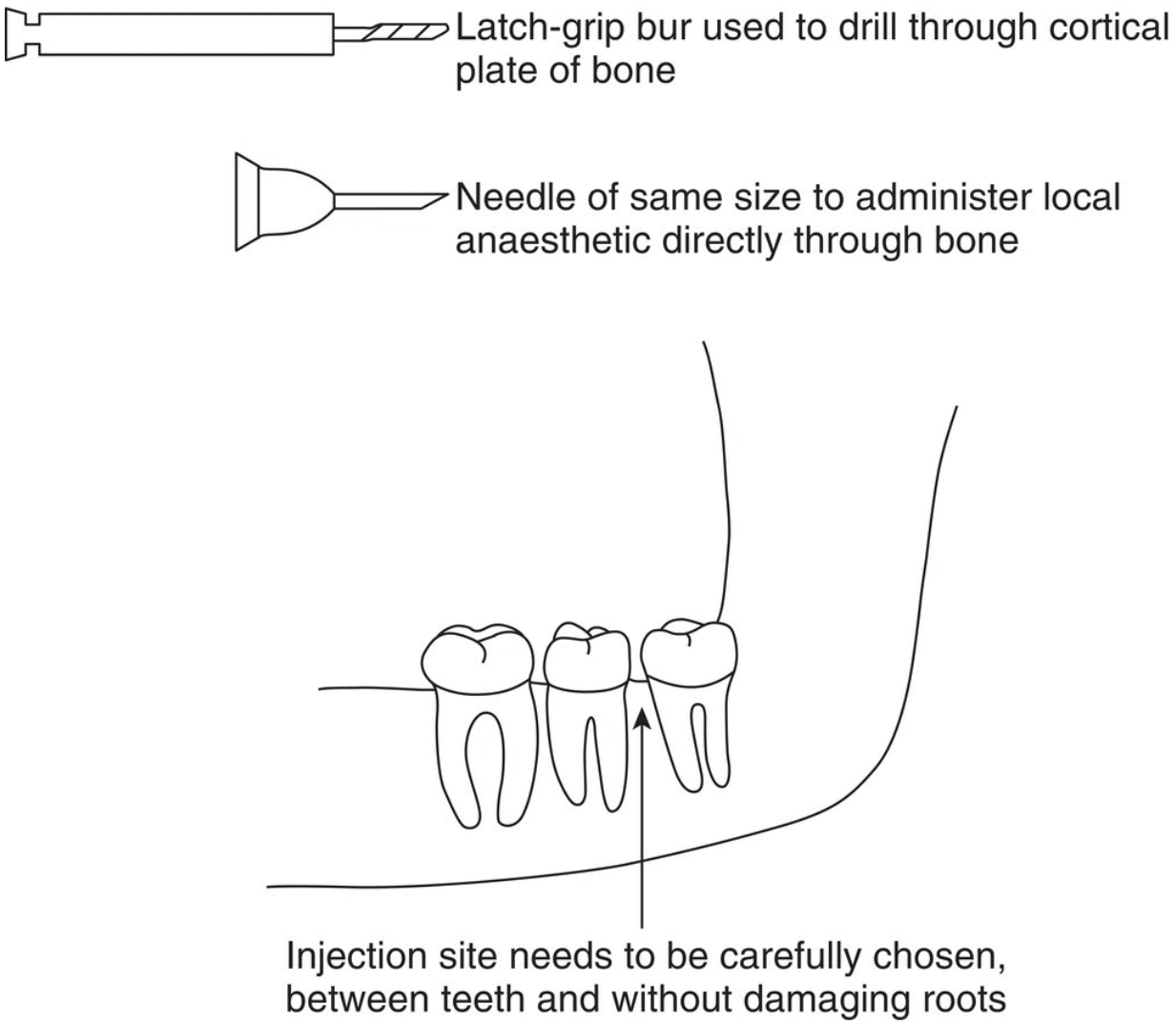


Figure 14.12 Intraosseous system.

This injection provides a relatively short duration, but profound depth, of anaesthesia for the tooth and buccal and lingual gum on either side of the injection site, but it does not numb the cheek, lip or tongue. This makes it an excellent method for extractions. Other advantages are that it works immediately and rarely fails, thus making it useful where an infiltration or block has been unsuccessful. The disadvantages are that it cannot be used where gingival (gum) infection is present, nor should it be used in the region of the mental foramen of the mandible, as the nerve could easily be damaged while the access hole is being drilled.

The technique is very old but has gained a new lease of life with the introduction of the Stabident kit, containing a special drill for

perforating the compact bone and a matching ultra-short needle for injecting directly into spongy bone.

Local anaesthesia for extractions

When a tooth requires extraction it is necessary to anaesthetise the surrounding periodontium as well as the tooth itself, as the periodontal ligament will be severed during the extraction procedure. The injections required for each tooth will be more readily understood by referring to the nerve supply of teeth.

Upper teeth

To anaesthetise any upper tooth for extraction, a local infiltration injection is given on both its buccal/labial and palatal sides. The buccal infiltration will anaesthetise the tooth and the buccal/labial periodontium, and the palatal injection will anaesthetise the palatal periodontium. It also helps to ensure sufficient anaesthesia of the tooth by infiltrating to the palatal root of the molars too.

For the second and third molars, some operators prefer to give a posterior superior dental block instead of a local infiltration on the buccal side. The nerve supply of the upper teeth and their gingivae is shown diagrammatically in Figure 14.13.

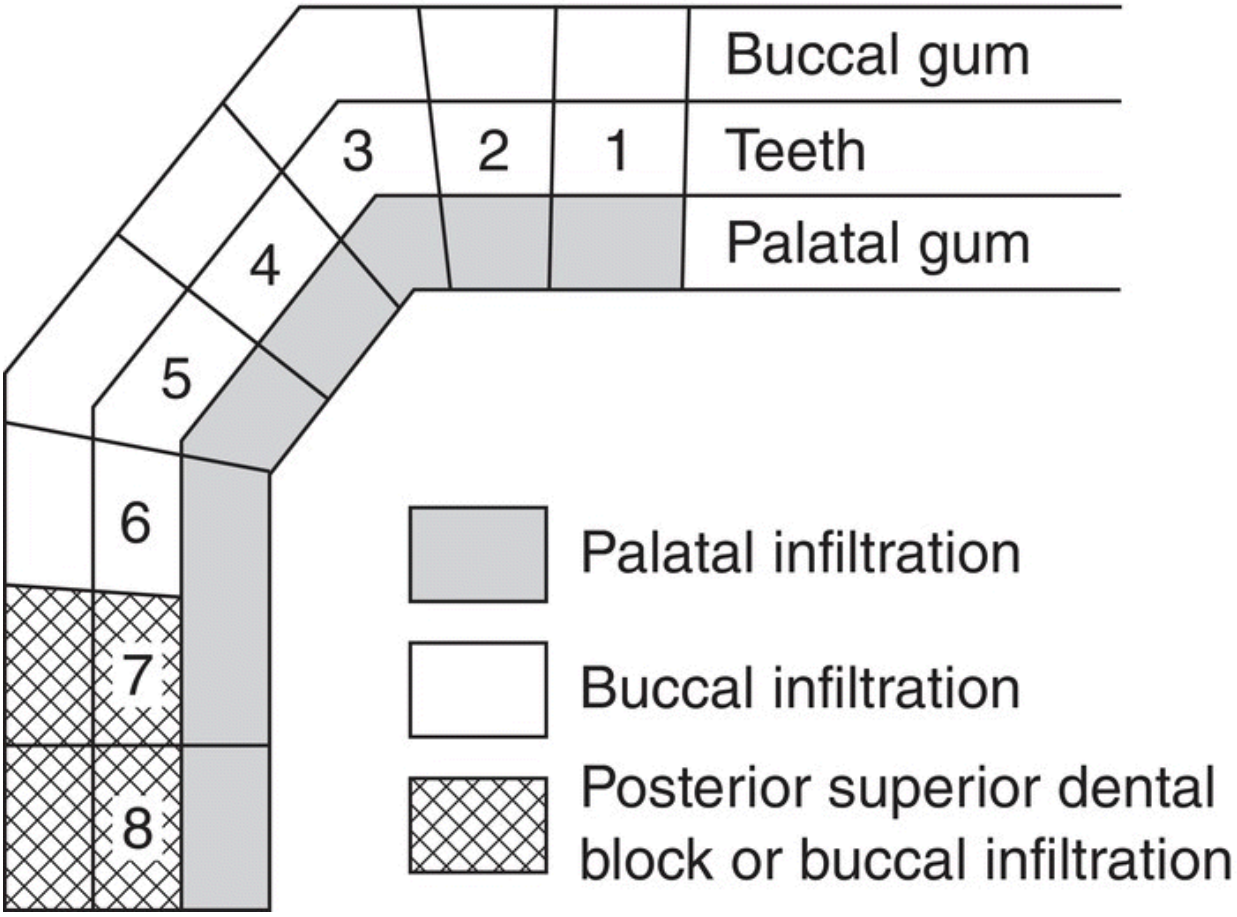


Figure 14.13 Injections for upper teeth.

Lower teeth

An inferior dental block injection blocks the lingual as well as the inferior dental nerve. This single injection will therefore suffice for the extraction of premolars, canine and incisors, as their buccal/labial periodontium is supplied by the end section of the inferior dental nerve, the mental nerve. Alternatively, the premolars, canine and incisors can be anaesthetised for extraction using a mental nerve block technique with a lingual infiltration against the necessary tooth, and many operators prefer this technique as it can be given more accurately than an inferior dental block.

For lower molars, whose buccal periodontium is supplied by the long buccal nerve, the inferior dental nerve block and an additional local buccal infiltration is required for full anaesthesia.

The compact bone in the incisor region of the mandible is sufficiently thin to allow the use of a labial and lingual local infiltration, and many operators prefer this technique rather than an inferior dental block for anaesthetising lower incisors. The nerve supply of the lower teeth and their gingivae is shown diagrammatically in Figure 14.14.

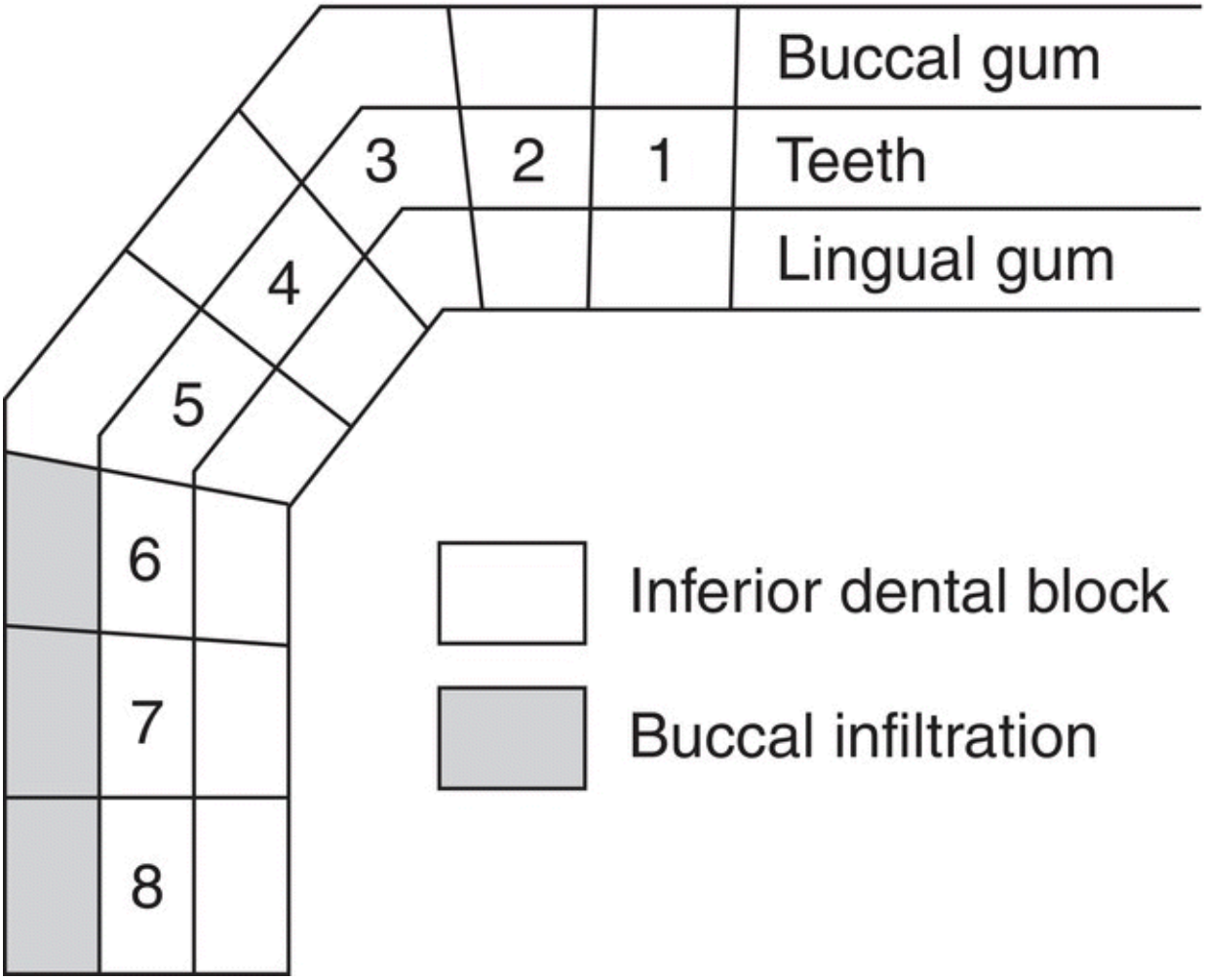


Figure 14.14 Injections for lower teeth.

Local anaesthesia for restorative treatments

It is unnecessary to additionally anaesthetise the palatal or lingual gingivae as well as the tooth and buccal/labial gingivae for restorative treatments, unless the gingivae in these areas need adjustment or removal as part of the restorative procedure. Examples of when this is necessary are listed below.

- A cavity has been present for some time and the gingiva has grown into the space present, so its removal is necessary to ensure that the filling material is fully adapted to the cavity walls.
- A crown lengthening technique is required during tooth preparation for fixed prosthodontics. Its adjustment is necessary to allow for a lengthened tooth preparation so that adequate retention of the restoration is achieved, or to achieve good aesthetics.
- A crown has been lost and the remaining root face has been covered by gingival overgrowth. Its removal is required to ensure an accurate impression is taken so that the new restoration fits the root face adequately.

Upper teeth

A local buccal/labial infiltration is enough for routine restorative treatments, although a posterior superior dental block is sometimes preferred for the second and third molars.

Lower teeth

An inferior dental block will anaesthetise every lower tooth, while a mental block may be used when treatment involves any tooth other than the lower molars. For restorative treatment involving just the lower incisors, a local labial infiltration will suffice instead of a full nerve block technique.

Preparation for local anaesthesia

All cartridges and needles are supplied by their manufacturers presterilised and ready for use. Reusable metal syringes are sterilised as usual in an autoclave. The newer 'safer sharps' style syringes (see Figure 14.4) are single use and must be disposed of in the sharps bin after use.

A long needle of 27 gauge is used for a nerve block. For local infiltration, a short needle of 30 gauge is usually preferred. Although needles rarely break during an injection, precautions must still be taken to deal with such accidents immediately. A suitable pair of artery forceps (such as Spencer Wells or mosquito forceps) should

always be available to grasp and remove the broken end; these instruments are often located within a surgical kit.

A topical surface anaesthetic is applied for a few minutes on a cotton wool roll while the local anaesthetic equipment is prepared for use. The required cartridge is loaded into the syringe and then the smaller plastic guard at the syringe end of the needle is removed so that it can be screwed onto the syringe hub. When an aspirating technique is to be used, those syringes with a screw-type plunger will need the device screwing into the cartridge bung *before* the needle is attached, otherwise the cartridge contents will be partially ejected as it is screwed in with the needle already attached.

Injection of cold solutions can be painful, so cartridges should not be stored in a refrigerator but kept at room temperature. The injection site may be dried and disinfected by applying a suitable disinfectant, such as chlorhexidine or iodine, on a pledget of cotton wool for 15 seconds. This disinfection procedure is not routinely carried out before administering a local anaesthetic for general dental treatment, but is more likely to be done during large surgical procedures, such as implant insertion or maxillofacial treatments. The injection is now given and the needle guard refitted immediately by the operator, using a suitable resheathing device (Figure 14.15) to avoid an inoculation injury. The used cartridge and needle are disposed of safely in accordance with the hazardous waste regulations. Both are classed as infectious hazardous waste, subcategory ‘sharps’, so they must be deposited in the sharps bin.

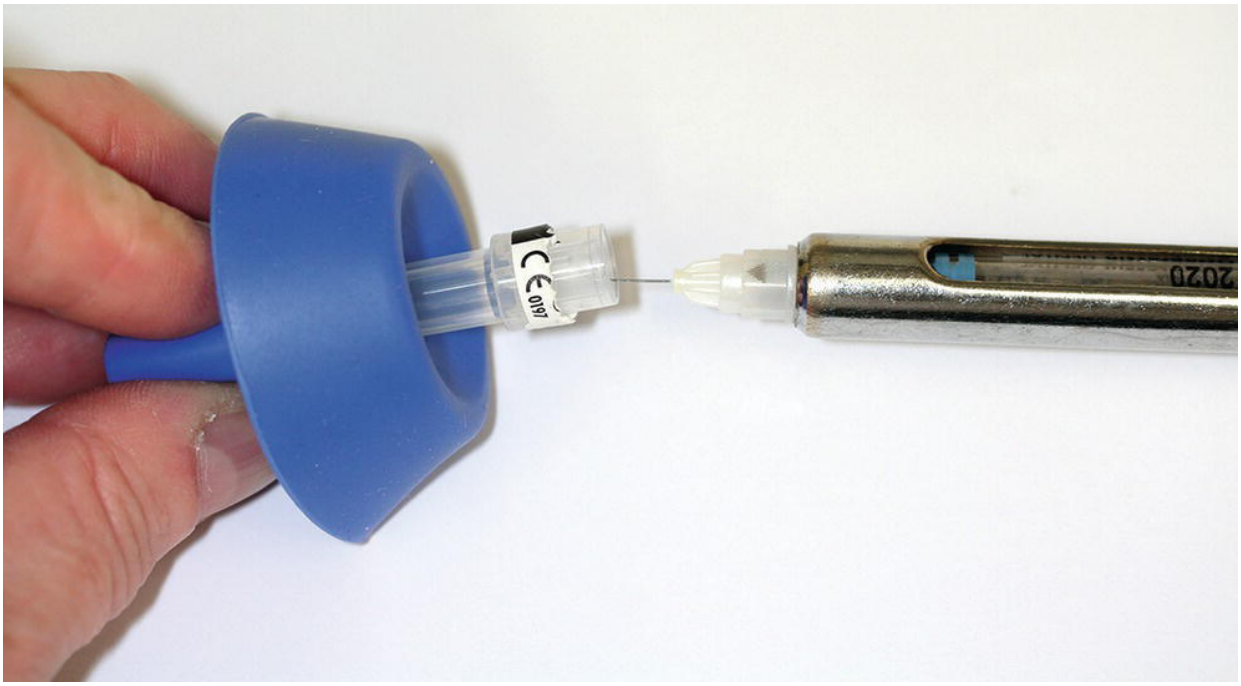


Figure 14.15 Resheathing using needle guard device.

When a ‘safer sharps’ style device is used, this is deposited whole directly into the sharps bin after use, by the operator.

Inoculation injury

The used needle is a very real source of cross-infection, as it has pierced the patient’s tissues and will be contaminated with blood (and possibly micro-organisms), no matter how small the amount. Resheathing of the needle is the most common cause of inoculation (needlestick) injuries to the dental team, and various needle guard devices have been designed to lower their incidence (Figure 14.15). The team member who administered the local anaesthetic should always take responsibility for resheathing the needle personally, to reduce the number of potential injured persons involved. Alternatively, and in accordance with the Sharp Instruments in Healthcare Regulations 2013, all nerve block and infiltration administrations can be given using one of the ‘safety’ syringes now available, which have an easy-use cover to slide over the needle from behind, once the anaesthetic has been delivered (Figure 14.16). This removes the need for anyone’s fingers to be close to the needle tip during resheathing. However, these devices are currently unavailable

for use when administering intraligamentary or intraosseous injections. Although the use of ‘safety’ syringes is not compulsory, each operator must carry out a risk assessment to determine if the continued use of the old-style syringes is safe and appropriate in their particular circumstances. The risk assessment and its results must be recorded and reviewed periodically to ensure the chosen technique remains appropriate.

Figure 14.16 Easy-use cover sliding over needle of ‘safety’ syringe.

If a contaminated needlestick injury does occur, the following actions must be taken:

- Stop working immediately, so that the patient and other team members are not contaminated and the potential for cross-infection to occur is minimised.
- Do not squeeze the wound but encourage bleeding, ideally under running warm water to slow down clotting at the wound site and increase the volume of potentially contaminated blood expressed from the wound.
- Under no circumstances should the wound be sucked to encourage bleeding, as this will increase the chance of cross-infection by pathogens still further.
- The wounded area should then be cleaned with disinfectant soap, dried, and covered with a waterproof dressing.
- The senior team member should be informed of the incident.
- The patient’s medical history form should be checked for known cross-infection risks, such as being HIV positive.

- If necessary, the matter should be reported to the occupational health advisor (OHA) at the local hospital, and any advice given should be followed immediately.
- The contact details of the OHA should be stored in the infection control policy documentation.
- The written sharps injury policy and actions to take should be displayed at every point in the workplace where sharps are used or handled, so wherever a sharps bin is located, the written policy should also be present.
- The incident should be recorded in the accident book (if there is only a low risk of serious infection) or a RIDDOR report should be written (if there is a high risk of serious infection) and the RIDDOR process followed.

Patient advice following local anaesthesia

Patients need to be informed of the expected effects they will experience after receiving a local anaesthetic, especially if it is their first injection. Otherwise, they may be unduly concerned at what they feel, or even inadvertently injure themselves by not realising the extent and depth of their anaesthesia.

- Sensation will be lost in the affected area for several hours. This varies between patients but usually lasts at least 2 hours when a local anaesthetic containing a vasoconstrictor has been used.
- During this time, they should not attempt to eat, drink or smoke as they may bite or burn themselves without realising.
- Chewing food should be avoided directly onto the teeth restored that day, to prevent damaging the new restoration (unless the dentist has said otherwise).
- When the anaesthetic is wearing off, they will feel a 'pins and needles' sensation in the area. This is called **paraesthesia** and is perfectly normal.
- They should wait for this 'pins and needles' sensation to completely wear off before attempting to eat or drink.

- Nerve block techniques may cause a localised tenderness of the soft tissues.
- Intraligamentary techniques may cause soreness of the surrounding gingivae.
- Contact the surgery if any problems persist.

Anxiety control

Some patients exhibit high levels of anxiety at the thought of undergoing any form of dental treatment, often due to a previous bad experience that may have occurred many years ago. The fear that all future dental treatment will be painful tends to stop these patients from attending for preventive care and regular treatment, and instead they usually book in as irregularly attending emergency patients with often serious oral problems.

Other patients will attend routinely for oral health assessment and preventive treatment, but will only undergo dental treatment (or at least certain aspects of it, such as an extraction) if they are able to have some form of anxiety control technique throughout the procedure. The two main types of anxiety control available are as follows:

- **General anaesthesia**: only performed in the hospital setting.
- **Conscious sedation**: can be performed in any suitably equipped dental workplace, as well as in dental hospitals and community clinics, and involves the following techniques:
    - **Oral sedation**.
    - **Inhalation sedation**.
    - **Intranasal sedation**.
    - **Intravenous sedation using single drug or multiple drugs**.

A separate technique of anxiety control, where the patient self-administers a small dose of an oral sedative prescribed by the dentist, is called **oral premedication**. The dose is usually taken at home by the patient rather than at the dental workplace, and often produces a sufficient level of anxiety control to allow routine dental procedures to be carried out without any further sedation.

This is a different technique to oral sedation, where a much larger dose of an oral sedative is taken at the dental practice, under the supervision of a dentist who is also competent in intravenous sedation. The level of sedation that occurs with oral sedatives varies

considerably between patients, and cannot be controlled once the dose has been ingested, unlike intravenous and inhalation sedation techniques. Consequently, the technique should be restricted to incidents where intravenous or inhalation techniques cannot be used. The monitoring and discharge requirements for oral sedation are the same as for intravenous sedation (see later).

General anaesthesia (GA) is a state of unconsciousness with complete loss of feeling and loss of the reflexes that normally protect and maintain the airway, such as the cough and gag reflexes. In the dental chair, the technique involved anaesthetic delivery via a nasal mask and was formerly used mainly for short procedures such as extractions (especially of the deciduous teeth in children), and the incision and drainage of abscesses. In the interests of patient safety this technique is now confined to the dental hospital setting only, where advanced levels of life support and suitably qualified staff are available on a daily basis.

Conscious sedation is a state of conscious relaxation which enables prolonged treatment to be carried out under local anaesthesia. It is used for patients who are otherwise too nervous to tolerate dental treatment. The patient remains conscious and completely relaxed throughout and retains all their protective reflexes against blockage of the airway. It is used mainly for long procedures such as the fitting of implants and multiple restorative treatments.

Some categories of special needs patients receive dental treatment under intranasal sedation but, again, the technique does not allow for the level of sedation achieved to be controlled and should only be used by competent staff and where the use of intravenous or inhalation sedation is inappropriate. Other patients who are too uncooperative to accept nasal mask general anaesthesia or sedation techniques can be treated in suitably equipped hospital premises, with critical care facilities, under *endotracheal anaesthesia*. This is the general anaesthetic method normally used in hospitals.

Other methods of anxiety control that do not rely on drugs to alter the patient's state of mind are:

- **hypnosis**
- **acupuncture**.

Whichever method of anxiety control is used, the dental treatment performed will be as for any other patient, and a dental nurse will be required to assist and carry out their usual chairside duties throughout.

For those nurses with an interest in intravenous or inhalation sedation and/or special care dental nursing, post-registration qualifications are available in both areas via the NEBDN. Details are available at www.nebdn.org.

General anaesthesia

Endotracheal anaesthesia involves delivery of the anaesthetic gas mixture directly into the lungs through a *nasotracheal tube*. The anaesthetist passes the tube through a nostril, along the floor of the nose, into the nasopharynx. From here, using a special instrument called a *laryngoscope*, the tube is guided by direct vision through the larynx and into the trachea. The oropharynx can then be packed with gauze to prevent any foreign bodies, blood, saliva or debris entering the airway.

The advantages of endotracheal anaesthesia are that it gives the anaesthetist complete control over the airway, with no danger of obstruction, and allows use of any resuscitative measures which may be needed, while for the operator it provides perfect anaesthesia with a clean, dry field of work for as long as required.

Referral for general anaesthesia

From time to time, some patients will need to be referred to the oral and maxillofacial surgery department of the local hospital to undergo treatment under general anaesthetic. Special arrangements must be made for these patients that will vary according to the local facilities, but there are strict guidelines for referral cases that must be followed at all times. In particular, no referral will be accepted where attempts at providing treatment under local anaesthesia have not been offered initially in the dental workplace setting.

The referral guidelines are as follows:

- The referral letter must justify the use of GA and give the relevant dental and medical history of the patient.

- The hospital dentist treating the patient must be satisfied that GA is necessary and appropriate for the patient, and that a thorough and clear explanation of the risks and alternative options has been given.
- When the decision to provide such treatment has been agreed by the patient, the treating dentist and the anaesthetist, the patient's written consent must be obtained.
- Clear and comprehensive written preoperative and postoperative instructions must be provided, and detailed records kept of all the dental procedures undertaken.
- The treating dentist must be satisfied that the facilities for such treatment, and the experience and training of the dental nurse, comply with the appropriate professional requirements.
- Adequate patient monitoring, emergency and critical care facilities and trained staff must be available in case of emergency, and these arrangements must be agreed and documented as available by all concerned.
- Adequate recovery facilities and trained staff must be provided for patients recovering from GA. They must be monitored continuously until pronounced fit for discharge by the anaesthetist, and provided with written postoperative instructions, before leaving with a responsible adult escort.
- All the team involved in dental treatment under GA must train together for dealing with emergencies, and practise such emergency procedures on a regular, and documented, basis.

The usual reasons for GA referral from a dental workplace to a hospital department are as follows:

- Young patients who require one or several extractions of deciduous or permanent carious teeth, and who will not co-operate under local anaesthesia or conscious sedation techniques.
- Older patients who require multiple third molar extractions, especially if a surgical technique is likely to be required for one or more teeth, due to impaction.

- Older patients with severe dental infection, where local anaesthesia cannot be used safely without risking the spread of the infection.
- Patient request, although this is for extraction only, not for restorative treatment.

Conscious sedation

Conscious sedation has replaced general anaesthesia as a method of pain and anxiety control in general dental practice. Guidelines have been in place for the safe delivery of conscious sedation in the dental setting since 2003, and the current national standards expected of all those providing conscious sedation services are set out in the publication *Standards for Conscious Sedation in the Provision of Dental Care 2015*. This has been produced as a report by the Intercollegiate Advisory Committee for Sedation in Dentistry, and is available at www.rcseng.ac.uk. It lays out the national standards required in the following areas:

- Education and training for each role (dentist, dental nurse, etc.).
- Environment where conscious sedation is provided, including necessary equipment.
- Level of reassessment and evaluation of skills to ensure that competencies are maintained, using specific CPD events.
- Use of audits and reflection to ensure continual learning and improvement occurs.

The report states that all staff new to the provision of dental care under conscious sedation must undertake formal postgraduate training in the various techniques, with dental nurses expected to study for and gain the NEBDN post-registration certificate in Dental Sedation Nursing. An excellent companion textbook for this course is available (*Basic Guide to Dental Sedation Nursing*, N. Rogers, 2011, Wiley-Blackwell). The combined course is under review with regard to offering a post-registration qualification in either intravenous sedation or inhalation sedation, rather than both together, but the textbook will still be relevant.

In the transitional phase of the new standards coming into place, it is accepted that a system of 'grandfathering' is necessary where those experienced dentists who have provided regular dental care under conscious sedation for some time can continue to do so, without acquiring a postgraduate qualification first, in order to maintain a service for patients. However, they and their team must comply with all the other guidance in the report, as follows and as described later.

- Maintain a written/electronic log of all sedation cases undertaken.
- Undertake 12 hours of relevant CPD per 5-year cycle, via an accredited training course.
- Undertake sedation-based audit and reflection regularly.
- Maintain competency in appropriate 'rescue' skills: for those carrying out intravenous sedation this is immediate life support (ILS) rather than BLS, so involves training in the use of nasopharyngeal airways and supraglottic airway devices (see later).
- Environment and equipment must meet those stated as requirements in the report.
- Ensure that appropriate clinical governance is in place to comply with the standards set out in the report.

Conscious sedation may be defined, in simple terms, as a technique that uses one or more drugs to induce a state of relaxation that:

- is sufficient to allow the injection of local anaesthetic so that the required dental treatment can be carried out
- allows verbal contact with the patient to be maintained throughout the procedure
- allows the patient to remain conscious throughout the procedure, and able to understand and respond to commands from the dental team
- ensures that the patient retains their protective airway reflexes.

Normally in the dental surgery, long procedures such as multiple or complex restorations are done under local anaesthesia, but some patients are too nervous or otherwise unco-operative to tolerate this. In such cases, sedation techniques may be used to provide prolonged painless operating time on a relaxed patient. The three methods of conscious sedation available for use in dental practice are as follows:

- **Oral sedation**: a large sedative dose in tablet form of an anxiolytic drug such as midazolam or temazepam is given at the dental workplace, but usually only when inhalation or intravenous sedation techniques cannot be used.
- **Inhalation sedation** (formerly known as 'relative analgesia'): the patient breathes a controlled mixture of nitrous oxide and oxygen through a nasal mask for the duration of the dental appointment.
- **Intravenous sedation**: a single drug (midazolam) is injected into the patient's vein in a controlled manner, so that their anxiety is reduced sufficiently for dental treatment to be carried out.
- **Intravenous sedation:** using two drugs, either a small dose of an opiate-based drug (usually fentanyl) followed by a controlled dose of midazolam, or a controlled dose of midazolam with 'top-up' doses of propofol, both to produce longer periods of sedation and especially in patients who do not sedate sufficiently with midazolam alone. Either technique requires a dedicated sedationist with specific training in multiple-drug sedation techniques, rather than the dentist acting as both sedationist and operator.

The advantages of using simple sedation techniques with suitable patients are:

- patients remain conscious and co-operative throughout the session
- they retain their protective reflexes against blockage of the airway

- there is no need for a long period of starvation beforehand, as with GA
- a separate anaesthetist is not required for all techniques except those involving more than one intravenous drug administration, as in simple cases the suitably trained dentist can act as both the sedationist and the dental operator.

However, the GDC has issued strict guidelines concerning the levels of experience and training expected of all surgery staff involved in delivering dental treatment under sedation techniques, as well as the records that must be kept.

- A full medical and dental history must be taken before using or referring for conscious sedation.
- The type of sedation proposed must be explained to the patient, and appropriate alternatives given.
- Written preoperative and postoperative instructions must be provided and written consent obtained, before the procedure is carried out. A suitable intravenous sedation consent form with instructions is shown in Figure 14.17.
- Adequate records must be kept during the procedure of the technique and drugs used. A suitable monitoring sheet for intravenous sedation is shown in Figure 14.18.
- As in all dental treatment, the dentist must only proceed within the limits of their own knowledge, training, skill and experience.
- A dentist who undertakes the dual responsibility of administering the sedation injection and providing the dental treatment must have completed relevant postgraduate education, training and CPD.
- They must ensure that the most appropriate type of sedation is used, and that the minimum amount of drug is administered to achieve a suitable level of conscious sedation for the dental treatment to be carried out.
- A second appropriately trained person must be present throughout the procedure to assist the dentist and be capable of

monitoring the condition of the patient, as well as assisting in any complication that may arise and acting as chaperone.

- Such a person would ideally be a dental nurse who holds the NEBDN Certificate in Dental Sedation Nursing, although a qualified and experienced dental nurse without this additional post-registration qualification is also currently acceptable in this role.
- Where a second medical or dental practitioner is administering the sedation, the treating dentist must ensure that the sedationist complies with the GDC guidelines already stated.

INFORMATION FOR PATIENTS UNDERGOING
INTRAVENOUS SEDATION

The technique of sedation by injection in the arm will relax you during your dental treatment. You will not go to sleep. You will be pleasantly drowsy, but able to talk and reply to questions. You may not be able to remember much about the treatment afterwards.

Make sure you advise the dentist of any changes in your medical history, including any medicines you are taking or any visits to your doctor.

The following advice will help you benefit most from this anxiety control technique:

ON THE DAY OF TREATMENT

- Please attend with a responsible adult escort, who is able to take you home and look after you once you have been discharged by the dentist
- Have a light meal a few hours before your appointment; such as toast and a cup of tea – you do not need to be starved for the sedation procedure
- Take any usual medicines at the usual times, unless otherwise directed by the dentist
- Do not drink any alcohol
- Do not wear make-up or nail varnish
- You will be asked to pay for the dental treatment scheduled to be carried out at the appointment before you are sedated – once sedated you will be under the influence of a drug and cannot pay otherwise until the effects have worn off

FOR 12 HOURS FOLLOWING TREATMENT

- Travel home with your escort by car, or a taxi will be arranged – you cannot travel home unescorted or by using public transport
- Stay resting quietly at home while supervised by your escort
- You MUST NOT do any of the following, for your own safety;
    - Use any complex machinery, including a cooker or power tools
    - Drive a motor vehicle – you are under the influence of a drug and are liable to prosecution if caught
    - Return to work that day
    - Sign any legal or business documents, or make any similar important decisions
    - Drink alcohol

HAVING HAD THE SEDATION PROCEDURE EXPLAINED TO ME, I GIVE MY CONSENT TO UNDERTAKE THE DENTAL TREATMENT I REQUIRE (AS SCHEDULED IN MY TREATMENT PLAN) UNDER INTRAVENOUS SEDATION.

I HAVE READ AND UNDERSTOOD THE ABOVE INFORMATION AND AGREE TO FULLY COMPLY WITH THE INSTRUCTIONS GIVEN.

Signed_____ Date_____

Figure 14.17 Example of an intravenous (IV) sedation consent form.

IV SEDATION SESSION RECORD

NAME: DATE:

IV DRUG	EXPIRY DATE	BATCH NUMBER	INCREMENTS		TOTAL DOSE
MIDAZOLAM			FIRST	LAST	ml

MH checked:

ASA: I or II

VENOUS ACCESS?	SITE	CANNULA
YES DIFFICULT NO	ACF HAND WRIST	23G BUTTERFLY 22G VENFLON

MONITORING TIME	OXYGEN SATURATION	PULSE	BLOOD PRESSURE

RECOVERY SITE	SURGERY ON DENTAL CHAIR		
FIT FOR DISCHARGE	WALK	TALK	LISTEN
POST-SEDATION INSTRUCTIONS	TO ESCORT VERBAL WRITTEN		
TIME OF DISCHARGE			
CLINICIAN NURSE			

Figure 14.18 Example of an intravenous monitoring sheet.

Conscious sedation guidelines and clinical governance (see Chapter 3) also require that:

- the technique must only be used when suitable equipment, facilities and drugs are immediately available at the chairside for treating complications
- all clinical staff are trained, practised and regularly updated to act as a team when using sedation techniques, monitoring patients and managing related complications
- supervision and monitoring of patients must be continued in the recovery area until the dentist decides they are fit for discharge, into the care of a responsible adult escort who has been provided with the written postoperative instructions.

Oral premedication and oral sedation

Some people are so frightened of experiencing pain while undergoing dental treatment, or even of just undergoing dental treatment itself, that they are unable to sleep beforehand or to co-operate adequately in the dental chair. Such patients can be relieved of their anxiety by the self-administration of a small dose of an anxiolytic drug such as temazepam or diazepam, taken orally as a tablet. It is usual for the patient to take the tablets at home, as a small dose (say 5 mg) taken the night before the dental appointment, and a second similar dose taken 1 hour before the appointment. This is called *oral premedication* and the technique may be used before any form of dental treatment, with or without local anaesthesia or conscious sedation being given at the dental practice. The oral premedication technique is particularly useful in reducing the gag reflex when impressions are required.

Oral sedation involves the administration of much larger doses of a sedative tablet (usually midazolam) at the dental practice on the day of treatment, under the supervision of the dentist. The effect of the tablet dose on the patient cannot be known beforehand, nor can it be controlled in the same way as inhalation and intravenous drugs can be, so the technique of oral sedation should only be used when these other techniques are unsuitable for the patient. The patient is far less

sedated than with the other techniques, as the tablets are partially absorbed in the digestive tract rather than affecting the central nervous system to produce adequate sedation. However, a suitable escort must still be available for the patient, and they must be monitored using a *pulse oximeter machine* (Figure 14.19) and assessed for discharge in the same way as for intravenous sedation. The pulse oximeter machine is connected to the patient by a finger probe, and records their pulse rate and oxygen concentration levels in the blood; some can also be used to read the patient's blood pressure. If either the pulse rate or oxygen levels deviate from the normal parameters set on the machine, an audible alarm will go off and dental treatment must cease while the patient is attended to.

Figure 14.19 Example of a pulse oximeter machine with blood pressure reading facility.

Inhalation sedation

This is the safest and best sedation method for children under the age of 16 years. It uses a gaseous mixture of *nitrous oxide* (N_2O) and

oxygen (O_2). Nitrous oxide is a powerful analgesic gas that is supplied in light blue cylinders. Medical oxygen is supplied in black cylinders with a white top. These gases are administered through an autoclavable or disposable nose mask, called a *nasal hood* (Figure 14.20), from a special anaesthetic-type machine that prevents overdosage of nitrous oxide by limiting its maximum concentration to 50% and the minimum oxygen level to 30%. The technique was formerly known as relative analgesia.

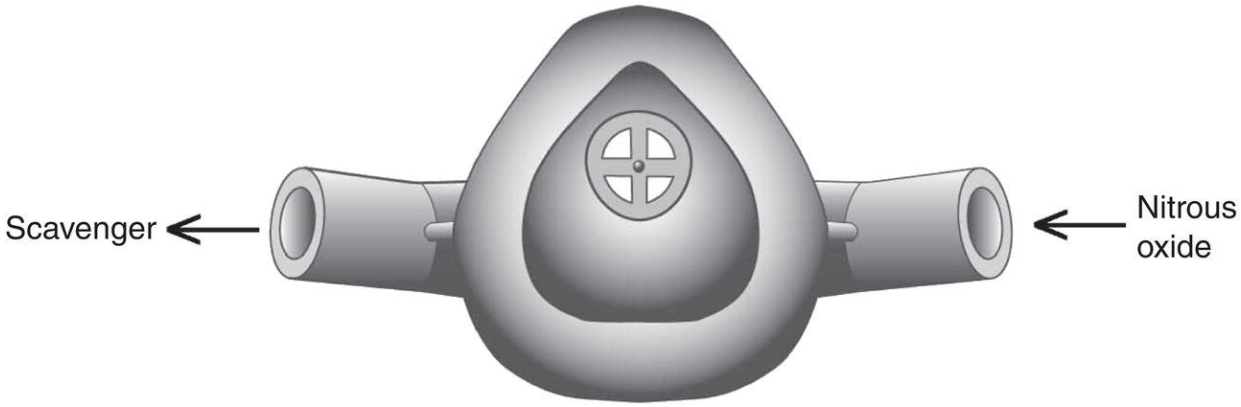


Figure 14.20 Nasal hood.

Sedation and analgesia are obtained by continuous inhalation of nitrous oxide and *at least* 30% oxygen. Apart from a small minority of cases, the degree of analgesia (lack of pain sensation) is insufficient to allow dental treatment without pain control, but the patient is sufficiently sedated to accept routine local anaesthesia.

Before the patient enters the surgery and the sedation session begins, the following checks are made:

- All the sedation equipment is working satisfactorily, with full gas cylinders, spare gas cylinders, resuscitation kit and the scavenging system ready for use.
- The patient's records have been read again, and the treatment plan is clear.
- An adult escort has accompanied the patient.
- All the preoperative instructions have been obeyed by the patient.

- The patient is not suffering from a cold or any other condition that may affect their ability to breathe through their nose.

The patient may then be shown into the surgery and seated, so that the treatment procedure can be explained and any questions answered. The patient is then lowered into the supine position and shown how to fit the nasal hood, and is then praised and encouraged throughout the whole of the following procedure:

- 100% oxygen is given at first, to allow the patient to familiarise themselves with wearing the nasal hood and breathing through it correctly, rather than breathing through their mouth.
- The flow gauge is adjusted to allow a first, 10% increment of nitrous oxide to be administered.
- The patient is told to expect pleasantly relaxing feelings as a 5% increment is then added. By altering the volume and tone of the voice while talking to the patient during the sedation, an element of hypnotic suggestion can also be used to enhance the sedative effect of the nitrous oxide.
- Further increments of 5% nitrous oxide are added until the patient is relaxed enough to accept a local anaesthetic injection, and then to undergo the required dental treatment.
- When the treatment is complete and the patient is ready for sedation to be discontinued, the nitrous oxide is switched off and replaced by 100% oxygen for 2 minutes to allow the inhaled nitrous oxide to be fully dispelled from the lungs.
- During this stage the patient remains receptive to more praise and positive suggestion concerning future treatment.
- Finally, the patient is asked to remove the nasal hood and the dental chair may then be gently raised to an upright position.

After 10–15 minutes the patient should be ready to leave the surgery, but must stay in the company of the escort for another 15 minutes before being discharged from the premises with the following instructions for the next 12 hours:

- Do not drive.

- Do not operate machinery.
- Do not drink alcohol.
- Do not sign legal documents.

The advantages of inhalation sedation over other forms of conscious sedation or GA are as follows:

- Patients may have a light snack up to 2 hours beforehand.
- Patient recovery is rapid (about 15 minutes) because the sedative drug is exhaled out of the lungs and does not become absorbed into the body.
- Electronic monitoring with a pulse oximeter is not required, but the pulse and respiration must still be checked manually by the team during the procedure.
- It is the safest and simplest form of conscious sedation, and is the best method for use with children.

The disadvantages of inhalation sedation are as follows:

- Safe delivery of the gaseous mixture requires a special inhalation sedation machine (e.g. Quantiflex MDM), which prevents less than 30% oxygen, and more than 50% nitrous oxide, from being given at any time. A normal GA machine cannot be used instead.
- The technique necessitates an active **scavenging system** for exhaled nitrous oxide, so that this is forcibly removed from the surgery area rather than being left to accumulate there, where it will be inhaled by the dental team during the working session.
- Passive scavenging, where the gas was allowed to dissipate from the area naturally, is no longer considered acceptable.
- COSHH regulations must be followed with regard to the maximum number of hours that staff can work with the gases, as overexposure carries significant risks to their health.
- In common with most other types of drug treatment, neither inhalation sedation nor intravenous sedation should be given in the first 3 months (trimester) of pregnancy.

- Pregnant staff should not be involved in the care and treatment of patients undergoing inhalation sedation.
- However, inhalation sedation is suitable for most patients with heart disease and high blood pressure as it reduces their stress levels.
- Nitrous oxide is addictive, so overuse or drug abuse by members of the dental team may be a problem.

A typical treatment session under inhalation sedation is shown in Figure 14.21.

Figure 14.21 Inhalation sedation session.

Intravenous sedation using a single drug

This technique gives a more profound level of conscious sedation than is achieved with inhalation sedation, and is more suitable for extensive dental procedures and for those procedures that provoke high levels of patient anxiety, such as surgical extractions.

A single sedative drug such as midazolam (Hypnovel) is injected intravenously, that is, into the patient's vein, in a controlled manner. Although it does not produce anaesthesia or analgesia, the drug acts on special receptors in the brain to provide patient relaxation that is sufficient to allow them to accept the administration of a local anaesthetic. Intravenous (IV) sedation produces *amnesia* (loss of memory of the procedure) and is suitable for patients over 16 years of age. A light meal is allowed, but not less than 2 hours beforehand.

The injection is usually given into a vein on the top (dorsum) of the hand or into one lying in the hollow of the elbow (antecubital fossa), and the plastic tube of the cannula remains in the vein throughout the procedure, in case any emergency drugs have to be given. The procedure of injecting the drug directly into a vein is called *venepuncture*. Several types of cannula are available to carry out venepuncture, although the preferred technique involves the use of a Venflon (Figure 14.22). The drug is administered to the patient in timed dose increments, so that the effect of each dose can be assessed for its sedative effectiveness before any more is given. This process is called *titration* and ensures that the patient does not become overdosed and fall into unconsciousness. The ability to titrate the dose during both intravenous and inhalation sedation sessions allows a controlled level of sedation to be achieved, and therefore makes both techniques much safer for the patient than oral sedation.

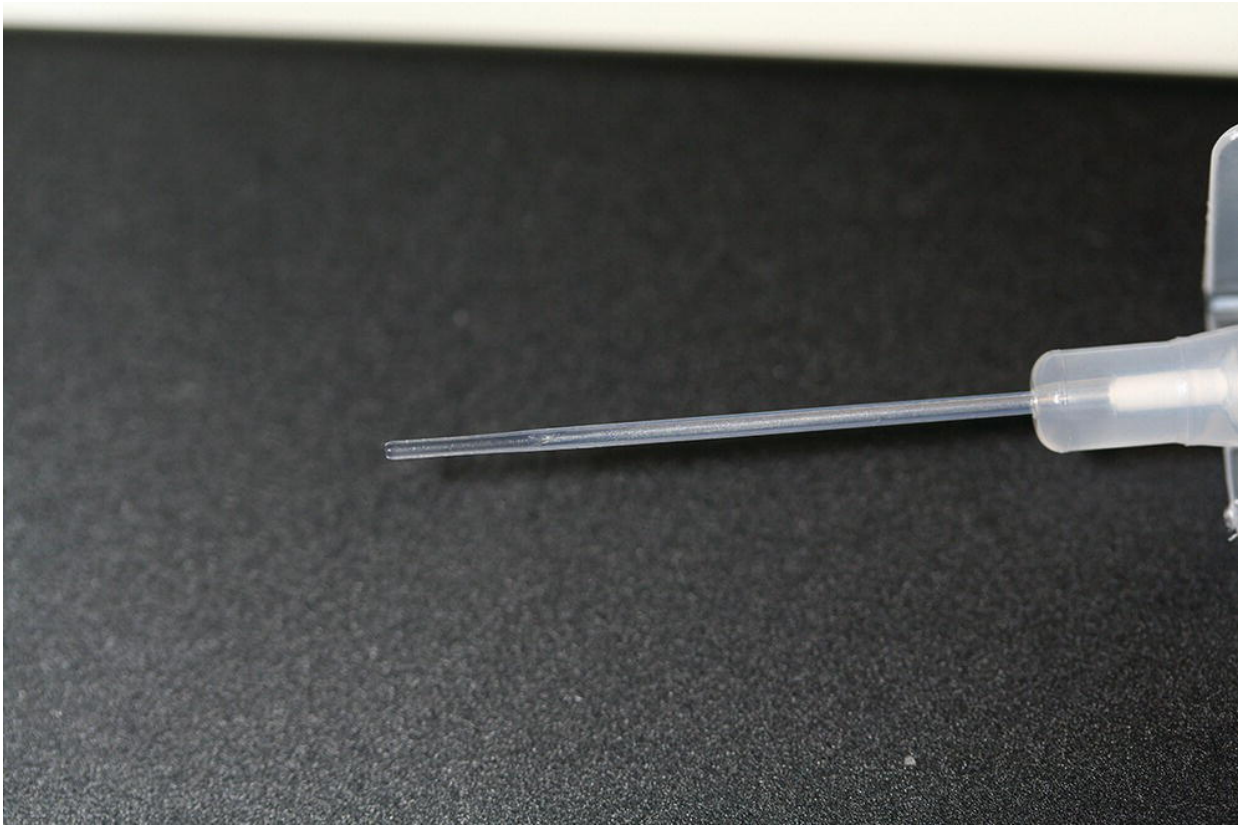


Figure 14.22 Venflon cannula showing needle and plastic tube detail.

The patient signs that indicate the onset of sedation are slurring of speech and difficulty in touching the end of the nose with the finger.

Monitoring the patient's vital signs is essential throughout the procedure, and appropriate equipment should be available to do so, together with a resuscitation kit. Two specific requirements in such a kit for intravenous sedation are the drug flumazenil (Anexate), which is an emergency antidote to an overdose of the sedation agents, and a pulse oximeter machine (see Figure 14.19).

Recovery takes up to an hour and, as for inhalation sedation, the patient must not be left unattended in the recovery room. When the dentist has confirmed that the patient is fit to leave, verbal and written instructions are given to their adult escort for the patient not to drive, operate machinery, take alcohol or sign legal documents for 24 hours.

The advantages of intravenous sedation over inhalation sedation are as follows:

- Better access to the patient's oral cavity for the dentist, as there is no nasal mask in the way.
- Rapid but controlled onset of sedation.
- Supportive hypnotic patter is not required during the sedation induction stage, although many operators still use it.
- Very effective degree of amnesia is produced, so no matter how difficult the dental procedure was during the session, the patient will not remember it. This is invaluable when trying to gain the patient's confidence to undergo procedures in the future.
- No nitrous oxide pollution of the surgery, and therefore no long-term risks to the dental staff.

The disadvantages of intravenous sedation are as follows:

- The drug does not produce analgesia, so the use of local anaesthetic is essential to enable all treatment to be carried out painlessly.
- The technique is unsuitable for children under 16 years of age, as their response to the drug is unpredictable.
- It should be used with caution in adults over 65 years of age, as some elderly patients may have an undiagnosed reduction of liver function, and be unable to metabolise and excrete the drug effectively.
- Midazolam causes a reduction in the rate and depth of respiration in many patients, and they may have to be encouraged to breathe more deeply, or receive a low flow of oxygen via a nasal cannula during treatment.
- Overdose of the sedation drug may cause severe respiratory depression, and the patient's airway will need to be supported if this happens, hence the need for ILS training and the use of various airways.
- Once injected, the drug and its sedative effects cannot be 'switched off'. Full recovery takes many hours and the patient will need to be supervised by a responsible adult for the rest of the day.

- There is the possibility of complications if the drug is accidentally injected into an artery instead of a vein, although a careful technique should prevent this from happening.
- There may be some bruising postoperatively at the cannulation site.
- Special monitoring equipment is required which is expensive to buy, but its use is essential in giving a wide margin of safety to the technique and it must always be available.
- The technique can cause hypotension (low blood pressure) in some patients, especially the elderly, and the new national standards require continual monitoring of blood pressure throughout the sedation procedure, so that this event can be avoided whenever possible.

The dental nurse's duties

Dentists are only allowed to use sedation techniques *and* act as the operator if a suitably trained and experienced dental nurse is present throughout. Such dental nurses are:

- able to assist the dentist in the preparation and use of sedation agents and all relevant equipment
- required to monitor a patient's condition throughout the procedure and warn the dentist of any impending problems
- required to assist efficiently and speedily in any emergencies such as respiratory failure, cardiac arrest or other types of collapse, so have suitable ILS training
- required to know the uses of all the contents of an emergency kit so that no time is lost in successfully instituting whatever resuscitation measures are needed.

In detail, then, these duties are as follows.

For both inhalation and intravenous sedation

- Check that all preoperative instructions have been followed and that the patient is still fit for sedation, especially that there have

been no changes to their medical history since they were assessed for sedation.

- Have monitoring and resuscitation equipment ready and checked for its correct functioning.
- Use a soothing patter to reassure and calm the patient, but do not interrupt or contradict the operator.
- Throughout the procedure, regularly monitor and record the patient's pulse, respiration rate and skin colour, using any monitoring equipment available, but also to be capable of monitoring the patient manually.
- Inform the dentist immediately of any changes in the patient's condition.
- Be prepared, under the dentist's direction, to render immediate assistance in resuscitation procedures.
- On completion of treatment, assist the patient to the recovery area, then monitor and safeguard their recovery until the dentist allows the patient to return home with an adult escort.
- Before leaving, the dentist or a sedation qualified dental nurse will remove any indwelling cannula, apply a dressing, and give verbal and written instructions: not to drive, operate machinery, take alcohol or sign legal documents for 24 hours, or the remainder of the day for inhalation sedation patients.
- At the end of the sedation procedure, ensure that all hazardous waste is disposed of in accordance with current regulations (see Chapter 4).

Duties specific to inhalation sedation

- Check the machine for correct functioning and cylinder labelling.
- Ensure spare oxygen and nitrous oxide cylinders are available.

Duties specific to intravenous sedation

- Have blood pressure monitoring equipment ready for use, and assist in its recording.

- Apply a surface anaesthetic to the intended venepuncture site, if required.
- Lay out an arm board, drug syringe and needle, drug ampoules and labels, cannulae, wipes and dressings.
- Lay out the mouth props (Figure 14.23), local anaesthetic equipment, and all the dental instruments and materials required, out of view of the patient.
- Immobilise and prepare the patient's arm for venepuncture, and help to raise a vein where necessary.
- Have the pulse oximeter ready for use.

Figure 14.23 McKesson mouth props.

Although no special qualifications are currently necessary for previously adequately trained dental nurses to assist in conscious sedation during the transition stage of the new standards implementation, they can prove their competence by attending a course and passing the examination for the NEBDN's Dental Sedation Nursing award, or a similar qualification, and should be encouraged to do so. All dental nurses new to the use of conscious sedation in their work role must achieve a suitable qualification in conscious sedation techniques. Further information is available from various accredited course providers, including the highly recommended courses available for dentists, dental nurses or the whole dental team at www.yorkshiresedationtraining.co.uk.

Care of the patient

Excessive fear of dental treatment is the most common reason for using sedation. Dental nurses should be constantly aware of such patients' anxiety and do everything possible to sympathise with their fears. A sympathetic and soothing manner will in itself make the whole procedure less stressful for the patient. Technical expertise alone is not sufficient for treating nervous patients. They require the extra support of dental nurses who realise that what is a routine day's work for them is a terrifying ordeal for a frightened patient. The dental nurse must be caring, compassionate, calm and approachable, and at all times have the patient's best interests at heart.

It is clear from this account that dental nurses have an extremely busy time during conscious sedation sessions, and up to three appropriately trained dental nurses may be required.

- One nurse assisting the sedationist and monitoring the patient during the procedure.
- A second nurse assisting the dentist to complete the dental treatment.
- A third nurse monitoring the previous patient in the recovery area.

Arrangements must also be made to ensure that messages, enquiries and telephone calls are dealt with by reception staff elsewhere, to prevent any interruptions or delays to proceedings in the surgery.

Dental nurses have an indispensable role to play in ensuring that the entire session runs smoothly, efficiently and with the maximum consideration for the patient's comfort.

Monitoring patients

Throughout any conscious sedation procedure, it is essential to check that the circulation is adequately oxygenated, that the patient's respiratory efforts are normal, and that their blood pressure is maintained at a suitable level. This is done by observing and recording the patient's vital signs: their skin colour, their oxygen saturation levels, their breathing rate and depth, the quality and rate of their pulse, and their blood pressure. This is called monitoring and is made easier by the use of the pulse oximeter.

Full monitoring records must be kept at the time of the treatment, and stored in the patient's record card (see Figure 14.18).

Colour

A patient's skin colour can be observed by watching the face (especially the lips), the nailbeds of their fingers or their ears. The colour seen indicates the state of oxygenation of the blood: a pink colour is normal, whereas a purple tinge (called *cyanosis*) indicates deficient oxygenation, and pallor and sweating denote a more severe deficiency. Any such changes require immediate identification and treatment of the cause.

Breathing and oxygen saturation

Regular chest movements show that a patient is breathing, and it is also apparent by watching the movements of the reservoir bag on the inhalation sedation machine, or by feeling for rhythmic movements of the upper abdomen. The pulse oximeter will also record the blood oxygen saturation levels via the finger probe when the machine is in use (Figure 14.24), and this should normally be in the 95–100% range. The machine alarm will indicate if the oxygen saturation falls below 90%, and action must be taken to raise it above this level again, as it could be due to an airway blockage.

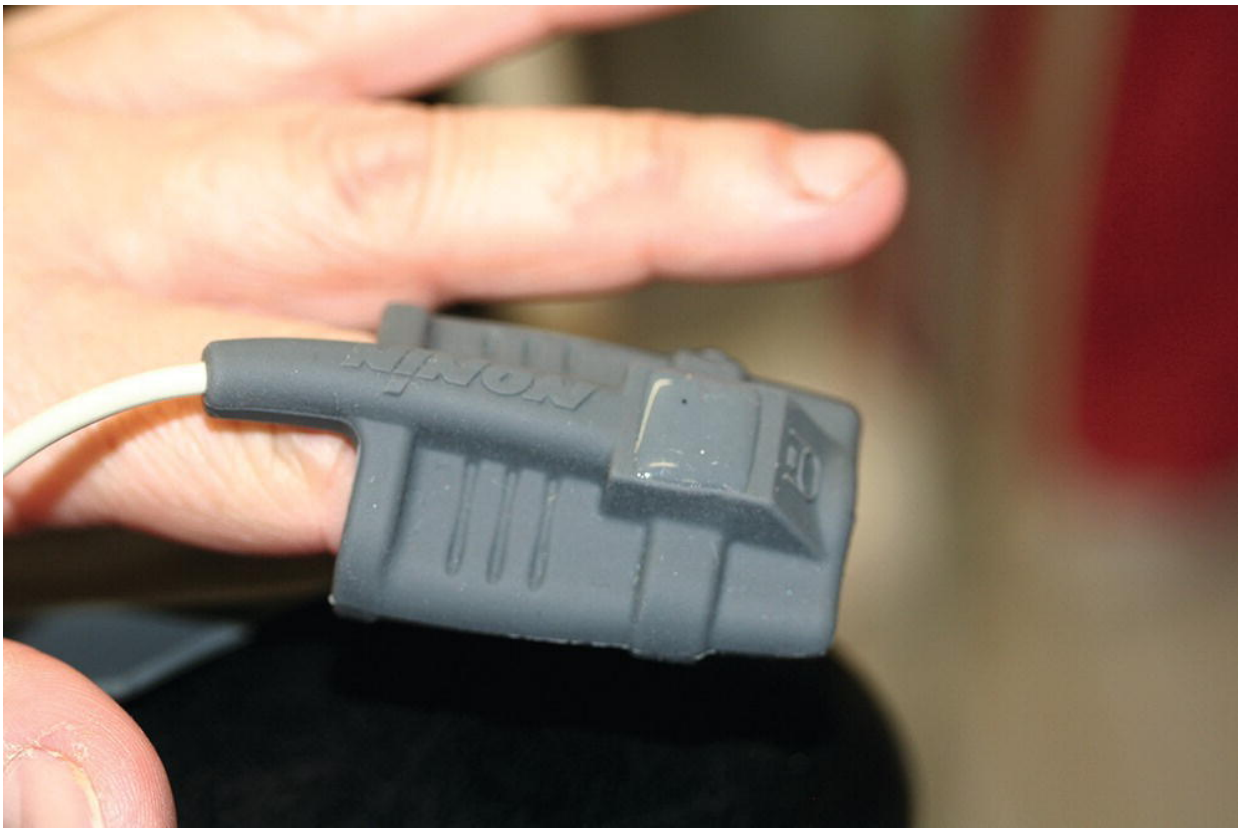


Figure 14.24 Finger probe in use to record oxygen saturation levels.

Pulse

The pulse can be felt where a superficial artery passes over underlying bone, and the usual sites are:

- the radial pulse in the inner wrist (see Figure 5.6)
- the carotid pulse in the neck (Figure 14.25).

Figure 14.25 Taking the carotid pulse.

The quality of the pulse indicates the rate, regularity and strength of the heartbeats. The pulse oximeter machine will also automatically indicate the pulse, when it is attached to the patient by the finger probe.

Blood pressure

The blood pressure is generally taken with an automatic machine (see Figure 5.5) rather than with the old technique of using a stethoscope and sphygmomanometer. Its measurement must be taken before, during (every 10–15 minutes) and after a sedation procedure, and gives an indication of the health and functioning of the patient's heart and circulatory system.

When the cuff device is inflated, it stops the flow of blood through the underlying artery. When the cuff is slowly deflated, blood starts flowing again (as the 'tap, tap' of the pulse) and this can be heard through the stethoscope or automatically sensed by the modern machine. The reading on the instrument scale at which the first sound

is heard is noted; this is called the *systolic* pressure and denotes ventricular contraction. As deflation of the cuff is slowly continued, the sound increases to a maximum and then disappears completely. The reading at this point is called the *diastolic* pressure and denotes ventricular relaxation between heartbeats.

Blood pressure readings are still measured in units of millimetres of mercury (mmHg), even though mercury is not used in modern equipment, and an average reading for a healthy young adult is 120/80 for systolic/diastolic pressures. However, it is quite usual for the preoperative systolic reading to be considerably higher than this in anxious patients, and is usually recorded at a more normal level once sedation has commenced and then postoperatively. Routinely, blood pressure readings above 140/90 would indicate some degree of cardiovascular problem, and the patient would be unsuitable for intravenous sedation. Inhalation sedation may still be used in the majority of these cases though.

The GDC requires dental nurses to be adequately trained and experienced for assisting with conscious sedation treatment, and this includes knowing how to monitor a patient's condition with the available equipment, and to understand the significance of their findings.

Sedation emergencies

With careful technique and appropriately healthy patients, emergencies are rare during conscious sedation sessions. However, the drug midazolam can act to depress the patient's respiration by reducing the rate and depth of their breathing efforts, and this usually occurs within the first 10 minutes after the midazolam has been given. However, it can also occur if the patient is given too large a dose, or the midazolam is injected too fast and the patient becomes over-sedated. If breathing stops (respiratory failure), air cannot enter the lungs and death will occur within a short time. The heart continues beating during these critical first few minutes as there is still some residual air in the lungs, but once this has been used up, the heart itself stops beating (cardiac arrest) and death is imminent.

Respiratory failure may also be caused by blockage of the airway in an over-sedated patient, as they may become unconscious and lose their

cough and gag reflexes. Poor positioning of the patient during the sedation session can also restrict their airway, by allowing the head to fall forwards and close the throat. This is easily remedied by extending the patient's head back so that their airway reopens, and providing support with the chair headrest and a neck cushion to hold their head in this position during treatment. Any drop in the patient's oxygen saturation levels will show immediately on the pulse oximeter, and action can be taken to correct the cause as soon as possible, and before the situation becomes more serious.

Blockage of the airway

Blockage of the airway is caused by obstruction of the entrance to the larynx by the tongue or a foreign body. It is recognised by the following signs:

- Patient's face becomes very blue and congested.
- Clammy skin (appears with a sheen of sweat over it).
- Rise in pulse rate and blood pressure.
- Patient may also make snoring or wheezing sounds.

During a conscious sedation session the patient should maintain their protective reflexes, but if they become over-sedated (especially when a multiple drug technique is used), they may lose these reflexes or experience significant muscle relaxation. If the tongue is displaced backwards it blocks the laryngeal entrance. Fortunately, this can be easily remedied by pulling the jaw forward, as the base of the tongue is attached to the mandible and moves with it. Tongue displacement may occur during a mandibular extraction when the operator may be exerting force to loosen a lower tooth in its socket. However, this type of obstruction is easily prevented by the dental nurse supporting the patient's jaw behind the angle of the mandible, thus making it difficult for the jaw to be accidentally pushed backwards by the operator. Ideally, a less forceful extraction technique is used.

Blockage by a foreign body is an extremely serious matter as it must be located and removed before the patient is able to breathe again. Fortunately, it is rare under conscious sedation, as the normal protective cough and gag reflexes that prevent such emergencies

remain active. However, it may still occur, even with conscious patients. Whenever possible, the patient should be encouraged to cough in the hope of dislodging the foreign object. If it is visible, a pair of McGill's forceps (or something similar) should be used to carefully grasp the item and remove it from the patient's pharynx.

Whatever method is used to clear the airway, the essential factor is speed. Respiration cannot occur while the airway is blocked, so delay in removing an obstruction may be fatal. The usual methods of removing an airway blockage discussed in Chapter 6 are less relevant in a sedated patient, as they are unlikely to be able to stand up for back slaps or abdominal thrusts to be administered. The patient's life is in the hands of the dental team in this situation, and hence the new requirement for the team to undergo ILS training techniques, which involves the ability to place certain airway devices if involved in providing dental treatment under conscious sedation. Various organisations offer this level of training, including that of the highly recommended Resuscitation Consultancy Medical Services at www.lifesupport-rcms.co.uk.

Overdose of sedative

An overdose of an intravenous sedation agent can cause respiratory failure by reducing the efforts of the respiratory muscles, so that the patient is unable to breathe in enough oxygen from the air or anaesthetic machine. This lack of oxygen is called *hypoxia* and its early stages are indicated by cyanosis (blue complexion). At this stage, intravenous injection of an antidote drug must be given, and in the case of sedation with midazolam, the antidote is *flumazenil* (Anexate). It reverses the action of midazolam and is an essential item for the emergency drugs kit in all workplaces using intravenous sedation techniques.

If these remedial measures are not taken, breathing will continue to weaken until it stops altogether. The face becomes ashen-grey and the pupils dilate. This will be followed by cardiac arrest unless oxygen can be introduced into the blood, by positive ventilation using emergency respiratory equipment. It is a legal necessity to have these items in any dental workplaces, whether conscious sedation techniques are carried out or not.

Emergency procedures

A state of preparedness is necessary for meeting dental emergencies associated with respiratory failure and cardiac arrest. A sterile, ready-for-use, emergency kit must be immediately available at all times (see Figure 6.1). The kit must contain the following essential items, and the items shown in bold must also be available every time conscious sedation is undertaken. BLS techniques are discussed in detail in Chapter 6.

- An efficient manual suction device for clearing a blocked airway, for use if the surgery suction unit is unavailable due to failure of the electric supply (see Figure 6.3).
- Range of oropharyngeal (Guedel) airways to maintain a patent airway via the mouth (Figure 14.26).
- Nasopharyngeal airway to maintain a patent airway via the nostril (Figure 14.27).
- **Range of supraglottic airway devices ('I-gels')** to maintain a patent airway in an unconscious patient, and allow direct and controlled oxygen delivery (Figure 14.28).
- Manual pulmonary resuscitator, such as Laerdal pocket facemask (Figure 14.29).
- Resuscitation drugs, **including flumazenil if intravenous sedation is used**.
- Syringes and needles for drawing up and injecting emergency drugs.

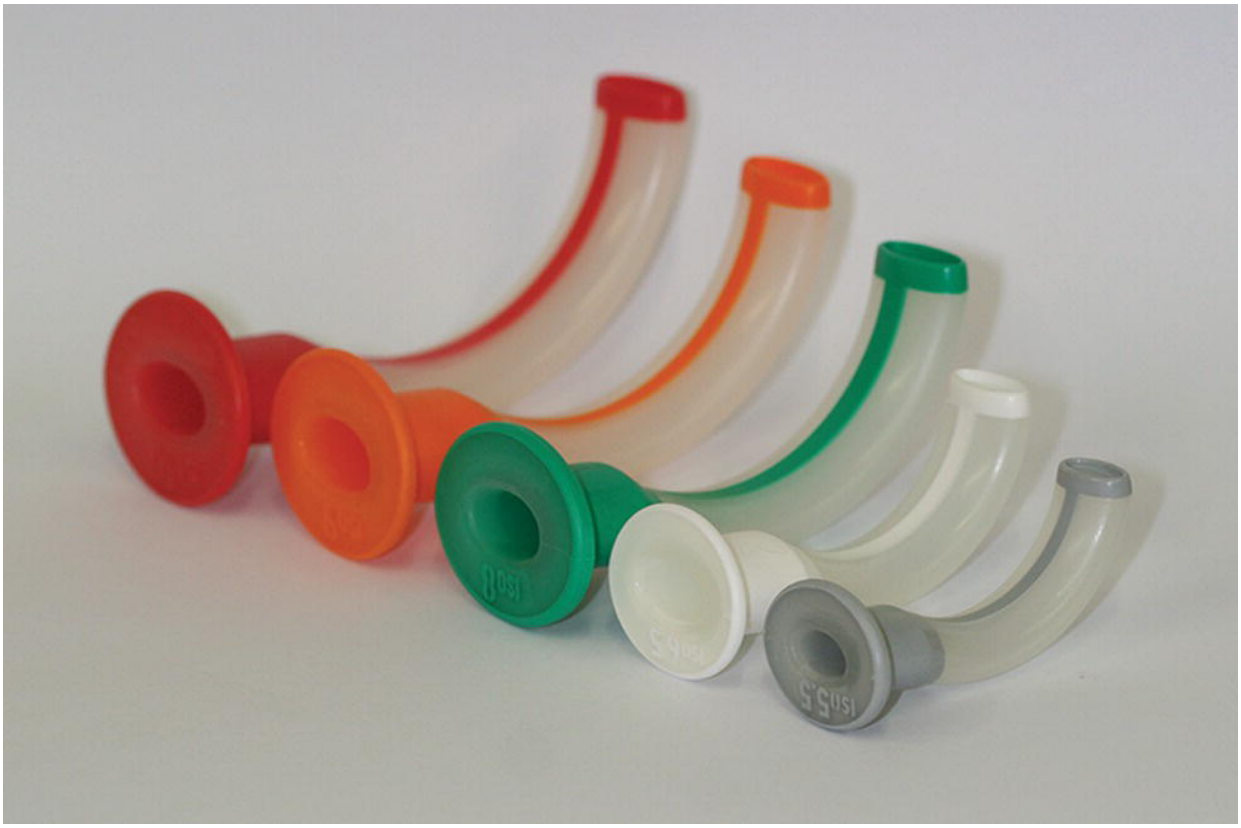


Figure 14.26 Range of oropharyngeal airways.

Figure 14.27 Nasopharyngeal airway.


i-gel O2™
Resus Pack
30-60kg 3
REF 8703000
LOT 31708804
2020-07
8703000-3-A
STERILE EO
Rx ONLY
MR SAFE
CE 0120
INTERSURGICAL
Intersurgical Ltd,
Crane House, Molly Millars Lane,

Figure 14.28 Supraglottic airway device: 'I-gel'.

Figure 14.29 Laerdal pocket facemask.

A cylinder of oxygen with tubing and suitable attachments for use with a resuscitation mask and bag must also be part of the emergency equipment (Figure 14.30).

Figure 14.30 Oxygen cylinder pack with resuscitation mask, bag and tubing.

Other forms of anxiety control

Two other forms of anxiety control, which do not rely on the administration of drugs, have begun to play more of a role in dental treatment over the last few years. They are *hypnosis* and *acupuncture*. Although qualifications are not currently a legal requirement for dentists wishing to use them in practice, there are suitable qualifications already available in both techniques. A brief outline of each discipline is given.

Hypnosis

This is a technique of anxiety control that relies purely on the skill of the hypnotist to produce an altered state of mind in the patient, so that they are neither fully awake or asleep. It is achieved by verbally achieving hypnotic suggestion, to produce the altered state.

No clear definition of hypnosis is available, but it can be described as 'a condition resembling sleep that has been induced in a susceptible patient by another person (the hypnotist), which renders the patient more amenable to verbal suggestion'. When it is successfully suggested to them by the hypnotist that dental procedures are painless or pleasant or even happy experiences, this is a powerful tool in overcoming a dental phobia.

Full dental hypnosis is not currently practised by many dentists but with patients who are already consciously sedated using one of the conventional techniques involving drug administration, it is relatively easy for the depth of their sedation to be accentuated by using hypnotic suggestion as well. The easiest method is for the dentist to merely alter the tone and depth of their voice while talking to the sedated patient, so that a low and slow, monotone style of speech is used. The desired suggestions are then repeated to the patient in a calm deep voice, often with key words dragged out in length, so for example the word 'slow' becomes 'sloooow'.

The technique requires lots of practice to be used successfully, and every dentist will develop their own favourite phrases and patter with time. Some examples are as follows:

- '... and any pain you feel will be just a tiny insect bite ...'

- '... and all the pain has been sucked away, and everything feels good now ...'
- '... and as you breathe in you can feel yourself becoming more and more relaxed ...'
- '... and you're lying on a nice sunny beach, and you can hear the waves gently lapping onto the shore ...'

Acupuncture

This is a branch of traditional Chinese medicine in which special needles are inserted into the patient's skin for the following reasons:

- As therapy for various disorders.
- To produce anaesthesia.
- To reduce anxiety.

Again, no qualifications are currently required, but the GDC would expect any dentist to have at least attended a validated training course before using the technique on patients.

The manner in which acupuncture works is not fully understood, but it is believed to be a combination of the following:

- The needle prick causes the patient's body to release its own painkillers (called **endorphins**) which act as local analgesics.
- The technique helps to induce a form of hypnosis in the patient.
- The needle prick acts as a distraction from the original source of pain.

However it works, acupuncture has been successfully used to carry out painless dental treatment, as well as to remove the gag reflex in susceptible patients so that impressions can be taken. It is also used as a technique for long-term management of chronic dental pain in temporomandibular disorders. Although acupuncture can be used to reduce the anxiety associated with dental treatment, it is currently seldom used to do so.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

15
Restorative Dentistry

Key learning points

A **factual knowledge** of

- cavity classification
- temporary and permanent filling materials

A **working knowledge** of

- cavity preparation and restoration using filling materials
- the instruments and equipment used in tooth restoration

A **factual awareness** of

- the causes of pulp death
- the various non-surgical endodontic techniques available to preserve a tooth
- the instruments and medicaments used in non-surgical endodontic techniques
- the technique of apicectomy

Following a dental examination during an oral health assessment, the dentist may often diagnose the presence of a cavity in a tooth. Cavities are caused by dental caries attacking the hard structure of the tooth, and if left untreated they will cause pain for the patient and will develop into a more serious dental problem that may result in the loss of the tooth. The aim of restorative dentistry is to repair and restore the tooth to its previous shape and function while also protecting the pulp tissue from damage, either by the caries bacteria within the cavity or by the actual restorative process itself. Research shows that both the action of drilling a tooth during restorative procedures, and some of the chemicals found in restorative materials, will cause an inflammatory response within the pulp tissue. Modern techniques of restorative dentistry are now aimed at protecting the inflamed pulp

during cavity preparation and allowing it to recover from the procedure and heal, so that the tooth remains vital.

Once detected then, a cavity will always require treatment and a treatment plan to do so will be decided upon, based on the following information:

- **Cavity size**: is restoration of the tooth feasible with a restorative filling alone, or should a fixed restoration (such as a crown) be considered?
- **Cavity position**: which tooth surface or surfaces are involved, and do aesthetics (appearance) need to be considered?
- **Tooth involved**: is a posterior chewing tooth involved that will require a strong and long-lasting restoration, or is an anterior tooth involved where chewing forces are lower but aesthetics have to be considered?
- **Extent of caries**: is it possible that full caries removal will cause pulp exposure, so that endodontic treatment will also be required, or may it be possible to use materials that allow a more minimal restorative technique to be used?
- **Patient's wishes**: is the patient amenable to restorative treatment, or are they likely to be unco-operative as may occur especially with younger children and some patients with special needs?
- **Patient's wishes**: the cost of any proposed treatment must also be considered by the patient, and some may choose to have a tooth extracted rather than pay more to save it.

Taking into consideration all these points, restoration by filling may be on a temporary or a permanent basis and may be carried out by the dentist or a dental therapist, in line with the GDC's *Scope of Practice* document.

- **Temporary restoration**: in less co-operative patients, and if a fixed restoration is being considered as the final restoration in the short term. The usual materials used are those which traditionally were also used as a base beneath deep permanent fillings:

    - zinc oxide and eugenol cement
    - zinc phosphate cement
    - zinc polycarboxylate cement.
- **Amalgam restoration**: in posterior teeth, where restoration strength and longevity are more of an issue than aesthetics, although amalgam is being replaced by new-generation composites and glass ionomer materials in these situations and it is being gradually phased out of usage.
- **Composite restoration**: in anterior teeth for aesthetics, although more modern composite materials are suitable for use in restorations in posterior teeth too.
- **Glass ionomer restoration**: in deciduous teeth (because of its fluoride release) and in certain cavity sites where retention of the restoration is difficult.

The aims of good cavity preparation are the same, wherever the lesion has occurred and whatever restorative material is to be used.

- To remove all caries from the cavity if possible, without causing pulp exposure.
- To remove the minimum amount of healthy tooth tissue while doing so.
- To avoid accidental pulp exposure, by poor dental technique.
- To seal the dentine tubules that are unavoidably cut open during cavity preparation, to prevent microleakage and minimise pulpal inflammation.
- To protect the pulp after treatment, traditionally by using linings or bases as necessary and more recently by the use of dentine bonding agents instead of bases.
- To produce a retentive cavity for restoration, if necessary (some materials are adhesive to tooth tissue).
- To restore the tooth to its normal shape and prevent stagnation areas developing, as these would allow plaque retention and further carious attack to occur.

- To restore the function of the tooth, for adequate mastication.
- To restore the retentive shape of the tooth if it acts as a bridge abutment or denture retainer.
- To restore the aesthetics of the tooth (its correct appearance).
- To alleviate any discomfort or pain experienced by the patient, due to the initial presence of the cavity.

Fillings

Classification of cavities

Cavities are classified into five different types, depending on the site of the original caries attack. This is called *Black's classification* after the American dentist who devised the system. In general usage, his classification also applies to the naming of the shape of the fillings inserted in each class of cavity, although the amount of healthy tooth tissue removed during modern restorative procedures is far less now than that removed in traditional techniques.

- **Class I** cavities are those involving a **single** surface, in a pit or fissure, so a class I filling could be an occlusal, a buccal or a lingual filling, for example.
- **Class II** cavities involve at least **two** surfaces of a posterior tooth, the mesial or distal, and the occlusal surface of a **molar** or **premolar**. Thus a class II filling could be a mesial-occlusal (MO) filling in a premolar, or a mesial-occlusal-distal (MOD) filling in a molar, for example.
- **Class III** cavities involve the mesial or distal surface of an **incisor** or **canine**.
- **Class IV** cavities are the same as class III but extend to involve the **incisal edge** on the affected side.
- **Class V** cavities involve the **cervical margin** of any tooth. Thus, a class V filling could be a labial cervical filling in an upper incisor or a lingual cervical filling in a lower molar, for example.

This universal method of cavity classification enables their accurate recording on the dental chart so that a restoration can be placed, and an example of each type of cavity is shown in Figure 15.1.

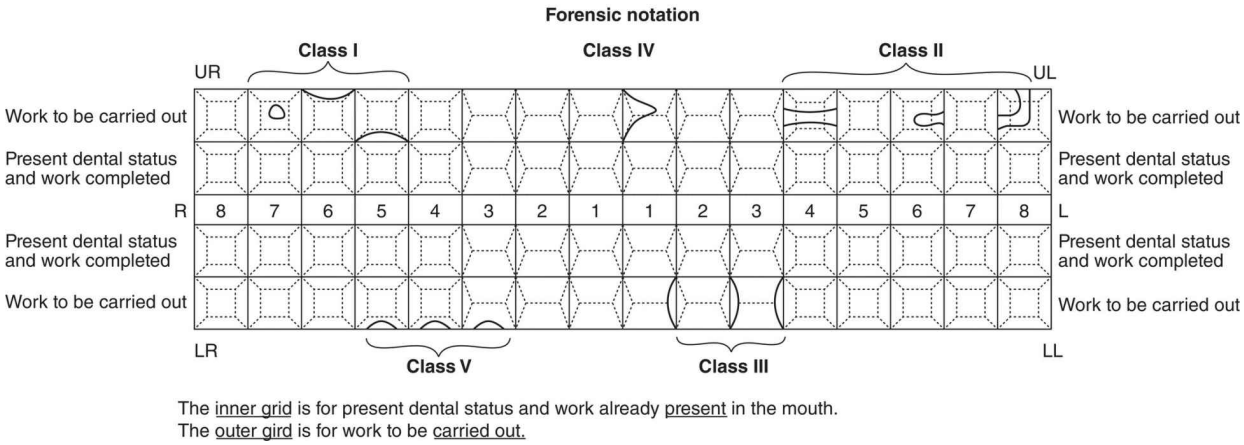


Figure 15.1 Completed chart with cavities recorded.

Cavity preparation

A permanent filling cannot be inserted directly into a grossly carious cavity. Instead, careful preparation of the cavity is required to ensure that:

- all plaque biofilm and soft carious dentine is removed from the cavity margins, although the deepest layer of dentine may be conserved to avoid exposure of the pulp
- as much of the enamel as possible is also conserved to help maintain the structure and strength of the tooth
- the chance of microleakage is significantly reduced in modern techniques by the use of dentine bonding agents which seal the tubules
- in more traditional techniques a base is placed beneath the filling material to help protect the pulp
- the filling will be as much a permanent fixture as possible, although its longevity will also depend on the standard of plaque biofilm control and good diet that the patient follows
- caries will not recur at its margins due to any restoration overhang or other defect.

Every dentist has their own personal preferences for the instruments used during restorative procedures such as the placement of fillings, and Table 15.1 shows the more usual items and an explanation of their

function. They are usually set out on a tray for use, which is often referred to as a *conservation tray* (Figure 15.2). The corresponding letter of some items in Table 15.1 identifies their appearance in Figure 15.2.

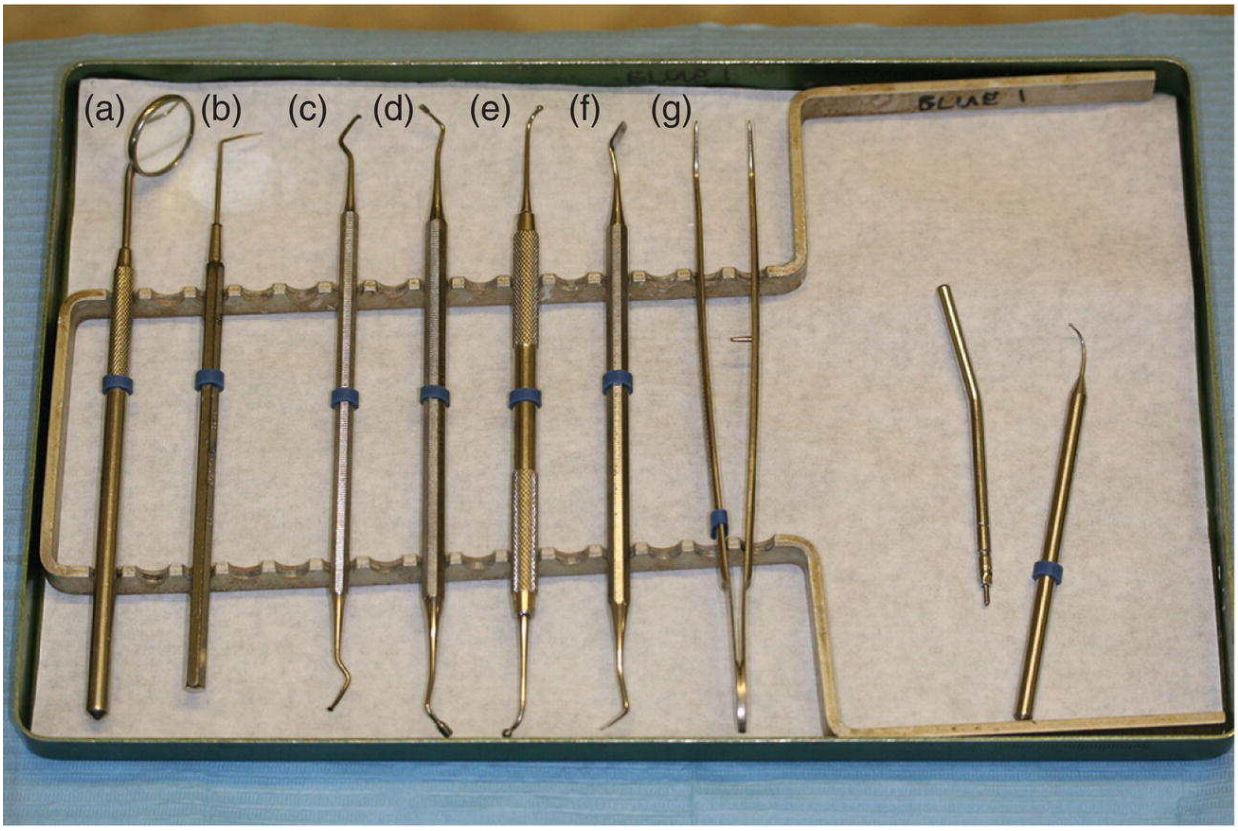


Figure 15.2 Conservation tray instruments, with letters corresponding to Table 15.1. (a) Mouth mirror. (b) Right angle probe. (c) Excavator. (d) Amalgam plugger. (e) Burnisher. (f) Flat plastic. (g) College tweezers. (The two items lying on the extreme right are not referred to here.)

Table 15.1 Some of the instruments used during restorative procedures.

Item	Function
Mouth mirror (a)	To aid the dentist's vision To reflect light onto the tooth To retract and protect the soft tissues
Right-angle probe (b)	To feel the cavity margins To feel softened dentine within the cavity To detect overhanging restorations
Excavators (c)	Small and large spoon-shaped, used to scoop out softened dentine
Amalgam plugger (d)	To push plastic filling materials into the cavity and adapt them to the cavity shape, leaving no air spaces and forcing excess mercury to the surface of the filling for removal during carving
Burnisher (e)	Ball-shaped or pear-shaped, to press and adapt the restoration margins fully against the cavity edges so that no leakage occurs under the restoration
Flat plastic (f)	To remove excess filling material and mercury from the restoration surface, and create a shaped surface that encourages food particles to flow off naturally, rather than becoming lodged around the restoration
College tweezers (g)	To pick up, hold and carry various items such as cotton wool pledgets
Gingival margin trimmer	To trim the margin of the cavity to ensure no unsupported enamel nor soft dentine remains. Their use is becoming obsolete with the wider range of burs available
Enamel chisel	To remove any unsupported enamel from the cavity edges. Their use is becoming obsolete with the wider range of burs available

The vast majority of tooth restoration carried out using fillings will require the administration of a local anaesthetic before proceeding, so

that the patient does not have a painful experience. Techniques of local anaesthesia are discussed in detail in Chapter 14.

Retention of fillings

Permanent fillings are meant to stay put permanently and the cavity must be specially prepared to provide maximum retention. Before explaining how this is done, it is necessary to consider the types of filling materials used: plastic and preconstructed.

Plastic fillings are soft and plastic (able to be moulded) on insertion but set hard in the cavity. They include:

- all temporary cements
- amalgam
- glass ionomer cements
- composites.

Preconstructed restorations are called *inlays* and are made in the laboratory, after the teeth have been prepared, and then cemented into place:

- gold
- porcelain
- other ceramic materials.

Retention for plastic fillings is obtained by simply cutting tiny grooves in the cavity walls to make the entrance smaller than its inside dimensions, as shown in Figure 15.3. As the materials are initially soft, they can be packed into the cavity easily to fill all the available space but cannot drop out of the cavity once set because they have hardened and are locked into position. For fillings involving occlusal and mesial surfaces, or occlusal and distal, a *dovetail* effect is produced by grooving the cavity walls to prevent the filling coming out mesially or distally (see Figure 15.3). Note that this diagram is deliberately exaggerated to show more clearly the principles of retention; in reality, sound tissue is not sacrificed for the sake of

extensive undercuts. Tiny grooves in the cavity walls are sufficient to provide adequate retention.

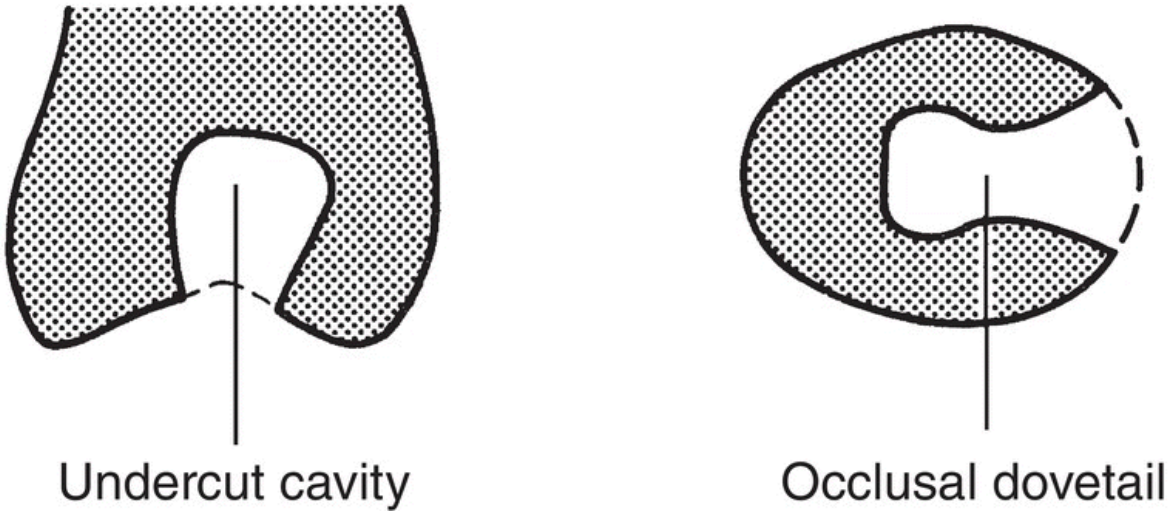


Figure 15.3 Undercutting of cavities.

Sometimes it is not possible to prepare cavities which are sufficiently undercut to retain a plastic filling. In such cases they may be made retentive in other ways.

- Self-tapping dentine pins for amalgam and other restorations (Figure 15.4).
- Acid etching for composites, to provide a microscopically rough surface on the enamel and allow mechanical locking of the material onto the enamel prisms.
- Chemical bonding for glass ionomer cement onto the dentine surface.

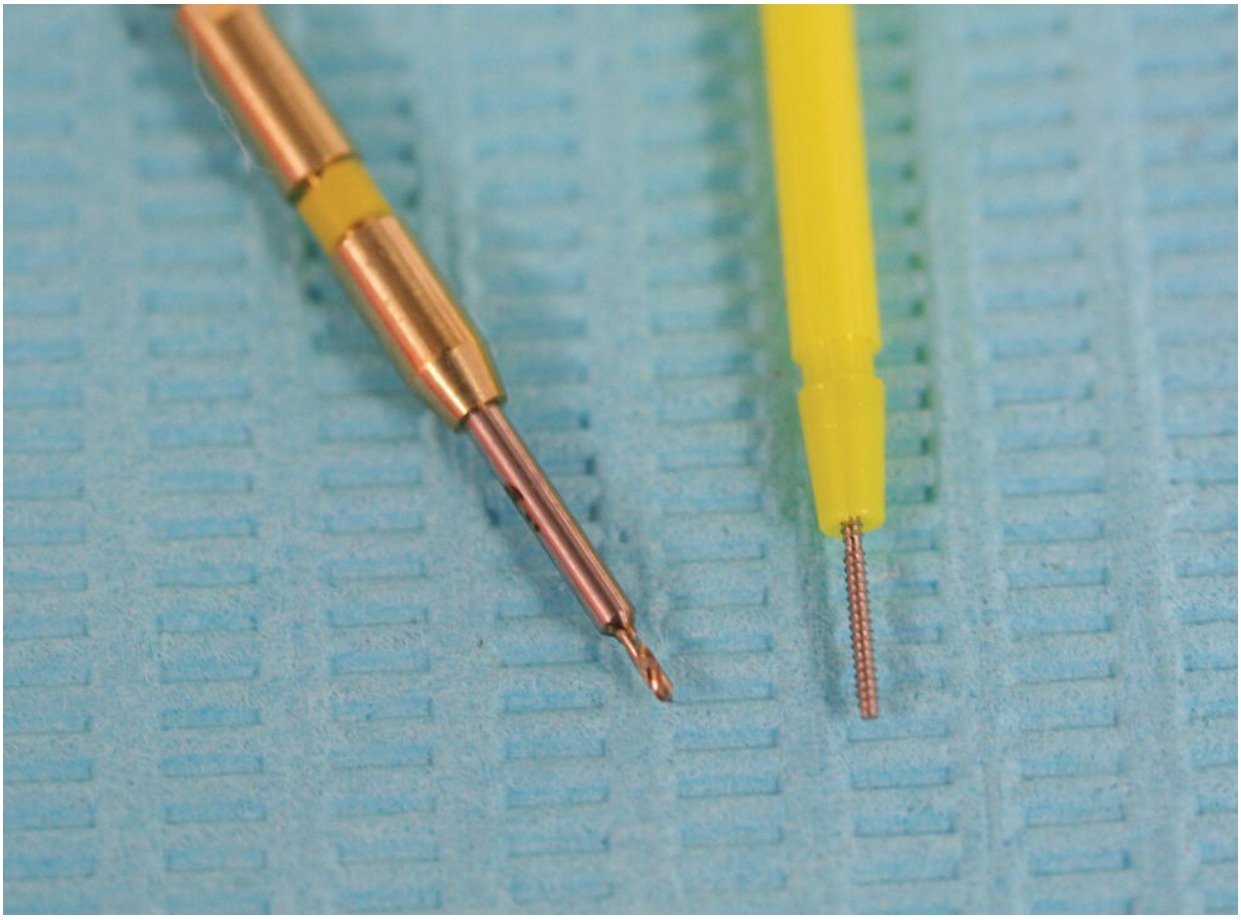


Figure 15.4 Dentine pin drill and self-tapping pin.

Acid etching and chemical bonding methods are covered in the appropriate section of this chapter, for the relevant filling material. Dentinal pins are placed by carefully drilling a small hole in the dentine of the tooth using the appropriate drill bit in the slow handpiece, and then drilling a self-tapping pin of the same size into the hole (the drills and pins are colour-coded for size). The pin is threaded like a screw, so it drills itself into the hole and then shears off once fully inserted, leaving sufficient length of the pin sticking out of the tooth so that the filling material can be packed into the cavity around it (Figure 15.5). Once the filling material has set hard, the pin provides retention by physically connecting the restoration to the tooth structure. Although the system may cause cracking of the dentine occasionally, it is still a useful technique of rebuilding a tooth when significant dentine and enamel have been lost.

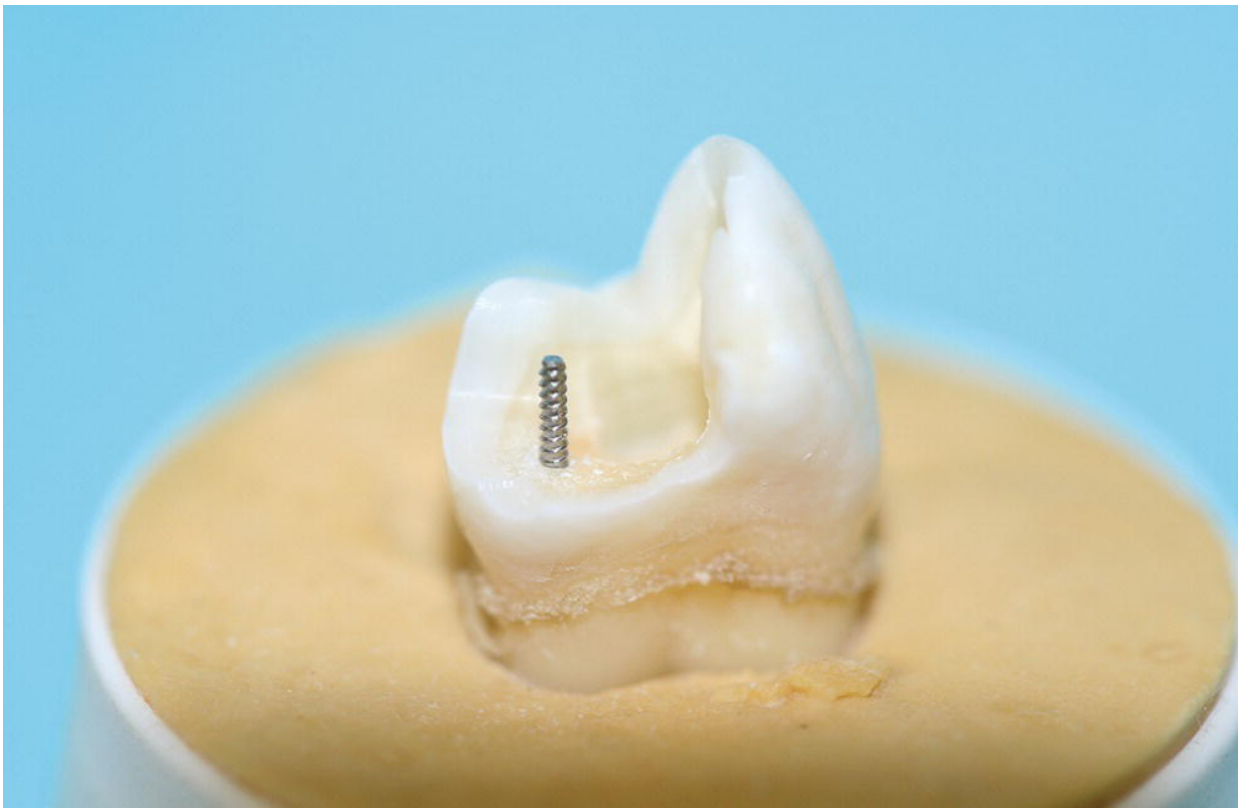


Figure 15.5 Dentine pin in place.

Inlays are hard and rigid when inserted into the cavity, so the dentist would not be able to place and seat them fully if undercuts were present. To prevent them coming out occlusally, they rely on parallel cavity walls to provide maximum retention and the use of adhesive cement to 'glue' them into the prepared cavity. As with plastic fillings, a small dovetail effect may be used to prevent dislodgement mesially or distally.

Cavity linings and bases

Traditionally, prepared cavities had a material placed in their deepest part before the permanent filling material was placed, either a lining or a base, depending on the depth of the cavity. The belief was that pulp damage after a restoration had been placed was due to chemical irritation from the filling material, or by the conduction of temperature changes to the pulp through the filling which irritated the pulp and resulted in tooth sensitivity or post-treatment pain.

Linings were placed as a thin layer on the floor of a shallow cavity, to protect the underlying pulp against chemical irritation from the permanent filling material. The main examples are the calcium hydroxide liners, such as that shown in Figure 15.6.

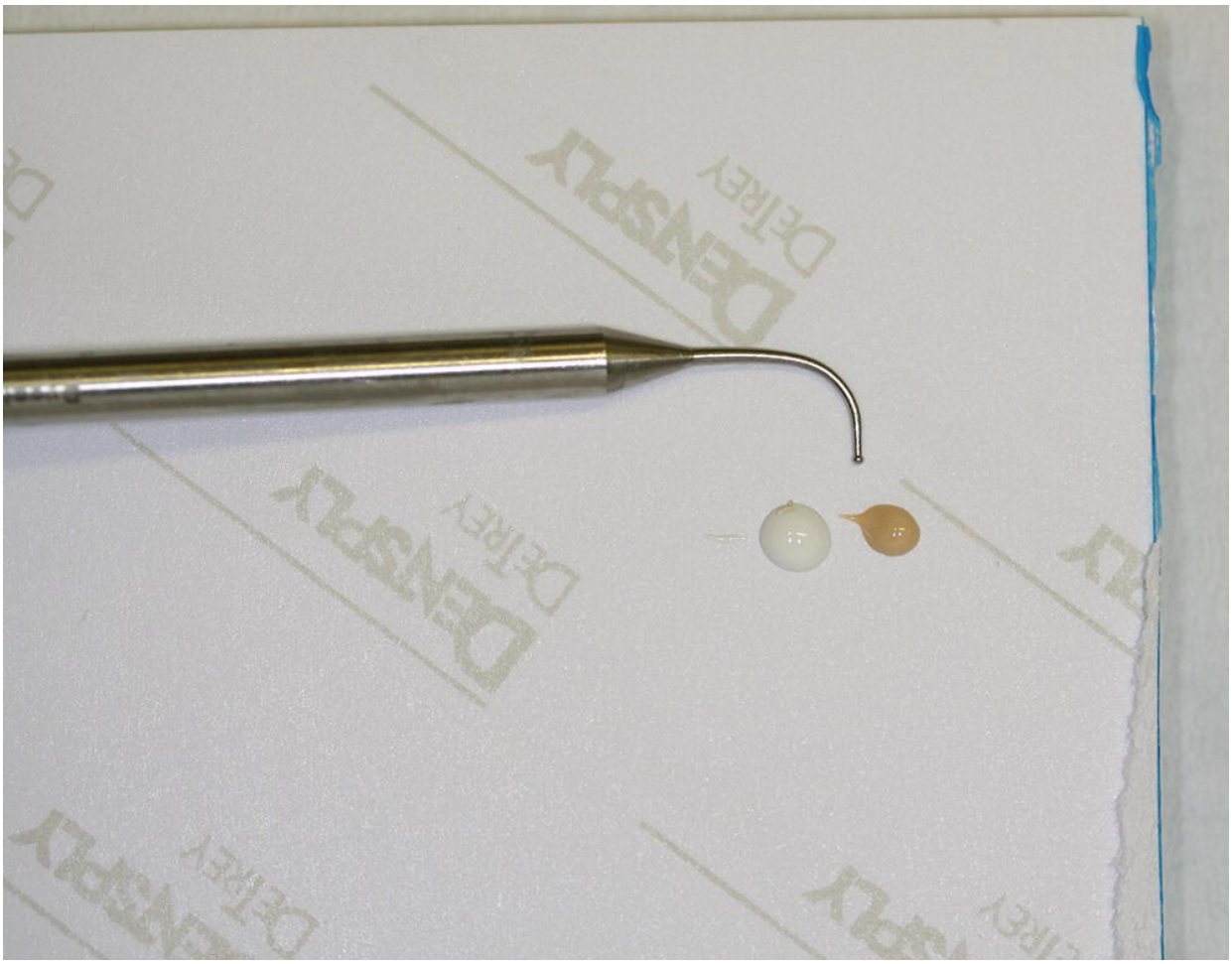


Figure 15.6 Example of calcium hydroxide liner with applicator.

Bases were placed in deeper cavities as a thicker layer to protect the pulp against chemical irritation and insulate it from thermal changes, as well as to protect it from the pressures used to pack the permanent filling into the cavity. Examples include zinc oxide and eugenol cements, zinc phosphate cements, and zinc polycarboxylate cements; these are discussed in more detail later, in their role as temporary restorations.

Currently, it is believed that the majority of any post-restorative pulp damage occurs due to the phenomenon of **microleakage**, where minute amounts of fluid, debris and bacteria are able to leak through

microscopic gaps between the filling and the cavity wall, enter the dentinal tubules and then contaminate the pulp tissue, causing inflammation. This 'swishing effect' of fluids and bacteria washing in and out of these microscopic gaps is known as the *hydrodynamic theory* of dentine sensitivity. Modern lining materials are those which are applied to the cavity walls and floor, and are able to seal the dentinal tubules and prevent microleakage by being able to bond directly to the dentine. This physically blocks the tubules and prevents fluids and bacteria from gaining entry to the pulp tissue. Examples of these types of modern lining material are resin-modified glass ionomer cements such as Fuji and Vitrebond, and the many dentine bonding agents now available, such as Scotchbond and Clearfil (Figure 15.7).

Figure 15.7 Examples of modern lining materials.

The ideal properties of modern lining materials are listed below.

- Adhere to dentine, especially by chemically bonding to it.

- Physically seal dentine tubules once set, to prevent microleakage.
- Insoluble once set, so they do not dissolve or disintegrate over time.
- Set by light curing, so that they can be manipulated in the cavity as necessary without setting prematurely.
- Radiopaque, so that they are visible on radiographs.
- Remain undamaged by other materials, such as acid etchant.
- Compatible with all restorative materials such as amalgams, composites and glass ionomers.

However, some of these modern lining materials are not suitable to be placed on the cavity floor itself as they may cause pulp damage due to their chemical composition; instead they are placed over a thin layer of a non-damaging liner such as calcium hydroxide cement in the floor of the cavity. The ability of some of the chemicals to cause cell damage is useful in killing any residual bacteria that are left within the cavity. However, where there is a potential pulp exposure present in the cavity floor, biocompatible materials which promote tissue healing are being used as a liner instead; examples include products based on calcium silicates, such as MTA and Biodentine. Research has shown these types of product to be superior to calcium hydroxide cements in stimulating pulp tissue healing.

Moisture control

Adequate moisture control during restorative procedures is one of the most important duties of the dental nurse. Control of moisture – from saliva, blood or instrument cooling sprays – is necessary for the following reasons:

- To protect the patient's airway from fluid inhalation, especially as the majority of procedures are carried out with the patient lying flat in the dental chair (supine position).
- To ensure the patient is comfortable during treatment, so that they do not have a mouth full of fluids while lying in the supine position during dental treatment.

- To allow the dentist good visibility to the treatment area, therefore avoiding inadvertent patient injury by catching the soft tissues or the wrong tooth with the drill.
- To allow the restorative materials to set correctly, without moisture contamination.
- To allow the adhesion of cements and linings to the tooth, without moisture contamination.
- To avoid the uncontrolled loss of materials from the cavity during use, such as acid etchant which can burn the soft tissues.

The following methods are used to control moisture:

- High-speed suction using an aspirator.
- Low-speed suction using a saliva ejector.
- Use of absorbent materials: cotton wool rolls, cotton wool pledgets or small sponges.
- Absorbent oral inserts such as Dryguard or DryDent Parotid (in the cheek) or DryDent Sublingual (beneath the tongue).
- Use of rubber dam.
- Compressed air drying, using the triple syringe (3 in 1) of the dental unit.

High-speed and low-speed suction

This is provided by either high-speed aspiration (suction), for fast removal of moisture during drilling, or low-speed aspiration for continual moisture control without sucking at the soft tissues. In the case of high-speed suction, the dental nurse uses a wide-bore aspirator connected to the suction unit to rapidly remove fluids, blood and debris from the treatment area. This prevents the patient from choking, as well as emptying the oral cavity of volumes of fluid that would be uncomfortable for the patient to hold without feeling the need to spit out. With low-speed aspiration, the patient holds a *saliva ejector* attached to the suction unit or *aspirator* to slowly but continually remove any fluids that have pooled in the floor of the mouth, so that the patient does not have to constantly swallow during

the treatment. Many different types of ejector are used but those with a flange to keep the tongue away from the treatment area are particularly helpful. The dental nurse may also use the high-speed aspirator tube as a soft tissue retractor. Examples of aspirators and ejectors are shown in Figure 15.8.

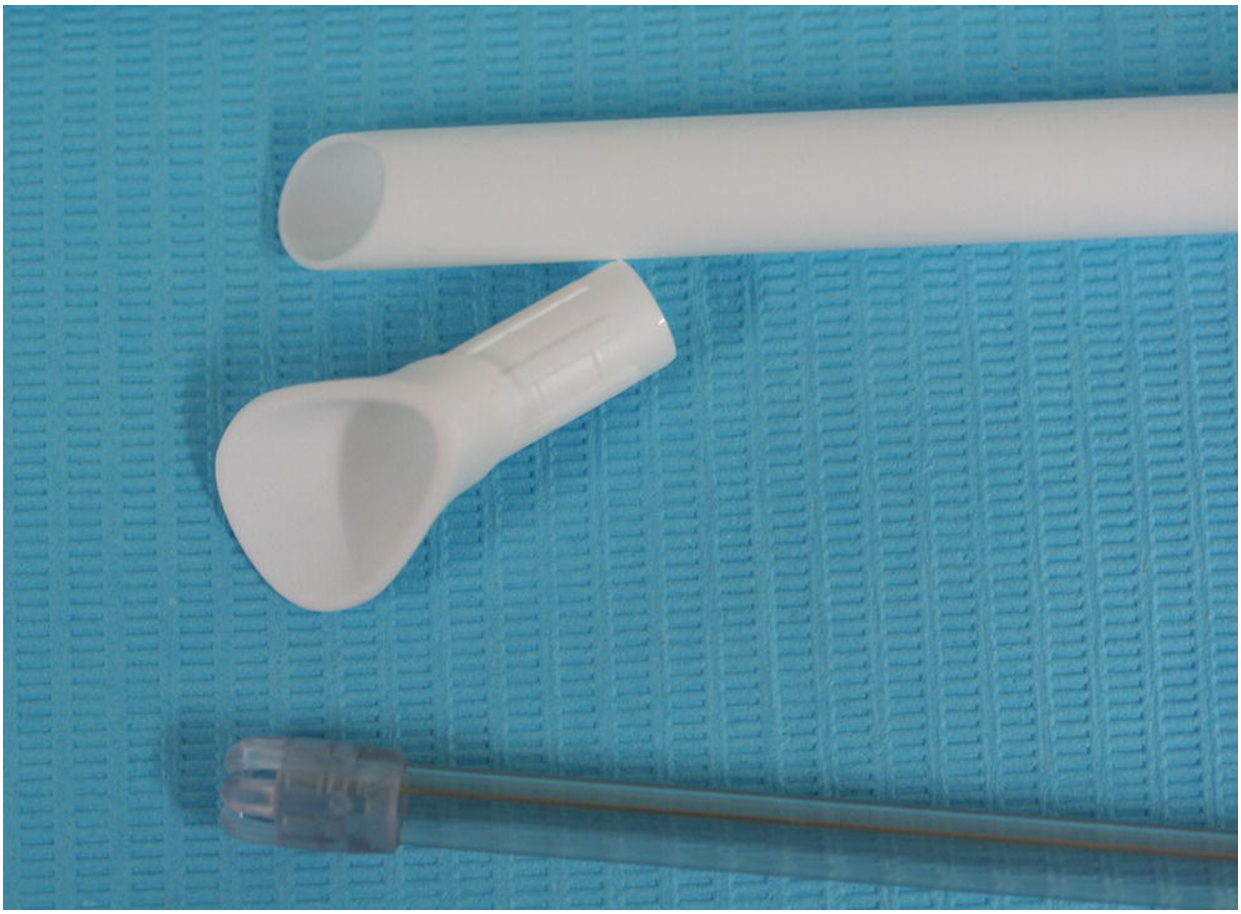


Figure 15.8 Aspirator and ejector tips.

Absorbent materials

Cotton wool rolls or absorbent pads are placed in the buccal or lingual sulcus to absorb saliva and keep the soft tissues away from the teeth. Cotton wool pledgets and small sponges are used to dab the actual cavity dry, while excessive saliva contamination can be prevented by placing a Dryguard or the newer DryDent Parotid over the parotid salivary gland duct. These pads contain an absorbent material similar to that used in babies' nappies, and can retain considerable volumes of fluid. A DryDent Sublingual is now also available to absorb fluids pooling in the floor of the mouth, by placing the moistened pad

underneath the tongue during the placement of dental restoratives. The cavity itself can be further dried by blowing it with compressed air from the triple syringe of the dental unit. Examples of some of these materials are shown in Figure 15.9.

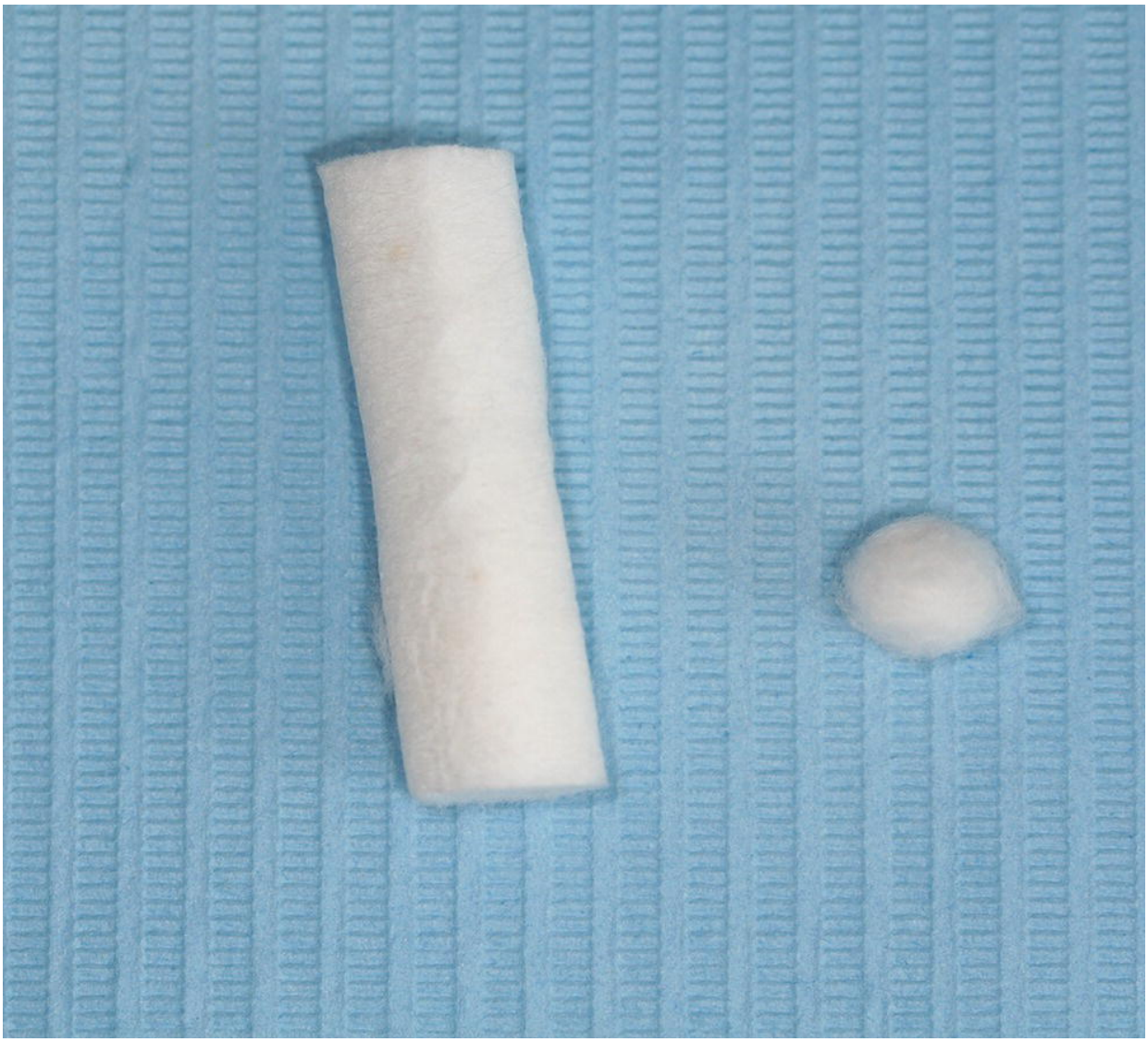


Figure 15.9 Cotton wool roll and cotton pledget.

Rubber dam

This is the best method of moisture control and the various components are shown in Figure 15.10.

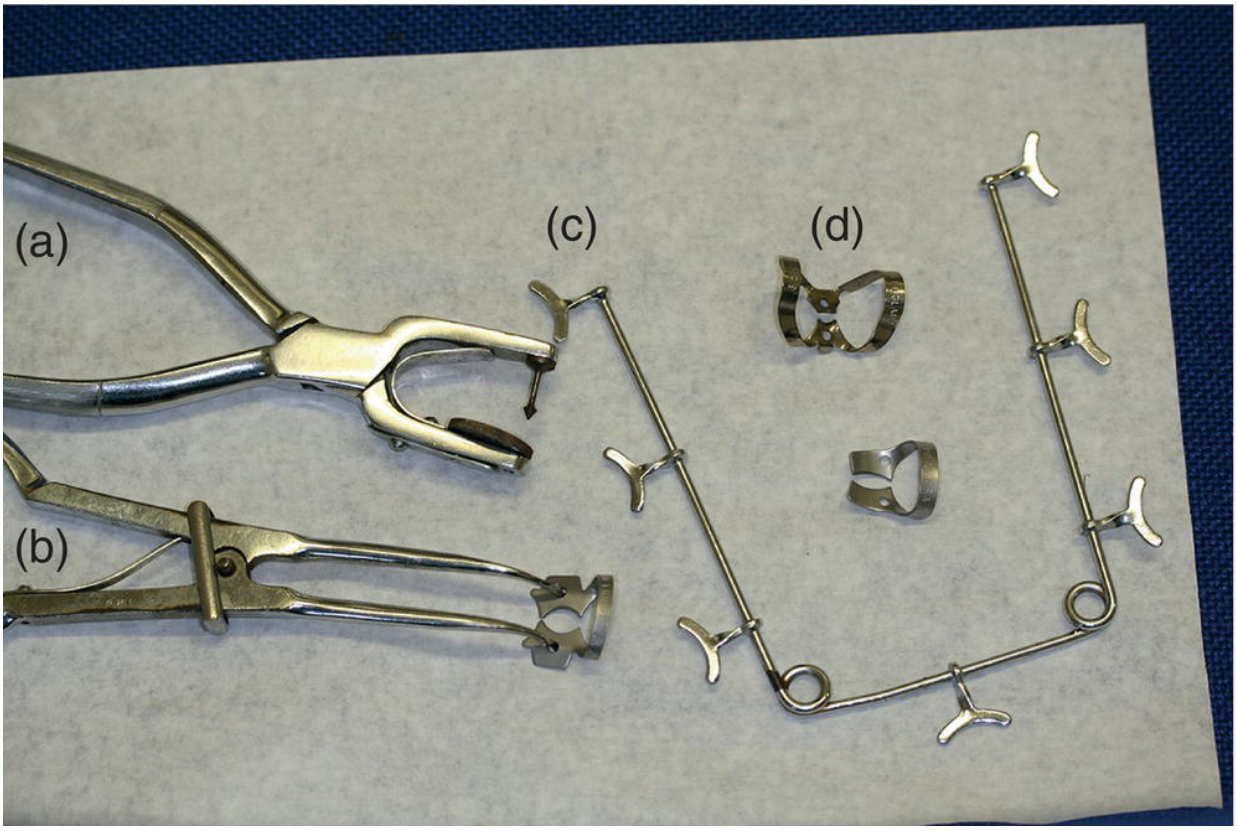


Figure 15.10 Rubber dam instruments. (a) Dam punch. (b) Clamp forceps, with clamp. (c) Dam frame. (d) Selection of other clamps.

A rubber dam is a thin sheet of usually a vinyl material (although latex rubber is still also available) which is placed over a tooth to isolate it from the rest of the mouth. A *rubber dam punch* is used to pierce a small hole in the rubber sheet, which is then fitted so that the tooth projects through the hole. The rubber dam is kept in place by a *rubber dam clamp* which is fixed on the tooth with rubber dam clamp forceps. Finally, a *rubber dam frame* is used to support the sheet while in use, so that it remains taut and maintains a clear visual field. A napkin is placed between the patient's chin and the rubber to make it more comfortable and a saliva ejector may be provided to remove any pooled saliva. Dental floss, elasticated cord, or an additional piece of rubber dam material is used to work the sheet between the teeth and hold it in place interdentally.

A rubber dam may be applied to any number of teeth. It enables the operator to keep a tooth dry and maintain an uncontaminated field during dental treatment, and prevents pieces of filling material, debris or small instruments falling into the patient's mouth.

This moisture control technique is more comfortable for patients as it prevents water spray or irrigation fluids entering the mouth, and far better for the dentist, as it improves access and visibility by keeping the tongue, lips and cheek out of the way. It also helps prevent cross-infection of patients and chairside staff, by minimising the aerosol of infected debris spread by the use of compressed air and water spray.

The two main uses of a rubber dam are:

- in root canal therapy (endodontic treatment), to maintain a sterile field and prevent inhalation or the swallowing of small instruments or irrigation solutions
- during the insertion of fillings (especially composites and glass ionomers) to avoid their failure due to saliva contamination.

Ideally, a rubber dam should be used for all endodontic procedures and most restorative procedures, in the interest of patient safety as well as enabling a clearer field of vision for the dentist. However, the technique is not well tolerated by every patient. The application of rubber dam is one of the extended duties permitted by the GDC that may be carried out by the dental nurse, some of which are discussed further in Chapter 18.

Equipment

Handpieces

Cavities are cut by the use of dental burs fitted into the head of a handpiece. The speed of cutting depends on the type of handpiece and the purpose for which it is used. They have a built-in water spray to counteract the heat generated when cutting hard tissue and may also have fibre-optic illumination to aid vision during cavity preparation.

Air turbine handpieces run at very high speeds of up to 500,000 revolutions per minute, and use friction grip *diamond* or *tungsten carbide burs* to cut easily through both enamel and dentine. There is a tiny air turbine motor in the head of the handpiece which is driven by compressed air. The advantages of air turbines are the ease and speed of cutting. The disadvantages are that they offer little tactile sensation (that felt through the fingers) to the dentist, so excessive

tooth removal can occur, and their vibration may be associated with a condition called vibration white finger when used over many years.

Slow handpieces run at around 40,000 revolutions per minute, and are driven by air or electric motors at the base of the handpiece. They may be contra-angle or straight in design, and are much more versatile in their range of speed and uses, varying from low-speed root canal treatment and removal of carious dentine to high-speed conventional cavity preparation. The contra-angle design incorporates latch grip stainless steel or tungsten carbide burs when used on teeth; the straight design incorporates friction grip stainless steel acrylic trimming burs when used to trim dentures. They are more user-friendly for the dentist, as the tactile sensation provided is much better. Portable versions of the electric motors are particularly suitable for domiciliary dental treatment (that carried out away from the surgery, often in the patient's home). An air turbine, a slow contra-angle handpiece and a slow straight handpiece are shown in Figure 15.11.

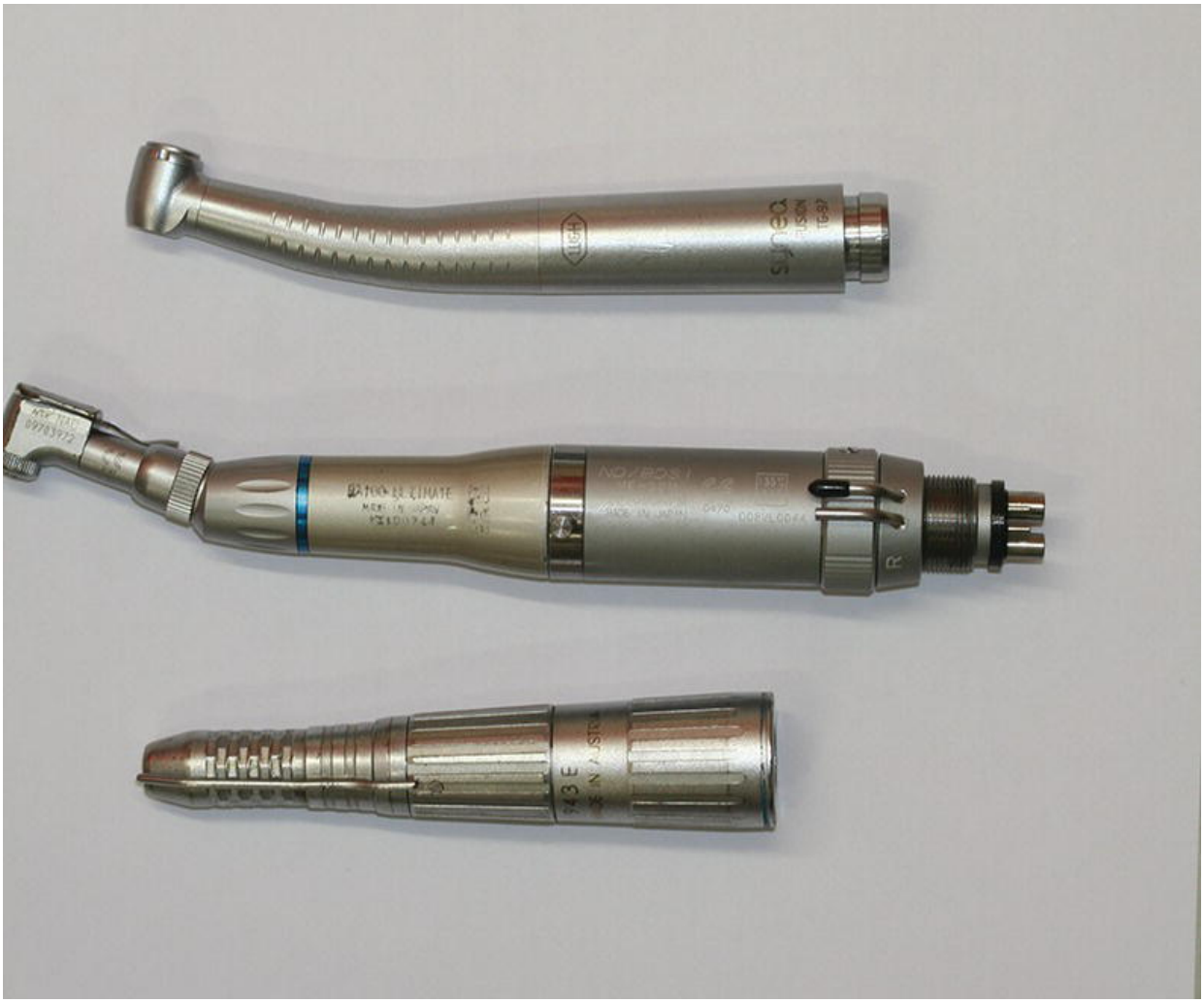


Figure 15.11 Air turbine handpiece (top), slow contra-angle handpiece with motor (middle) and slow straight handpiece (bottom).

Burs

Burs for low-speed procedures are made of steel. They are used for removing caries, cutting dentine (but not enamel), trimming dentures and other laboratory work. Examples are shown in Figure 15.12.

Figure 15.12 Slow-speed burs with latch grip shanks.

Burs for high-speed handpieces have diamond or tungsten carbide cutting surfaces and are used for rapid removal of enamel, dentine and old fillings. Examples are shown in Figure 15.13.

Figure 15.13 High-speed burs with friction grip shanks.

Straight handpiece burs have a long plain (friction grip) shank (Figure 15.14). Burs for low-speed contra-angle handpieces are short and have a notch in the shank which fits by a *latch grip* (see Figure 15.12). Short burs are also used for air turbine handpieces but they have a plain shank which gives a *friction grip* (see Figure 15.13).

Figure 15.14 Straight handpiece burs with long plain (friction grip) shank.

Contra-angle low-speed handpieces with smaller heads, and using even shorter burs, are used on children. They are called *miniature* handpieces and burs.

The cutting ends of burs are made in many different shapes to allow different types of dental treatment to be carried out (Figure 15.15) but those most commonly used are as follows:

- Round: used for gaining access to cavities and at low speed for removing caries.
- Pear: used for shaping and smoothing cavities.
- Fissure: used for shaping and outlining the cavity.

Figure 15.15 Bur shapes.

Polishing instruments

There is a great variety of polishing instruments but they generally comprise fine abrasive stones, wheels, discs and strips, finishing burs,

brushes and polishing pastes. Apart from hand abrasive strips, they are all used with a handpiece. Finishing burs and stones are used for smoothing cavity margins and trimming fillings (Figure 15.16). Abrasive discs and strips are used for fine trimming and polishing.

Figure 15.16 Polishing burs.

Small abrasive stones, wheels and brushes are manufactured with a shank which fits the appropriate handpiece. Larger wheels, stones and abrasive discs require an independent mounting shank called a *mandrel*. Conventional wheels and metal discs are fitted on a Huey mandrel, sandpaper discs with a metal centre and Soflex discs use a Moore mandrel, and plain sandpaper discs a pinhead mandrel (Figure 15.17).

Figure 15.17 Polishing kit containing various mandrels and discs.

Care of instruments

All cutting instruments must be kept sharp because blunt ones are inefficient and painful for the patient. Hand instruments such as chisels and excavators should be sharpened regularly on a small flat oilstone (*Arkansas stone*) or with an abrasive disc in a straight handpiece. Diamond burs are cleaned in an ultrasonic cleaner and autoclaved after use, although any that become heavily contaminated during use or that are used on known high-risk patients are considered as single-use items and are discarded. Stainless steel burs used in the slow contra-angle handpiece are single-use items and they, along with all blunt burs, are discarded into the sharps container.

All handpieces must be lubricated regularly according to manufacturers' instructions during the decontamination and sterilisation process; this may be before or after sterilisation, or both, depending on the manufacturer. The methods used are described in Chapter 8.

Air abrasion

Modern technology has allowed an old method of tooth preparation to be reintroduced into dental practice. It uses compressed air and a special handpiece to convey a jet of abrasive particles onto a tooth surface, by which it can remove hard tissue, soft carious tissue or surface stains and even abrade metal or composite restorations before cementation or repairs. It is less painful than conventional cavity preparation but has not come into general use for this purpose, although it is rather more popular as a means of stain removal from discoloured teeth.

Role of the dental nurse during restorations

There are some nursing duties that are specific to the preparation and placement of restorations, and others that are very similar in other areas of dentistry, but the good dental nurse must be competent and proficient in all. As the clinician carrying out certain restorative procedures may be either a dentist or a dental therapist, the general term 'operator' will be used. The role of the dental nurse during restorative treatment can be summarised as follows:

- Have a good understanding of the procedure to be carried out.
- Be aware of their position in the dental team for the procedure. This may be as the chairside nurse assisting directly with the procedure or as a second nurse available to mix materials as required.
- Have all the patient records, charts, radiographs and consent forms completed and available for the appointment.
- Communicate effectively with the patient throughout the procedure, inspiring confidence and trust.
- Monitor the patient throughout the procedure, ensuring their comfort and well-being and giving reassurance where necessary.
- Assist during the administration of local analgesia: having the correct syringe and needle loaded with the correct cartridge if directed (many operators tend to carry out this task themselves), passing them safely to the operator for use, then retrieving them after use and safely resheathing the needle using a hands-free

device to avoid needlestick injury (wherever possible resheathing should be carried out by the operator rather than the nurse).

- Provide careful but efficient moisture control and soft tissue retraction throughout the procedure, ensuring that no soft tissue trauma is caused.
- Anticipate and pass instruments to the operator in the correct order of use during the procedure.
- Be aware of the required lining, base and restorative material to be used for the procedure, and mix each accordingly when directed.
- Be proficient in the four-handed technique of passing instruments to the operator as required, ensuring all items are passed safely (and especially not across the patient's face).
- Follow the infection control policy to fully decontaminate the surgery after the appointment.
- Follow the health and safety policy with regard to hazardous waste disposal, especially in relation to waste amalgam.
- Ensure that all records, charts, etc. are correctly and securely stored for future use after being completed by the operator, maintaining patient confidentiality at all times.

Temporary restorations

These are placed as a temporary measure, before the tooth is restored permanently, and are used for a variety of reasons.

- As an emergency measure to seal a cavity and prevent carious ingress.
- During endodontic treatment, as repeated access may be required to the pulp chamber over several appointments.
- During inlay construction to seal the preparation while the permanent inlay is constructed.
- To allow a symptomatic tooth to settle and become symptom-free, before being permanently sealed.

There are several materials available for use as a temporary restoration, some of which have other uses in dentistry – they are multipurpose materials. Overall, they are unsuitable for use as a permanent restoration because they are too soft to chew on, are too soluble in saliva, and would not remain intact for long periods.

The key features of all temporary restorations are as follows:

- Quick mixing and placement.
- Cheap compared to permanent restorative materials.
- Easily removed from the cavity when required.
- Not strong enough to be chewed on routinely.
- Have varying degrees of adhesiveness to the tooth.
- Some contain sedative ingredients to help settle inflamed pulps.

A variety of materials is available, under many trade names, but temporary restorations can generally be categorised into one of the following groups of cement materials:

- Zinc oxide and eugenol.
- Zinc phosphate.
- Zinc polycarboxylate.

The use of softened gutta percha as a temporary restorative material is now practically obsolete. The use of the zinc-containing cements listed above as a base beneath permanent restorations is also gradually reducing, as the modern dentine bonding liner materials described previously gradually succeeds them.

Zinc oxide and eugenol

Presented as zinc oxide powder and eugenol liquid (oil of cloves), the cement is made by mixing increments of the yellowy powder with a drop of the clear eugenol liquid on a glass slab with a spatula (Figure 15.18).

Figure 15.18 Zinc oxide and eugenol cement in increments, ready to mix.

When ready for use, the cement should be able to be rolled into a sausage shape with the spatula, without sticking to it or leaving an oily smear across the glass slab.

Uses of the cement are:

- temporary filling
- non-irritant base for deep cavities
- sedative dressing for painful carious teeth and for dry sockets
- main constituent of some impression pastes, periodontal packs and root filling materials.

The main advantage of the cement over other temporary restorations is that it is soothing and non-irritant to the pulp and can be safely used in deep cavities. Originally the material was slow setting but strengthened quick-setting proprietary brands such as Kalzinol have

been available for many years now. In this form it is generally regarded as a satisfactory base for metal fillings.

However, the cement is not compatible with composite filling materials due to its oily nature, and cannot be used as a base beneath these types of restorations. Manufacturers' instructions must always be followed in selecting a suitable liner for any non-metallic fillings, and there are many alternatives now available with the advent of modern dentine bonding lining materials.

Also, some patients are allergic to preparations containing eugenol, although special eugenol-free alternatives are now available.

Zinc phosphate

Presented as zinc oxide powder and phosphoric acid liquid, the cement is prepared by mixing increments of the white powder with the clear liquid on a glass slab with a spatula (Figure 15.19). Two different mixes are used.

- A thick mix of putty consistency to use as a temporary filling or a base beneath a permanent filling.
- A thin creamy mix to use for crown and inlay cementation (called a **luting cement)**.

Setting of the cement takes a few minutes depending on various factors.

- A warm glass slab accelerates the setting time.
- A cold slab slows down the setting time.
- A thick mix sets more quickly than a thin mix.
- A dry slab must be used as moisture accelerates setting.
- Powder contaminated by moisture in the air will set too quickly for use, so it is most important to screw the bottle cap on tightly, immediately after the powder has been dispensed onto the slab.

Figure 15.19 Zinc phosphate cement in increments, ready to mix.

These various factors can be used to advantage, depending on the particular use of the cement at the time. If a long setting time is required, such as when cementing a bridge, a cold dry slab can be used to give the maximum setting time possible, so that the cement can be loaded into each retainer and then the bridge fully positioned, before it begins to set. This ability to control its setting time is the overriding advantage of zinc phosphate cement.

Experience soon teaches a dental nurse how much powder and liquid to set out, but occasionally too little or too much powder will be put on the slab. In the former case, more powder can be added from the bottle, but the mixing end of the spatula must not be used for this purpose as it will contaminate and spoil the whole bottle. Excess unused powder may only be returned to the bottle if it is certain that it has not been contaminated by any liquid or mixed cement on the slab; ideally, excess powder should be disposed of rather than returned to the bottle.

A cool *thick* glass slab should be used for mixing zinc phosphate cement. Thin slabs are warmed by the dental nurse's hand and can make the cement set too quickly.

Uses of a thick mix of the cement are:

- as a temporary filling
- as a cavity base
- for blocking out undercuts in inlay and crown preparations, although more modern materials such as glass ionomer are more likely to be used nowadays.

Uses of a thin mix of the cement are as a:

- luting cement to place inlays, crowns and bridges
- luting cement to place orthodontic bands.

The main advantage of the cement is that it sets very hard within a few minutes and therefore makes a sound base for permanent fillings, and also a more durable temporary filling than zinc oxide and eugenol materials. Furthermore, its ability to adhere to dentine makes it satisfactory as a luting cement for prefabricated restorations.

The main disadvantage is that in deep cavities it is now known to be irritant to the pulp, as the acidic nature of the liquid component produces a mixed material with a pH of 2. In these cases, a sublining of calcium hydroxide is inserted onto the cavity floor beneath the zinc phosphate base cement. The alternative is to use a different base material altogether, or to use one of the superior dentine bonding liners. Zinc phosphate cement is also moisture sensitive and will not adhere to a damp cavity, so good moisture control is required during its use.

Zinc polycarboxylate

Presented as white zinc oxide powder and clear, viscous polyacrylic acid liquid, or as these two components combined in the powder and sterile water as liquid. In each case the cement is prepared by mixing increments of the powder to the liquid or sterile water on either a glass slab or a waxed paper pad with a spatula. A measure is provided by the manufacturer for exact measurement of each increment.

The advantage of using the anhydrous system with sterile water is that only one bottle of material is needed and there is no liquid to

deteriorate, to be used up too soon or left over when the powder bottle is empty. Furthermore, as the polyacrylic acid liquid is viscous (thick and 'gloopy' in consistency), it can be difficult to dispense from the bottle and also difficult to mix. Mixing with water is much easier and quicker.

Uses of the cement are:

- a thin mix for use as a luting cement with fixed restorations and orthodontic bands
- a thick mix for use as a cavity base
- therefore, an alternative to zinc phosphate cement.

The main advantages of polycarboxylate cement are that it is less irritant than zinc phosphate cement and far more adhesive to dentine. For these reasons many operators prefer its use to that of zinc phosphate (Table 15.2).

Table 15.2 The main categories of temporary restorative materials and their advantages and disadvantages.

Material	Advantages	Disadvantages
Zinc oxide and eugenol	Cheap Sedative to inflamed pulp	Reacts with composites Eugenol can burn soft tissues
Zinc phosphate	Sets quickly Sets hard Adhesive to dentine	Irritant to pulp in deep cavity Moisture sensitive
Zinc polycarboxylate	Most adhesive cement	Sticks easily to instruments so difficult to place

The main disadvantage is that it can be rather difficult to manipulate as it is adhesive to stainless steel instruments. Excess cement must be wiped off the spatula and instruments before it fully sets, as it is difficult to remove by manual scrubbing and unlikely to be removed by the action of the ultrasonic bath.

Linings

Traditionally, these are materials placed in the deepest part of the cavity, over the pulp chamber, before a restoration is placed. Their aim is to protect the pulp from chemical shock by providing a barrier between the permanent restoration and the living pulp tissue, so that chemical irritation from the restoration is not transmitted to the pulp. As discussed previously, it is now believed that the majority of post-restorative pain is due to microleakage of fluid and bacteria between the cavity wall and the restoration, and modern lining materials are placed on the cavity floor *and* walls to seal the cut dentinal tubules and prevent microleakage.

The material traditionally referred to as a lining in dentistry is calcium hydroxide. It is presented in various forms to produce a calcium hydroxide paste on mixing: as calcium hydroxide powder and resin in a solvent, as two pastes to be mixed together, or as the more usual premixed single paste for light curing after placement (see Figure 15.6).

Uses of the cement are as follows:

- Universal cavity lining, as it is non-irritant to the pulp and compatible with all filling materials.
- It promotes the formation of secondary dentine around the outer border of the pulp chamber, so allowing the tooth to attempt to protect the pulp and heal after a carious attack.
- It promotes the remineralisation of hard tooth tissue, by allowing its calcium content to be incorporated as calcium hydroxyapatite crystals.
- It can be used as a sublining on the cavity floor beneath those modern dentine bonding liners which contain potentially pulp-damaging chemicals. In these cases use of both products results in the pulp being protected and also the dentinal tubules being sealed against microleakage.
- Pulp capping (see later).
- Pulpotomy (see later).
- Other root treatment procedures (see later).

Calcium hydroxide is currently the more likely lining material to be used for non-metallic fillings as it has no deleterious effect on them or the pulp, although the modern dentine bonding liner materials are becoming rapidly popular for use in shallower cavities (some examples are shown in Figure 15.7). The alkalinity of calcium hydroxide also counteracts the acidity of zinc phosphate and other potentially irritant modern products, and this alkalinity also helps to kill any residual bacteria present in deep carious lesions, where further drilling to remove them is likely to cause pulp exposure.

The main disadvantage of the material is that in deep cavities, and especially those with metal fillings, it can only be used as a sublining as it forms too thin a layer to insulate the pulp against thermal irritation. Another base material must be inserted on top of the calcium hydroxide to provide a thicker layer of insulation against the conduction of heat or cold through metal fillings, or one of the dentine bonding liners can be used over the cavity walls. In deep cavities where pulp exposure may have occurred, research has shown that modern biocompatible materials based on calcium silicates are superior to calcium hydroxide in stimulating pulp tissue healing, but it is unlikely that they will fully replace it for some time still. In shallow cavities, calcium hydroxide alone or one of the dentine bonding agents are satisfactory lining materials for metal fillings. Another disadvantage of calcium hydroxide is that it is also soluble in water, unless a light cure product is used.

Permanent restorations

These are the materials used to permanently restore the tooth to its full function and appearance, and they must all have the following properties:

- Set sufficiently hard to allow normal masticatory function to occur, without fracture of the material.
- Not to dissolve or otherwise deteriorate in saliva over time.
- To be biologically safe, by not reacting with the body's tissues or giving off any harmful chemicals.
- Capable of being applied to the tooth using normal conservation instruments, in a straightforward manner.

- Have a reasonable working lifespan of years, rather than of months.
- Ideally, they should be aesthetically acceptable, although this limits the use of amalgam.

The three commonly used materials are *amalgam*, *composite* and *glass ionomer*.

Amalgam

Amalgam has been in use for over 180 years and is probably still the most widely used permanent restorative material for posterior teeth in the UK. Despite advances in dental material science, it is still often cheaper to buy and more durable and easier to use than its tooth-coloured competitors, composite and glass ionomer. However, following the international decision to reduce the presence of toxic mercury from all its sources in the environment worldwide, amalgam is to be gradually phased out as a dental restorative material, probably over the next decade.

Amalgam is prepared by mixing a powdered *alloy* with liquid *mercury*, usually provided as a preloaded capsule as illustrated in Figure 15.20. The two constituents are kept apart in the capsule by a rubber separator diaphragm until mixing occurs, when the mixing vibration dislodges the separator and allows the powder and liquid to come into contact with each other. The mixture produced forms a plastic mass, which is packed into the tooth cavity and sets hard in a few minutes. The main constituents of amalgam alloy powder are:

- silver (up to 74%)
- copper (up to 30%, in high copper alloys)
- tin (variable quantities)
- zinc (small quantities).

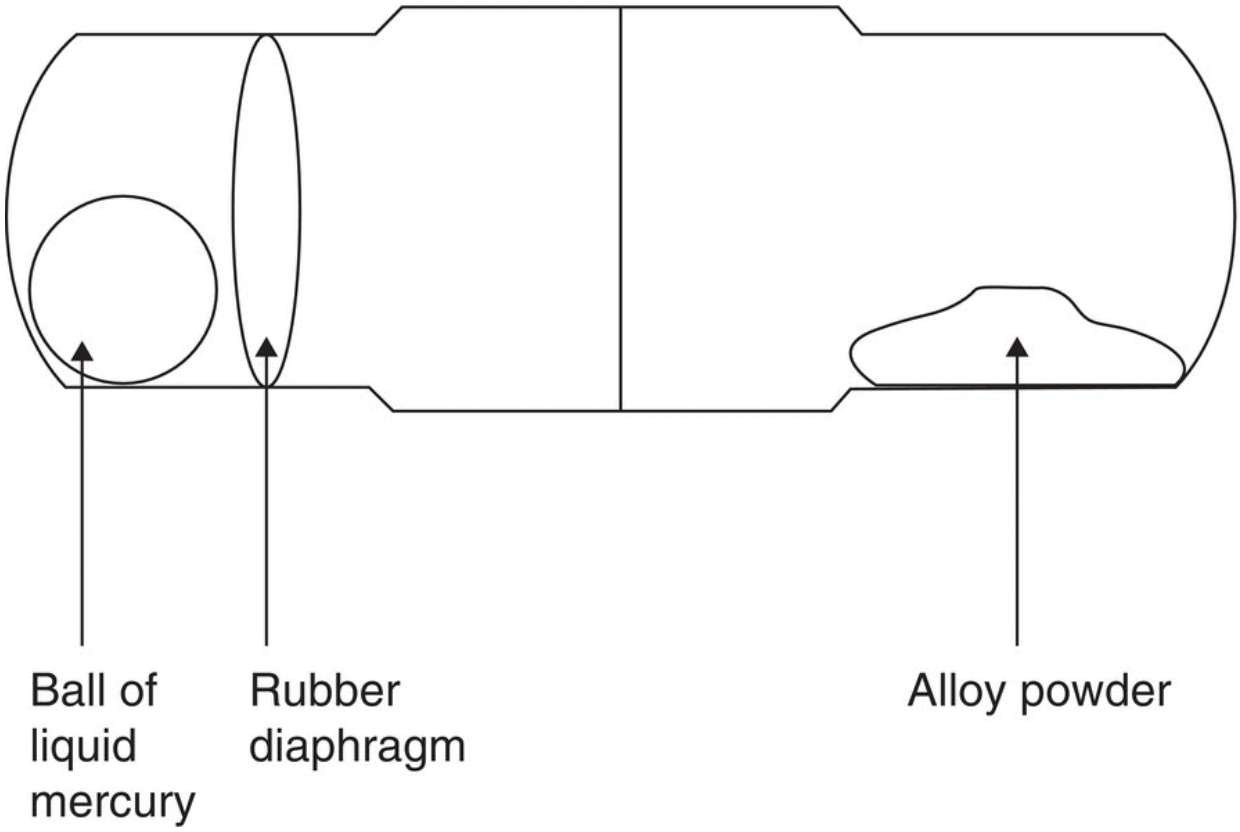


Figure 15.20 Amalgam capsule.

The preloaded disposable capsules are inserted into a special machine for automatic mixing called an *amalgamator* (Figure 15.21).

Figure 15.21 Amalgamator with capsule loaded.

Varying the alloy powder constituents produces an amalgam mix with different levels of marginal ditching and discoloration. Modern amalgams tend to have a 'high copper' content (up to 30% copper) to reduce these unwanted effects as much as possible.

As amalgam is a non-adhesive plastic filling material (able to be manipulated) and a good thermal conductor, cavities are made retentive, lined to insulate the pulp against thermal injury, and the entire cavity may be varnished to give a good marginal seal before inserting the amalgam material, although cavity varnish is being rapidly replaced in this role by the modern dentine bonding lining materials now available.

Very large cavities may have too little crown structure left for adequate retention to be provided using undercuts and dovetails (see Figure 15.3), and in these cases self-tapping dentine pins are used to provide retention instead (see Figures 15.4 and 15.5).

Recommendations for providing the best long-term results of amalgam restorations are as follows:

- In shallow cavities, a calcium hydroxide lining on the floor of the cavity or a dentine bonding agent on the walls and floor of the cavity will suffice as a lining and provide a marginal seal.
- Medium cavities may have a zinc oxide and eugenol base placed or a dentine bonding agent on the walls and floor of the cavity, as above.
- Calcium hydroxide or one of the calcium silicate-based materials is used as a sublining in deep cavities, with one of the traditional zinc cements used as a base, or with one of the dentine bonding liners used to line the walls of the cavity and provide a marginal seal.

Amalgam restoration procedure

The general technique for amalgam restoration of a tooth, and the instruments used, are as follows:

- All dental personnel and the patient must wear the correct PPE throughout the procedure; in particular, the patient must be given safety glasses to wear.
- All caries is removed from the cavity using burs and excavators as described previously, and without breaching the pulp chamber.
- The cavity is **undercut** so that the amalgam restoration does not fall out.
- **Moisture control** techniques are used so that all fluids and debris are removed from the mouth, and so that the cavity remains dry during material placement.
- Adequate **soft tissue retraction** with aspirators or mouth mirrors is applied, without causing trauma to the patient.
- **A lining or base** is placed on the floor of the dry cavity to protect the pulp, if required; alternatively, a dentine bonding liner is placed over the whole cavity surface to seal the dentine tubules and prevent microleakage.
- A **metal matrix band** in its holder will be adapted to the tooth to prevent amalgam spillage during placement, whenever a class

II cavity is involved. This will either be a Siqveland or a Tofflemire matrix outfit (Figure 15.22).

- To ensure full adaptation of the band to the tooth in the interproximal area, a wedge may be pushed between the tooth and its neighbour to give a tight fit.
- Alternatively, one of the modern sectional matrix systems may be used for the same purpose (Figure 15.23).
- Their advantage over the traditional Siqveland or Tofflemire systems is that they do not have to be loaded and prepared by the dental nurse beforehand, and then disassembled after use and disposed of in the sharps container, activities which sometimes may result in sharps injuries.
- Instead, the matrix is removed from the tooth by the operator using the necessary implement and can then be simply dropped into the sharps bin in one action.
- The alloy and mercury are mixed in the amalgamator and the amalgam produced is inserted into the cavity in increments, using the amalgam carrier (Figure 15.24).
- Each increment load is fully pushed and **condensed** into the cavity, using the amalgam plugger. The use of a matrix system at this point for class II cavities is vital, to prevent the amalgam being pushed out of the cavity and into the interdental area, where it will set and prevent adequate cleaning interdentally (Figure 15.25).
- Once filled, any excess amalgam is carved off the tooth and the surface of the restoration is shaped so that food debris is naturally directed away from the interproximal areas, mimicking the normal occlusal fissure pattern of the tooth.
- The edges of the amalgam are adapted fully to the tooth surface by use of a burnisher instrument, so that no gaps or ridges remain.
- All excess amalgam and mercury are removed from the oral cavity through the **high-speed suction**.
- The matrix band is removed and the restoration is checked for **overhangs**.

- The **occlusion** is checked and adjusted as necessary.

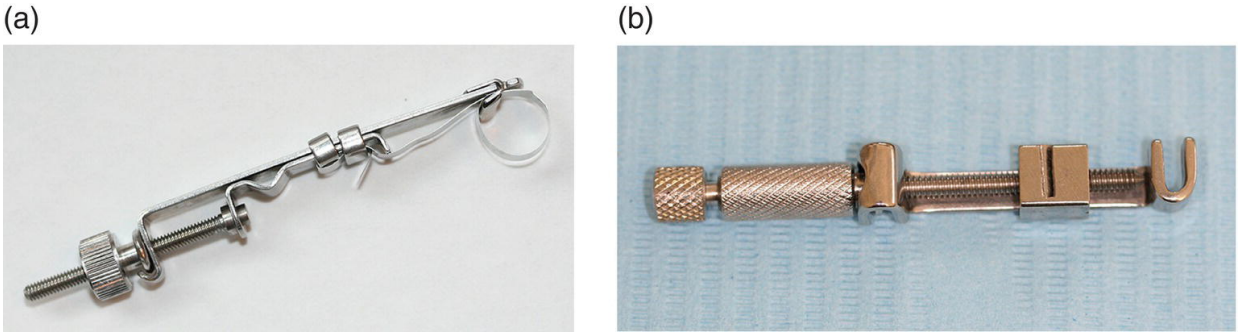


Figure 15.22 Matrix systems: (a) Siqveland; (b) Tofflemire.

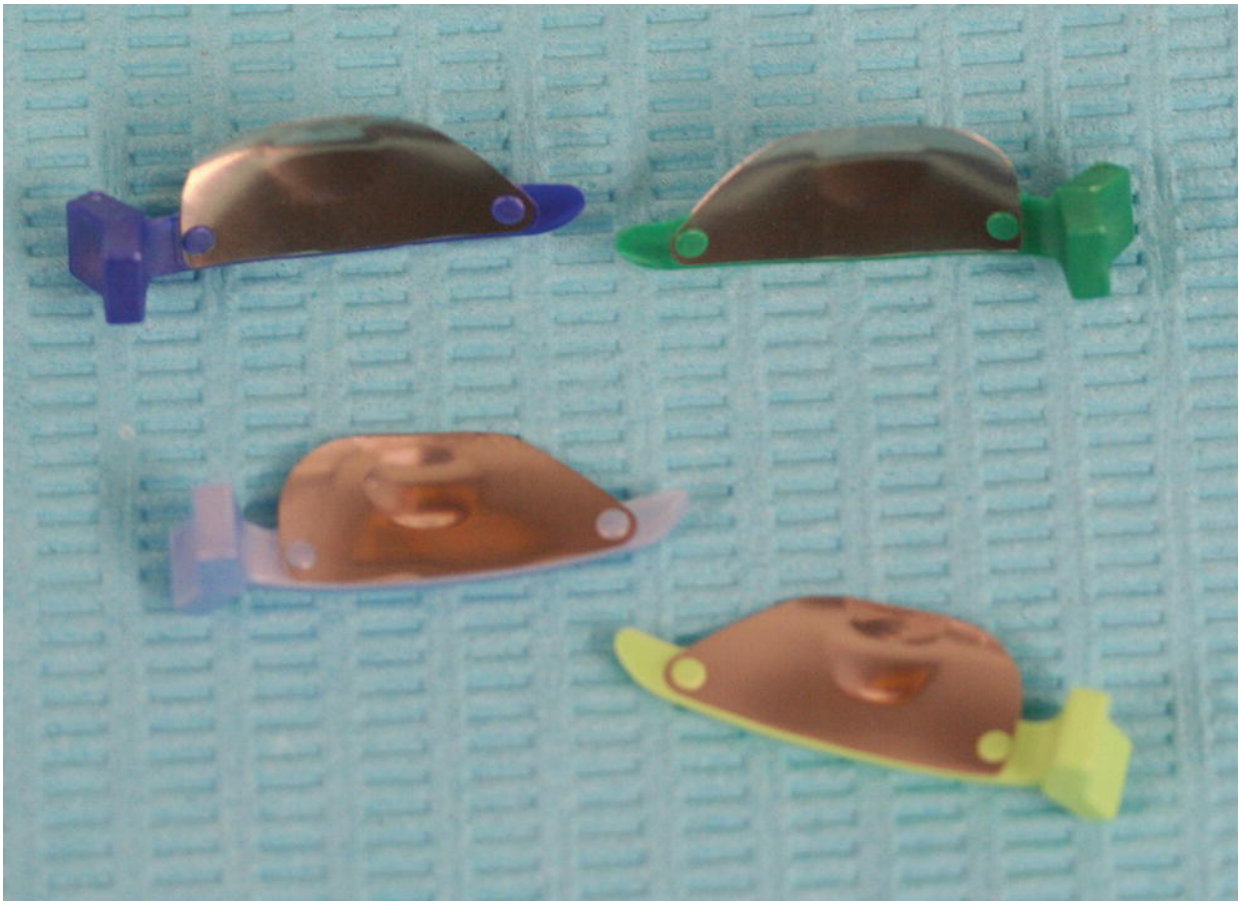


Figure 15.23 Example of sectional matrix system.

Figure 15.24 Plastic amalgam carrier.

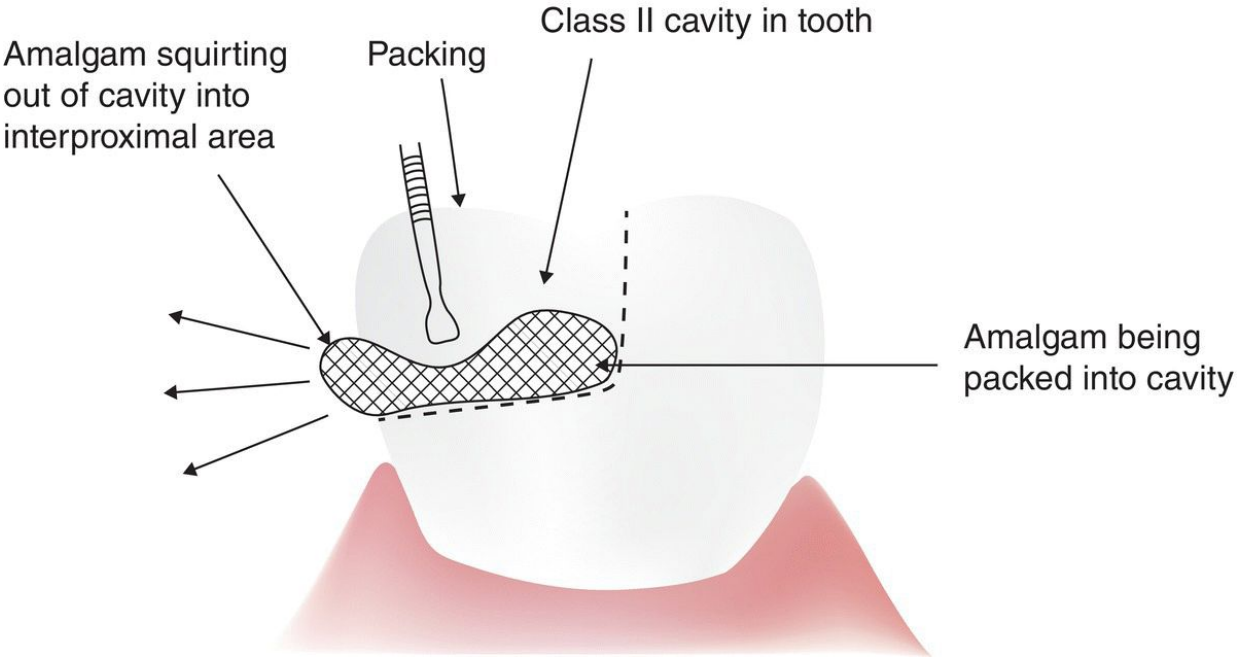


Figure 15.25 Amalgam forced interdentally during condensation of class II restoration with no matrix in place.

A summary of the materials and instruments involved is shown in Table 15.3.

Table 15.3 Amalgam restoration procedure: materials and instruments.

Item	Function
Liner and/or base material	To protect the pulp from microleakage, chemical irritation and thermal shock Various available including dentine bonding agents, calcium hydroxide and some of the temporary cements, all suitable under amalgam restorations
Matrix system	To prevent overspill in cavities of two or more surfaces Siqveland, Tofflemire, sectional systems available; the bands are single use
Wedges	Placed interdentally with older matrix systems, to tightly adapt the band to the tooth Both wooden wedges and plastic wedges are available
Amalgam carrier	Autoclavable 'gun' used to pick up and carry the amalgam to the cavity, where it is squeezed out
Amalgam plugger	Instrument to pack and condense the amalgam into the cavity so that no air spaces remain
Finishing instruments	To ensure the restoration is adapted to the tooth and is not high in occlusion Various items used: Ward's carver, flat plastic instrument, burnisher, greenstone drills

Although the initial set of the amalgam takes only a few minutes to occur, it is not complete for several hours. The patient is therefore instructed not to attempt to eat or drink until the effects of the local anaesthetic have worn off, or for at least 2 hours after treatment if no anaesthetic was used. If considered necessary, the filling may be polished at a subsequent visit using water-cooled *finishing burs*, brushes and pumice paste, or greenstones (Figure 15.26). Amalgam finishing burs are made of steel for use in low-speed handpieces and come in a variety of shapes but are distinguished from other burs by having far more cutting blades than usual.

Figure 15.26 Greenstones for use with slow handpiece to polish amalgam restorations.

The advantages and disadvantages of amalgam are shown in Table 15.4.

Table 15.4 The advantages and disadvantages of amalgam.

Advantages	Disadvantages
Easy to use	Mercury is toxic
Can be condensed (packed) into a cavity so that air voids are eliminated in the body of the filling	Undergoes constant corrosion in the oral environment, due to chemical reactions with foods, drinks
With the use of a matrix system, contact points can be predictably produced during packing	Placement of the filling does not strengthen the tooth overall
Relatively cheap, compared to composites and glass ionomers	Not retentive to tooth, so cavities must be undercut to ensure the filling does not fall out
Good set strength which allows heavy chewing forces without causing filling fracture	Can transmit thermal shocks, so liners and bases are required in deeper cavities
Forgiving material, which requires less skilful technique to place successfully than other materials	Does nothing to prevent microleakage unless the cavity is lined with a dentine bond first
Excellent longevity, lasts for many years under normal conditions in well-maintained mouths	Aesthetics are poor, so its use is limited to posterior teeth

Mercury poisoning and the Regulation on Mercury

Despite the many advantages of amalgam over other permanent restorative materials, its one big disadvantage is the fact that it contains mercury, which is known to be toxic. It was formerly believed that mercury poisoning could only occur after several years

of mishandling. However, it is now known that it can occur within a few months if a large quantity of mercury is spilled. There is also debate about the safety of the material within the oral cavity, although there is no evidence to suggest it is linked to health issues. The risks of poisoning in the environment from all sources of mercury, including dental amalgam, are considered so great that a global treaty (the Minimata Convention) has been agreed to protect the environment from mercury pollution generally. This means that dental amalgam is likely to be gradually phased out as a restorative material, probably within the next decade (although this time span is not certain yet). The plan adopted to achieve this in Europe (and therefore the UK) is referred to as the Regulation on Mercury and the measures required are as follows:

- From July 2018, amalgam should not be used in the following patient groups unless the dentist decides it is strictly necessary for the medical needs of the patient:
  - children under 15 years
  - pregnant women
  - breastfeeding women.
- From January 2019, all amalgam used in the UK must be available as pre-dosed capsules only, and not as separate alloy powder and liquid mercury to be mixed in older amalgamators.
- Also, from this point every dental practice must have amalgam separators in place on all dental units and all instrument cleaning sinks.
- All current separators in use must meet specifications to retain at least 95% of amalgam particles by January 2021, while all those fitted new after January 2019 must achieve this level of efficiency immediately.
- Only authorised waste management agencies can be used for the handling and collection of amalgam waste from the dental workplace.

In the meantime, every dental nurse must therefore understand the risks involved and the methods of preventing hazards associated with

the use of mercury and amalgam.

Mercury poisoning can occur in the following ways:

- **Inhalation** of the vapours.
- **Absorption** through the skin, nailbeds, eyes and wounds on the hands.
- **Ingestion** by being swallowed.

Although the possibility of skin contamination is obvious when handling mercury or amalgam, the risk of inhaling mercury vapour is not. Both mercury and amalgam release mercury vapour at ordinary room temperature – the higher the temperature, the more vapour is released. Mercury vapour is odourless and invisible, so it is of the utmost importance to keep all mercury and waste amalgam in sealed containers in a cool well-ventilated place, not near a hot steriliser or radiator, or even in sunlight. In particular, amalgam carriers must be dismantled and fully emptied of any residual amalgam before they are autoclaved, not only to prevent the release of mercury vapour in the decontamination area but also to prevent blockage of the carrier by hardened amalgam residue.

Another source of potential mercury poisoning is during the removal of old amalgam fillings. This releases a cloud of minute amalgam particles which can be inhaled or contaminate eyes and skin. It can be prevented by combining the wearing of suitable PPE and the use of copious water spray and an efficient aspirator, which is sealed to prevent the release of vapour in the clinical area. The use of a rubber dam and safety glasses is the best protection available for patients during filling removal.

Apart from very rare cases of allergy, there is currently no evidence of danger to patients from the presence of their amalgam fillings, as a well-placed restoration should have had all excess mercury removed during the procedure. Pregnant chairside staff involved in restorative procedures involving amalgam may also be concerned, but regular urine tests for mercury contamination of staff can be carried out to show if any risk is present.

The symptoms of mercury poisoning are as follows:

- Early symptoms may include headache, fatigue, irritability, nausea and diarrhoea.
- At this stage it is unlikely that mercury poisoning would be suspected.
- Later symptoms are **hand tremors** and **visual defects** such as double vision.
- The final stage is **kidney failure**, and then death.

Precautions to be followed by all staff

The routine use of PPE, such as gloves, mask and safety glasses, or visors worn for protection against cross-infection, will provide protection against mercury hazards. Dental nurses can be reassured that no danger exists if the following precautions are taken. However, they are so important that they are repeated here, having been previously covered with other occupational hazards in Chapter 4.

To avoid absorption of mercury through the skin, the basic rules of cross-infection control should be followed.

- Always wear disposable gloves when handling mercury, mixing amalgam and cleaning amalgam instruments.
- Do not wear open-toed shoes in the clinical area, as the floor may be contaminated by spilled mercury or dropped amalgam.
- Do not wear jewellery or a wrist watch as they may harbour particles of amalgam.
- Incidentally, gold jewellery can be spoiled by contact with mercury or amalgam.

To avoid pollution of the air by mercury vapour, the following precautions must be taken:

- Ideally, a preloaded capsule system should be used, rather than the old-fashioned system of bottled mercury and alloy powder being manually loaded into the amalgamator. This will be mandatory from January 2019.

- If the latter system is still in use, containers of mercury must be tightly sealed, and stored in a cool well-ventilated place.
- When transferring mercury from a stock bottle, great care must be taken not to spill any. It is very difficult to find and recover mercury which has been dropped on the floor or working surface as it is a liquid metal and rolls away easily (see Figure 4.8).
- For removal of old amalgam fillings, the use of a high-speed handpiece with diamond or tungsten carbide burs, water spray and efficient aspiration helps to reduce the aerosol of amalgam dust and mercury vapour while the use of a rubber dam will protect the patient.
- Surgery staff must wear full PPE throughout such procedures, as they should for all chairside procedures.
- All traces of amalgam must be removed from instruments before autoclaving, otherwise vapour will be released as the autoclave heats up; this is especially pertinent with amalgam carriers.
- Keep the surgery well ventilated.
- Amalgamators and the capsules used therein should be checked after use as cases have been reported of mercury leakage from capsules during mixing.
- Amalgamators must be stood on a tray lined with aluminium foil so that any droplets can be easily collected and disposed of as hazardous waste, using a disposable syringe (see Figures 4.9 and 4.10).
- The machines must also have a lid over the capsule holder, so that leaking capsules do not throw their dangerous contents into the surgery.
- All premises using amalgam must have a **mercury spillage kit** so that any accidents can be dealt with swiftly and correctly (see Figure 4.11).

Surgery hygiene

Much can be done to minimise any dangers of working with mercury by adopting the following rules of surgery hygiene, many of which would be common sense anyway.

- Smoking, eating, drinking and the application of cosmetics must not take place in the surgery. Any of these actions could permit absorption of mercury, from mercury vapour in the air or from contaminated hands.
- The storage and handling of mercury must be confined to one particular part of the surgery, away from all sources of heat.
- Any spillage of mercury *must* be reported to the dentist or other senior staff member.
- Mercury spillage kits must be used for the safe recovery of all spillages greater than a few droplets.
- Vacuum cleaners must never be used for this purpose as they vaporise any mercury they pick up and discharge it back into the surgery.
- Floor coverings must not have any cracks or gaps in which mercury or amalgam can be trapped, and carpets must not be used as a surgery floor covering.
- Surgery equipment and plumbing must have easily accessible filter traps to collect particles of waste amalgam flushed through spittoons, aspirators or other suction apparatus. This waste must be collected and transferred to the surgery waste amalgam containers.
- Modern aspirators and cleaning sinks must be fitted with an amalgam separator, so that no waste material enters the drains (Figure 15.27).
- Waste amalgam must be saved in sealed tubs containing a mercury absorption chemical and taken for collection by specialist waste contractors for recycling (see Figure 4.5).
- Efficient ventilation is essential at all times of the year, and high surgery temperatures should be avoided.
- The Environment Agency of the UK, via the HSE, must be notified of any large spillage that may result in mercury poisoning, under RIDDOR.

Figure 15.27 Waste amalgam separator trap under sink.

Safe disposal of waste amalgam

All amalgam waste and extracted teeth with amalgam fillings must only be collected for disposal by authorised *hazardous waste contractors* (see Chapter 4). The reason for this is that most other hazardous waste is incinerated, and if that containing any amalgam waste was included the incineration process would pollute the air with mercury vapour. Before collection by the authorised contractor, the amalgam waste must be stored in special containers, which they supply, and which prevent the escape of mercury vapour (see Figure 4.6). The contractors may also arrange periodic testing of the workplace mercury vapour levels and the checking of amalgamators for mercury leakage. If these tests show an unexpectedly high concentration of mercury vapour in a workplace with no report of a spillage occurring previously, expert advice can be sought from the local environmental health experts, acting under COSHH regulations, in tracing the source and resolving the problem. As stated previously, urine tests can also be carried out on staff to ensure that they have not

been exposed to high levels of mercury vapour, although unfortunately these tests are not routinely carried out by occupational health departments at the moment.

Mercury spillage

Accidental spillage of mercury or waste amalgam must always be reported to the dentist or other senior staff member. If a spillage occurs, globules of mercury can be drawn up into a disposable intravenous syringe or bulb aspirator and transferred to a mercury container (see Figures 4.8 and 4.9) while small globules can be collected by adhering to the lead foil from X-ray film packets. Waste amalgam can be gathered with a damp paper towel. For larger spillages, the following protocol should be undertaken:

- Stop work and report the incident to the dentist immediately.
- Put on full PPE.
- Globules of mercury or particles of amalgam must be smeared with a **mercury absorbent paste** from the mercury spillage kit (see Figure 4.11).
- This consists of equal parts of **calcium hydroxide** and **flowers of sulphur** mixed into a paste with **water**.
- It should be left to dry and then removed with a wet disposable towel and placed in the storage container.
- Risk assess the incident to determine if protocols require amendment.
- Larger spillages still require the evacuation of the premises, the sealing of the area and the involvement of the local **environmental health** team to remove the contamination as a specialist procedure.
- The **HSE** will be notified under RIDDOR, so that an investigation can be carried out to determine if the practice procedure needs to be changed to prevent a recurrence of the spillage.

Composite restorations

Composites are tooth-coloured restorative materials that are presented in a wide range of shades, to match the darkest or lightest tooth. Modern systems are set quickly by exposure to a blue curing light, rather than the older systems that relied on a chemical reaction for setting to occur. Composites were initially developed for the aesthetic restoration of anterior teeth, but many modern products can also be used for restoring posterior teeth. However, their development is too recent to know whether they will routinely wear as well here as amalgam fillings, although many developing countries have been using composites posteriorly for years, as they have had little or no access to amalgam. Tables 15.4 and 15.6 can be used to compare and contrast the advantages and disadvantages of the two materials.

Composite materials consist of an *inorganic filler* in a *resin binder*. The inorganic filler, which acts as a strengthener, may consist of *powdered glass*, *quartz*, *silica* or other *ceramic particles*. This is incorporated into the resin binder to produce the composite material, which then requires a catalyst to produce setting. The particle size of the filler can be varied to produce the following range of materials:

- **Microfine composites**: very small particle size, giving superior polishing and a gloss finish for anterior restorations.
- **Hybrid and nano composites**: various size particles to give higher strength and better wear resistance for posterior restorations.
- **Universal composites**: combination of microfine and hybrids, to be used for both anterior and posterior restorations.

Composite filling materials

The composites used for permanent restorations contain a filler, resin binder and catalyst. When the catalyst is activated it makes the filling set. The original composites, such as Adaptic, were supplied as two pastes: one containing a resin binder and filler, the other containing a catalyst. Mixing the two together activates the catalyst and makes the filling set. This method of mixing two components to produce setting is called a *chemical-cure* (self-curing) system. However, it has been almost superseded by materials containing a catalyst activated by

exposure to light (e.g. Tetric, Filtek, Heliomolar). This setting method is called a *light-cure* system. However, there is still a need for chemical curing in situations where metallic restorations (crowns, bridges and inlays) are cemented into, or onto, prepared teeth. The blue curing light cannot penetrate metal, so a special type of *dual-cure* composite material has been developed which is both self-curing and light-curing; in use it can be set at the margins of the metallic restoration by a curing light and then will self-cure chemically beneath the metallic restoration.

Light-cure system

Unlike chemical-cure composites, which cannot set until two components are mixed together, light-cure materials (e.g. Filtek, Solitaire, Helioseal) have introduced an ideal setting system. A single component contains the resin binder, filler and a special catalyst which is only activated when exposed to a very bright light. The spot of intensely bright blue light activates the catalyst and makes the material set in less than a minute. No mixing is required. The unique advantage of this system is that the dentist has more control over the setting time of the restoration, although the material will eventually begin to harden under the influence of the overhead dental light.

The single component of light-cure composites enables manufacturers to supply their product in multidose dispensing syringes, or single-dose capsules called *compoules* (Figure 15.28) with an injector gun (Figure 15.29), thereby allowing the dentist to inject the filling directly into a prepared cavity. The dentist then has as much time as necessary to adapt, contour and trim the filling material before commanding it to set. In this way, the time-consuming removal of excess material which has set rock-hard can be avoided.

Figure 15.28 Composite compoule.

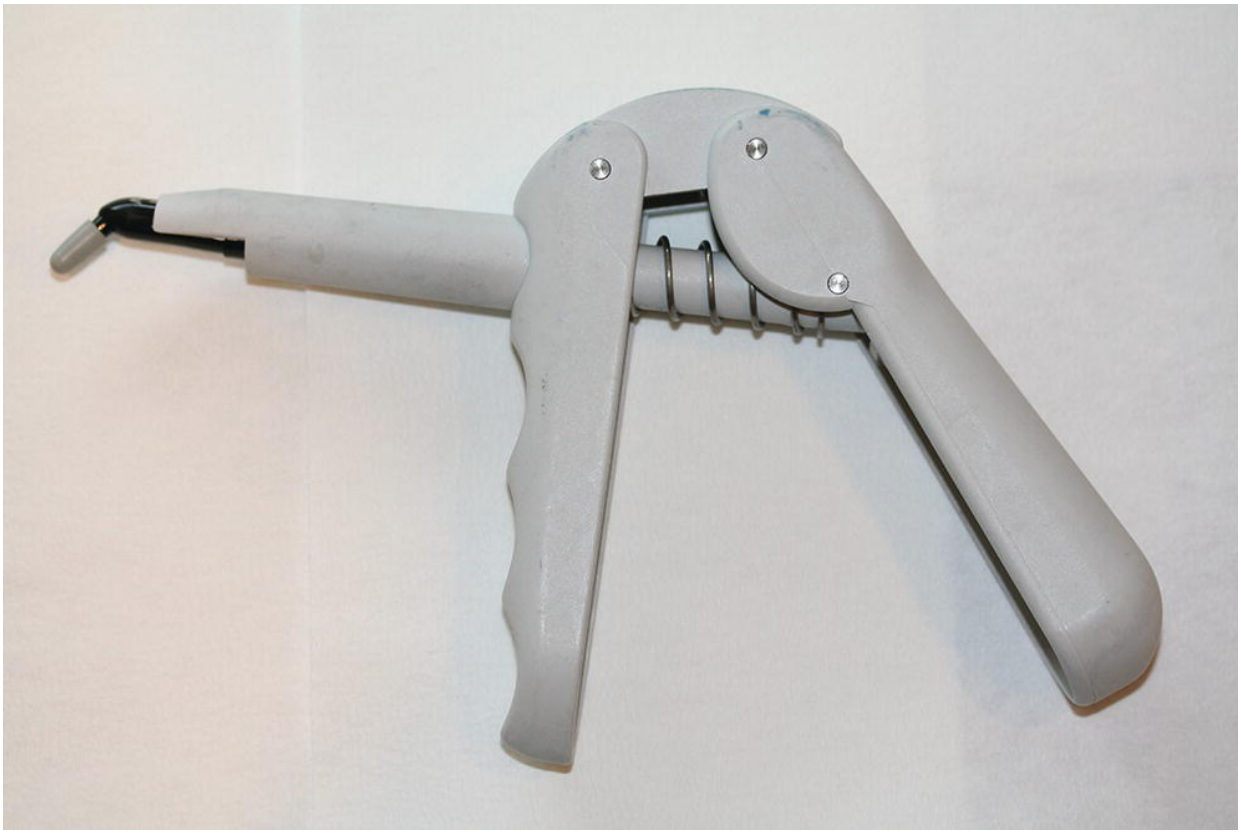


Figure 15.29 Compoule in the injector gun.

Alternatively, and to avoid cross-infection and material wastage, the dental nurse can inject sufficient material for small restorations onto a waxed pad or glass block from where the dentist can pick it up and place it into the cavity. The compoule and its contents remain uncontaminated and can be used on other patients in the future, using the same technique.

Just a thin layer of composite is needed to fill a shallow cavity and this only requires one application of the curing light. In larger cavities this would only cure the surface layer of conventional composite materials as the light cannot penetrate layers thicker than 2 mm. In order to obtain full curing in such cases, the composite is inserted in a thin layer, then light-cured before adding another thin layer and light-curing again. This sequence is repeated *incrementally* until the cavity is completely filled with fully cured composite (Figure 15.30). One way of saving time in such cases was to partially fill a large cavity with a thick layer of lining material, followed by a surface layer of composite that can be cured in one application of the light. The usual lining material for this purpose was glass ionomer cement (described later). However, recent materials research and development has produced a new era of *bulk-fill* composites – restoratives that can be placed in one go up to a depth of 4–5 mm (depending on the material) to either completely fill the cavity or to fill the majority of the cavity and then have a 'capping' layer placed for better aesthetics, using a conventional light-cure composite material. This technique significantly reduces the clinical time required to restore a large cavity with composite filling material, excessive treatment time being one of the main disadvantages of using composite materials rather than amalgam. Examples of bulk-fill materials include Aura Bulk Fill, Surefil SDR, Venus Bulk Flow, and Filtek Bulk Fill (Figure 15.31).

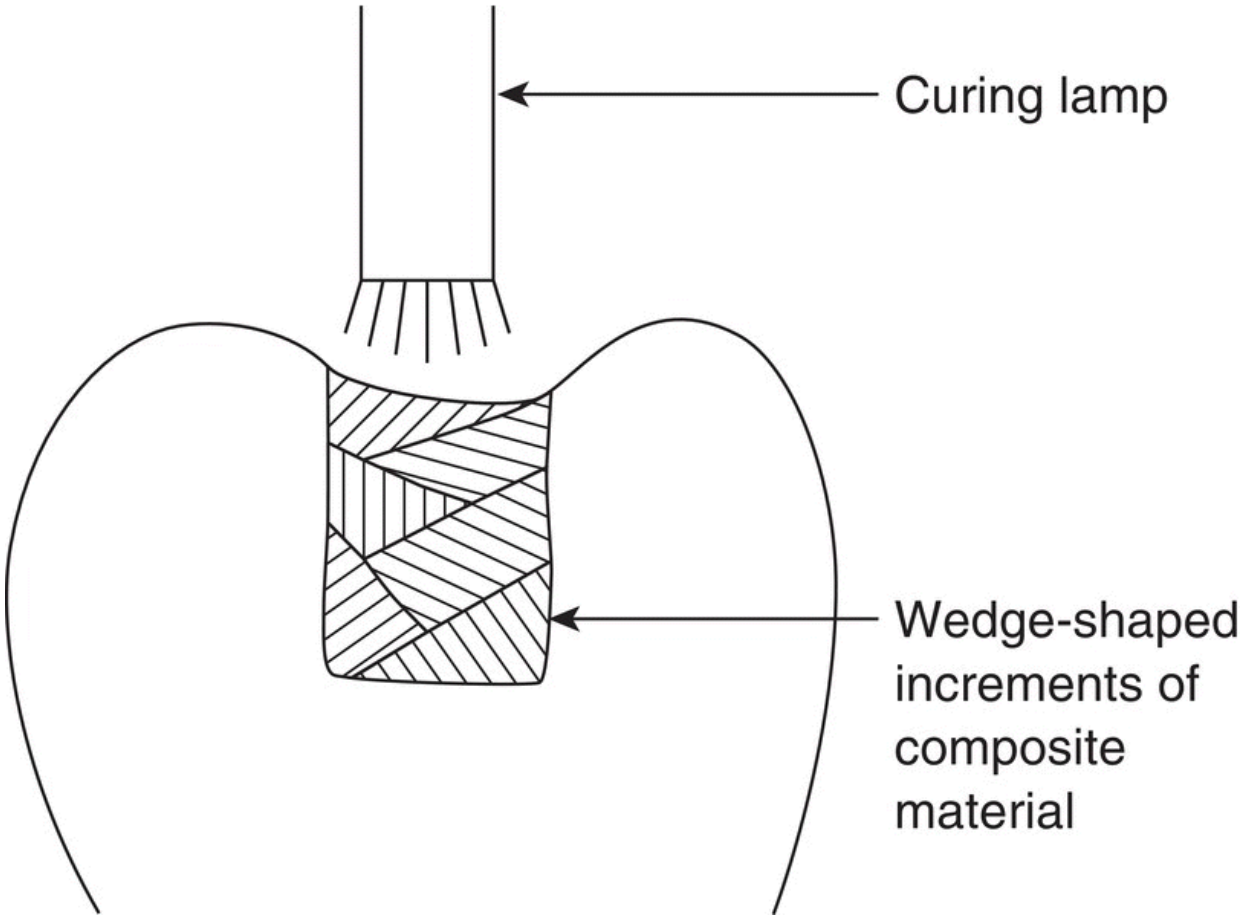


Figure 15.30 Composite increment curing technique.

Figure 15.31 Example of a bulk-fill composite material.

There are so many different brands of composite material, and so many different types of curing light, that it is essential to strictly

follow manufacturers' instructions for the curing time, light bulb life, and care and maintenance of this equipment. A simple test of the curing light's effectiveness is to cure a small measured portion of composite on a glass block or mixing pad and then check that it has set hard throughout its full thickness. Many modern curing lights have an integral 'cure test' port within the design of the unit (Figure 15.32), where the tip is simply placed into the port and activated; if the bulb is failing so that the expected depth of cure is not adequate, either a visible or audible alarm results and the matter can be addressed.


Perfection
Plus

Figure 15.32 Curing light with 'cure test' facility.

Composite restoration procedure

The procedure for the placement of a typical composite restoration, and the additional instruments, equipment and materials that may be required for the procedure, are described below.

- All dental personnel and the patient wear the correct PPE throughout the procedure, especially orange-tinted safety glasses to counteract the blue curing light.
- All caries is removed from the cavity, without breaching the pulp chamber.
- Moisture control techniques are used so that the cavity remains dry; this may involve the placement of a rubber dam.
- Adequate soft tissue retraction is applied, without causing trauma to the soft tissues.
- Calcium hydroxide lining, a glass ionomer base or one of the new calcium silicate-based materials is placed to protect the pulp if required.
- **Transparent matrix strip** is placed interdentally if required, to separate the tooth from its neighbours (Figure 15.33), especially with anterior composite restorations.
- Alternatively, one of the **sectional matrix systems** may be placed (see Figure 15.23), especially with class II composite restorations.
- Cavity edges are chemically roughened in a selective etch technique, by being coated with **acid etchant** (33% phosphoric acid) for about 15 seconds (see Figure 4.12).
- Microscopically, this roughens the enamel surface by dissolving the interprismatic substance and leaving the prisms projecting from the tooth surface.
- This is thoroughly and carefully washed off and collected by the high-speed suction, and the cavity is wiped dry.
- **Dentine primer** may be placed at this point.

- Alternatively, the whole cavity is etched, washed and dried with phosphoric acid in a total-etch technique, or one of the more recent **self-etch** adhesive bonding materials is used in one application to etch the enamel and prime the dentine at the same time (Figure 15.34).
- **Resin bond** is wiped over the etched enamel and cured for about 10 seconds.
- This adheres to the prisms and provides tags for the composite to stick to when placed.
- Alternatively, the whole cavity is wiped over with one of the modern adhesive lining materials, such as a resin-modified glass ionomer or a dentine bonding agent (see Figure 15.7).
- Shade is determined and the composite material is pumped into the cavity in increments of 2 mm, and cured with the curing light.
- The cavity is gradually fully filled and cured, while the matrix strip is adapted tightly to avoid any overhangs.
- Alternatively, one of the new bulk-fill composite materials is used to fill the cavity in one stage, either with or without a capping layer, depending on the particular product used.
- Restoration is finished using a variety of finishing strips (Figure 15.35) and/or finishing burs (see Figure 15.16).
- Occlusion is checked using articulating paper and adjusted as necessary.

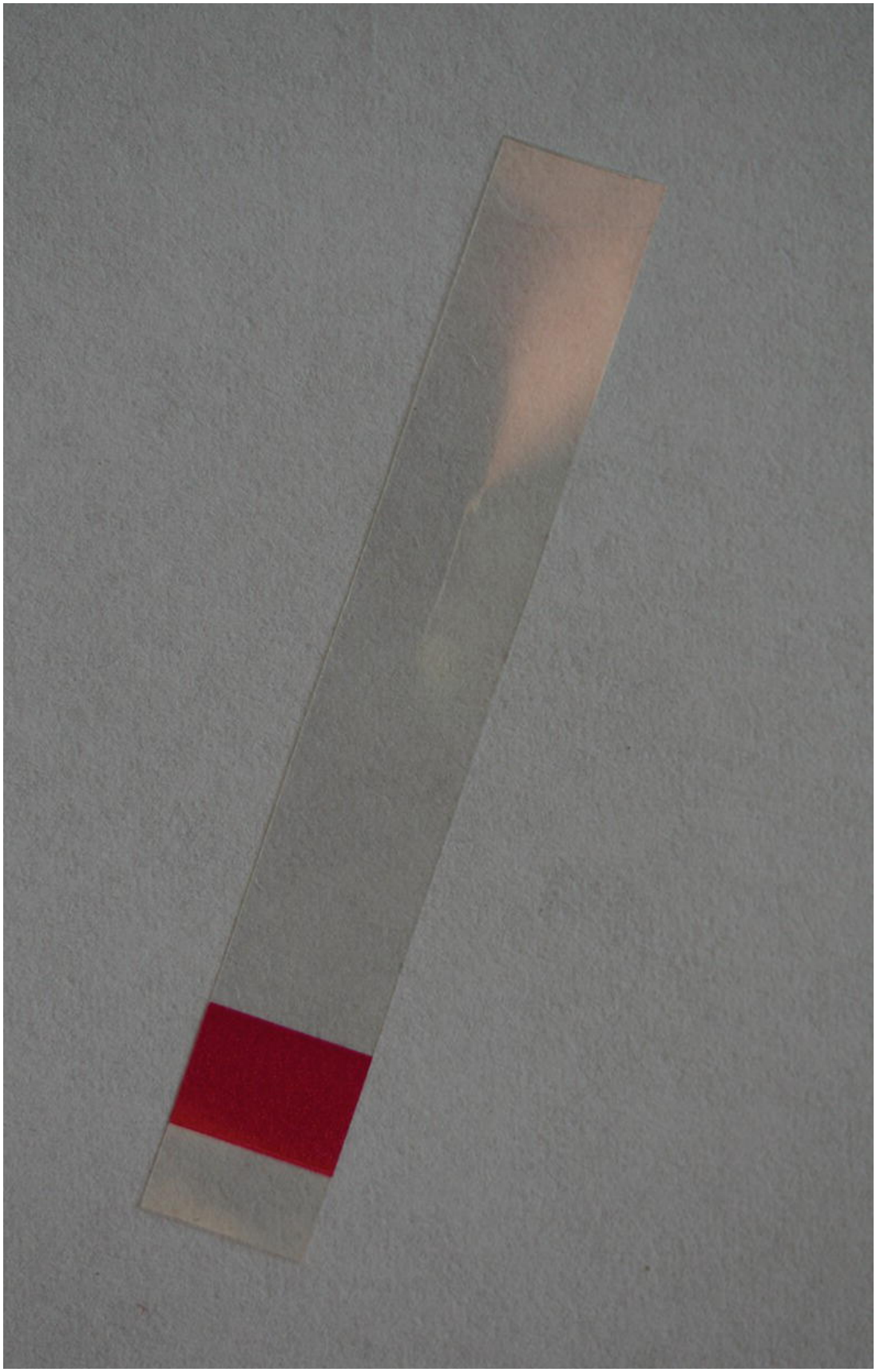


Figure 15.33 Transparent matrix strip.

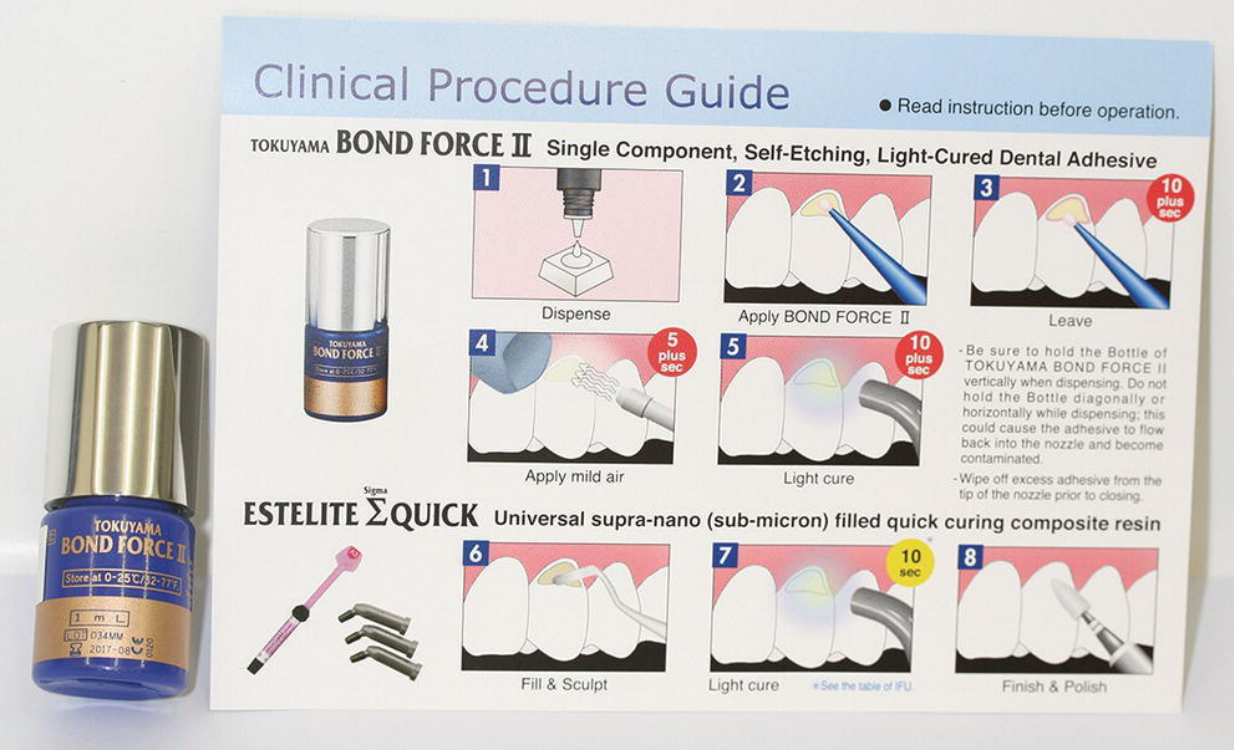


Figure 15.34 Example of self-etch adhesive bonding material.

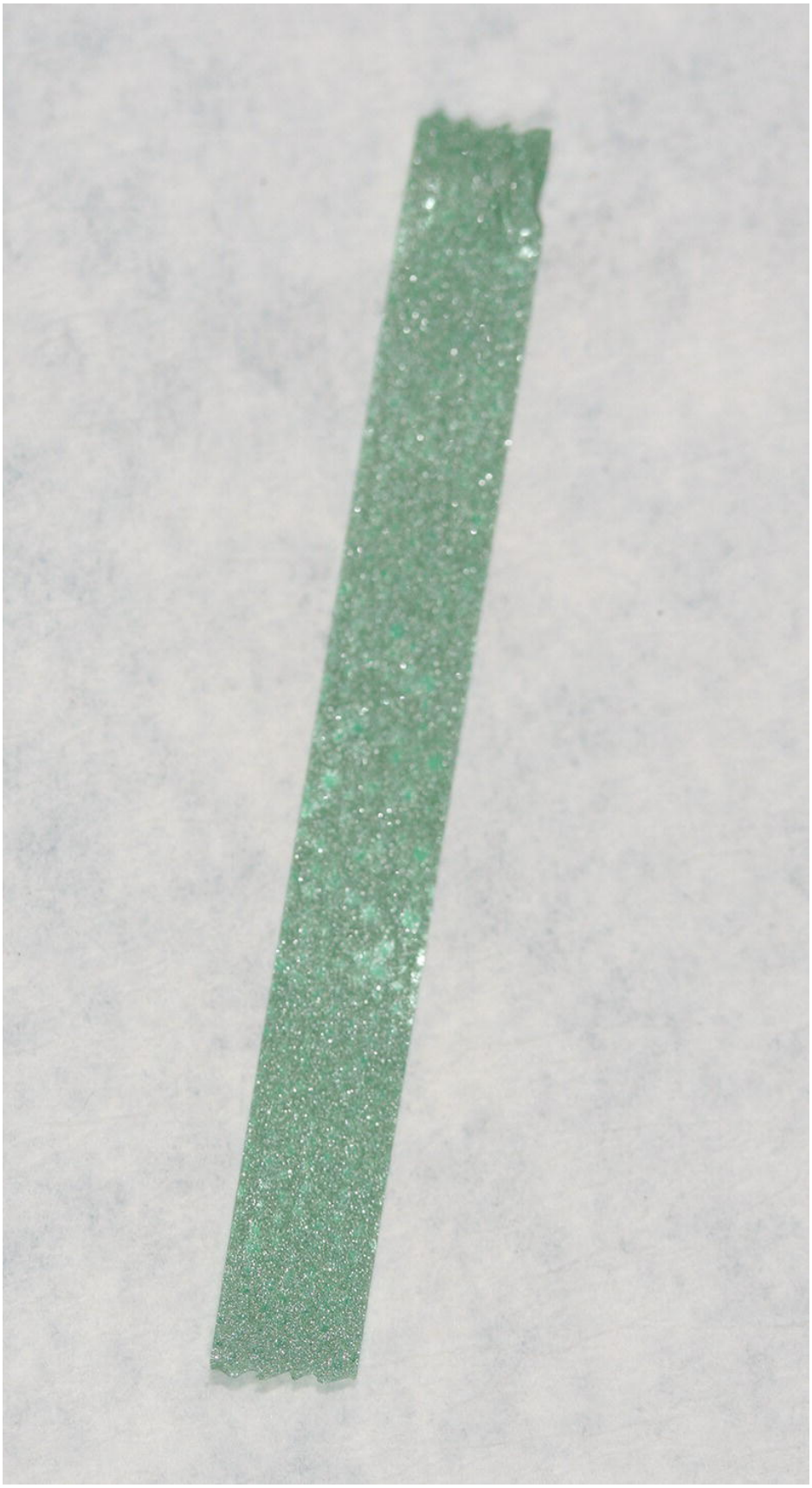
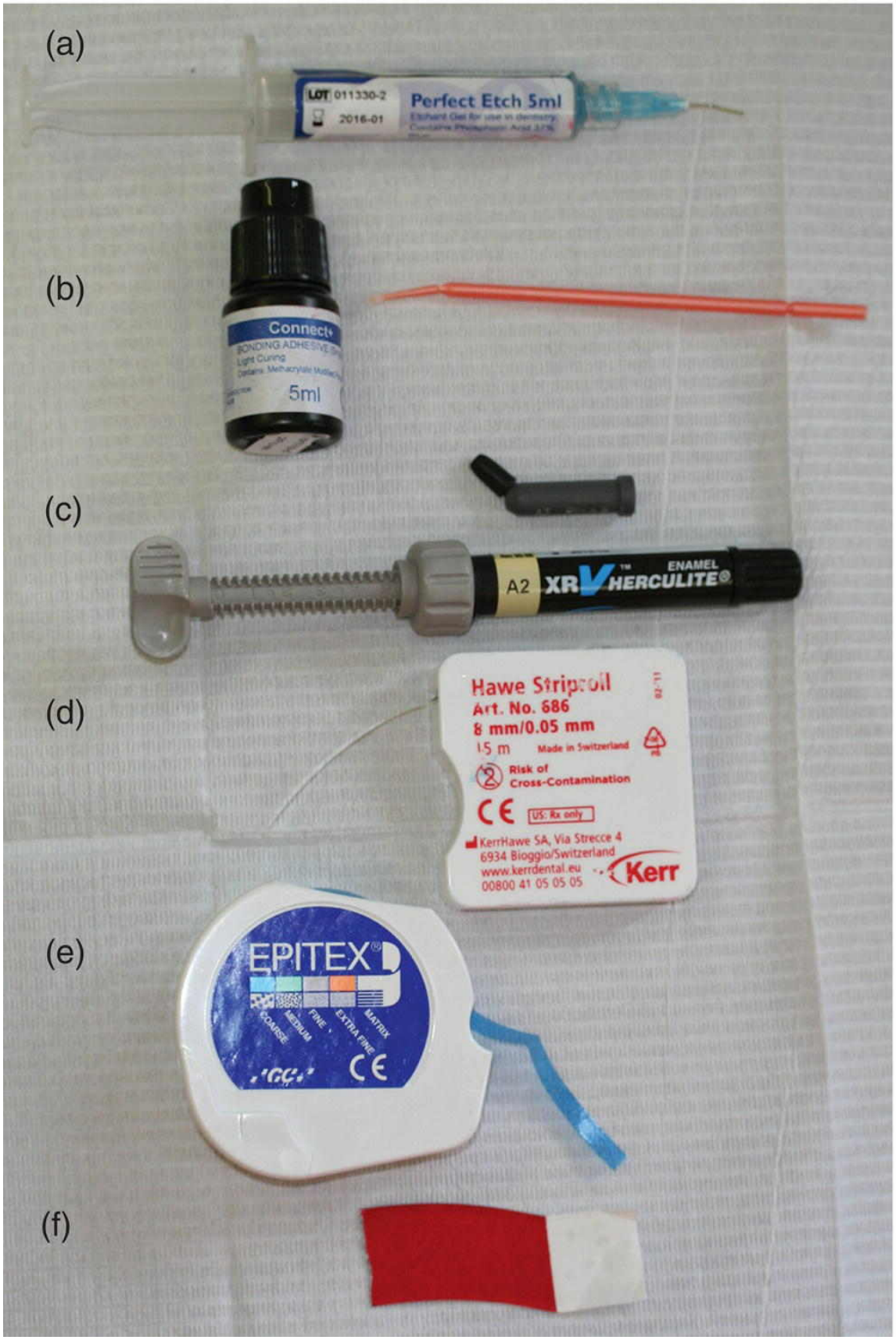


Figure 15.35 Finishing strip.

A typical equipment and materials lay-out for a conventional anterior composite restoration is shown in Figure 15.36.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8 mm/0.05 mm
15 m
Made in Switzerland
Risk of
Cross-Contamination
US: Rx only
KerrHawe SA, Via Strecce 4
6934 Bioggio/Switzerland
www.kerrdental.eu
00800 41 05 05 05
Kerr
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COARSE
MEDIUM
FINE
EXTRA FINE
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Figure 15.36 Equipment and materials for composite filling procedure. (a) Acid etchant. (b) Resin example and applicator. (c) Composite material example. (d) Transparent matrix strip. (e) Finishing strip. (f) Articulating paper.

A summary of the materials and instruments involved is shown in Table 15.5 and the advantages and disadvantages of composite restoratives over others are shown in Table 15.6.

Table 15.5 Composite restoration procedure: materials and instruments.

Item	Function
Liner or base material	To protect the pulp from chemical shock Calcium hydroxide lining, and glass ionomer base or calcium silicate-based material in deep cavities
Modern, full cavity adhesive agent	Applied to the cavity walls (and floor if suitable) as a dentine bonding agent to provide adhesion between the dentine and the restoration To seal dentine tubules and prevent microleakage
Matrix system	Transparent matrix strips, to allow curing of the composite through it Various sectional holder systems available, or held in place manually when working anteriorly
Plastic instruments	To place the composite and remove excess before curing Various designs available, the most common one being a flat plastic instrument Ceramic-tipped instruments, to avoid adherence of the material, are available
Finishing instruments	To ensure no overhangs are left and that the surface of the restoration is smooth Various items used: specially shaped plastic instruments, abrasive strips, polishing discs, polishing burs of various designs

Table 15.6 The advantages and disadvantages of composite restoratives.

Advantages	Disadvantages
Excellent aesthetics with a wide range of shade choice	Technique sensitive, so clinical skill is required to achieve good results
Adhesive to tooth using acid etch and bond, so less tooth tissue removal during cavity preparation	Longer procedure than for amalgam restoration unless modern bulk-fill materials are used
Little marginal leakage occurs, due to their adhesion to enamel	More expensive material than amalgam
Use of dentine bonding agents over the whole cavity significantly reduces microleakage, and therefore post-restorative sensitivity	Cannot be condensed into the cavity, so adequate contact points can be difficult to achieve unless one of the modern, waxy consistency bulk-fill materials is used
Sufficient strength in smaller posterior restorations with conventional materials	Not as strong and hard-wearing as amalgam in posterior teeth unless more advanced products are used
Reinforces the strength of the tooth after restoration, due to the adhesive bond between the filling and the tooth itself	Possible chemical safety issue with resin bond of older products
Indirect inlay technique possible for larger restorations, although modern direct composite materials are proving to be as good as indirect materials	Can only use glass ionomer as a base, as composites react with older zinc-based bases
Fast set with curing light	Acid etchant can burn soft tissues if used carelessly
Available in premixed compoules for easy insertion into cavity	Safety issue with curing light causing eye damage; orange-tinted safety shield must always be used

Safe handling and usage of composite

Great care is required when using the acid etch liquid or gel during the placement of a composite restoration, to prevent soft tissue damage to the patient or the dental team. It consists of a 33% concentration of phosphoric acid, and this is more than sufficient to cause acid burns and permanent scarring of the patient's soft tissues, including their facial skin.

Also, the blue curing light used to fast-set the restoration can cause damage to the retina of the eyes if looked at directly, so the patient must wear correctly tinted safety glasses during treatment (orange tinted are best). An orange-tinted protective shield should also be held over the fibre-optic end of the light during use, to prevent the dental team from having to look at the light without eye protection.

Other uses of composite materials

These materials have a variety of other uses besides tooth restoration, the most usual of which are discussed below.

Restoration of fractured incisors

Before acid etching techniques were introduced, the most satisfactory way of restoring fractured incisors was by fitting a porcelain jacket crown. Unfortunately, this is unsuitable for children as the pulp chambers of immature teeth are too large and crown preparation may cause pulp damage. This, together with the fact that incisor fractures most commonly occur during childhood, meant that some other form of temporary crown had to be used, and these were of relatively poor appearance.

Composite filling materials and acid etching have transformed the treatment of fractured incisors. Small fractures in children and adults can be permanently restored in this way. Although porcelain jacket crowns and modern all-ceramic crowns may remain the best treatment for extensive fractures, acid-etched restorations provide children with a satisfactory alternative until such time as the tooth, and the patient, are ready for a more permanent restoration.

Enamel margins are acid etched and lined with a bonding agent. A hybrid composite filling material is applied in a clear plastic crown

form, such as an Odus pella crown form (Figure 15.37). The crown form is used to avoid the need to hand-shape the restoration during placement. When it has set, any excess material is trimmed off and the restoration is polished where necessary.

Figure 15.37 Odus pella crown forms, with coloured sponge within each to aid visibility.

The acid etch/composite filling technique is also used for building up malformed or misshapen teeth to improve their appearance; for the direct bonding of orthodontic brackets, porcelain veneers and small bridges (see later); and for the construction of temporary splints. The latter are involved in stabilising loosened teeth due to trauma or periodontal disease and are made by bonding a length of wire or fibreglass tape to the loose tooth and its neighbours with a light-cure composite. The whole structure becomes rigid once cured, and the

loose tooth is then firmly held in place while the periodontal ligament and alveolar bone around the tooth are able to repair themselves.

Fissure sealing

As mentioned in Chapter 13, fissure sealing is used as a caries prevention measure. Occlusal fissures and buccal pits are natural stagnation areas where caries commonly occurs. If these fissures can be sealed over soon after eruption of a permanent posterior tooth, the occlusal surface and buccal pit should then stay free of caries.

The advent of new materials, such as composites and glass ionomer cements, allows fissure sealing to be done with minimal (if any) cavity preparation, because they are adhesive to the tooth structure itself. Retention is obtained by acid etching the fissures or pits. Whichever material is used, any existing caries is removed and the cavity is filled at the same time as the sound fissures. It is hoped that in the vast majority of cases, the procedure is carried out as a preventive measure on a caries-free tooth anyway, rather than as a treatment for existing disease.

The application of fissure sealants should be done as soon as possible after eruption but requires a completely dry occlusal surface. This is difficult to achieve in young children but may be overcome by applying a fluoride varnish (e.g. Duraphat) as a temporary seal, until a child is co-operative enough to permit the attainment of a dry field for sufficient time.

Unfilled resins and flowable composites

All the composite filling materials described so far consist of a resin binder incorporating an inert inorganic filler. They are accordingly called *filled resins*. A catalyst (either chemical or light) makes the resin set, while the filler remains unchanged throughout. This gives the unset material its paste consistency and the set filling its hardness and durability.

Thus, it is only the resin and catalyst which are actually involved in the setting process. Several brands of composite make use of this fact by providing a liquid base containing just the resin without a filler. This is called an *unfilled resin* and sets in the same way as all the

others by using the same catalyst. These unfilled resins (e.g. Delton, Helioseal) are available in chemical-cure or light-cure brands.

The advantage of an unfilled resin is its liquid consistency. Both resin and catalyst are liquids and the mixture can be easily flowed over acid-etched enamel, into fissures or mixed with a filled resin paste to give any desired consistency. Unfilled resins are accordingly used as fissure sealants (although coloured materials are also available) and for surface glazing.

By adding a reduced amount of filler material to an unfilled resin, a composite material is produced which is in a liquid format and can flow into cavities and naturally spread out to cover an area – these are *flowable composites*. They are ideal products to use as liners in cavities and will seal dentinal tubules when used with a dentine bonding agent. Due to their similar chemical composition they are also compatible with conventional composite restorative materials as well as with the modern bulk-fill composite materials. Figure 15.38 demonstrates the differing consistency of a flowable composite material and that of a conventional composite restorative material.

Figure 15.38 Example of a flowable composite and a conventional composite.

Dentine bonding agents

Although acid etching can satisfactorily bond older composite materials to enamel, it cannot bond them to dentine. Small undercuts are therefore required for adequate retention of some composite restorations.

A new group of dental materials are now available which can bond composites to dentine and enamel. There is such a bewildering range of products available, with such a confusing pattern of instructions for use, that no consensus on the ideal type of product seems to have been achieved. However, the simplest product would be one that is a single-component, one-stage application to enamel and dentine, without any need to keep the prepared tooth dry. Some light-cured products that approach these ideals are already available, such as Optibond Solo Plus and Solobond M. The material used will be an individual choice by the dentist, based on previous experience and knowledge of dental materials. However, some of the dentine bonding agents contain chemicals which are irritant to pulp tissue and require a liner material to be placed beneath them on the pulpal floor of deep cavities.

With the expectation of amalgam eventually being phased out as a restorative material for environmental reasons, the research and development of dental materials science has rarely been more active than it is now in a bid to produce alternative restorative materials which strive to meet the ideal criteria shown below:

- cost-effective
- able to reduce/prevent microleakage and therefore post-restorative pain
- increase the strength of the restored tooth by bonding to its structure
- aesthetic
- hard-wearing during normal occlusal function, with reasonable longevity
- clinically easy to use and manipulate.

The modern composite materials now available are not far from achieving most of these ideals, and as research progresses and new

products are developed it is likely that eventually the perfect composite will emerge.

Glass ionomer cements

Glass ionomers are tooth-coloured restorative materials that are adhesive to all the hard tissues of the teeth, so they tend to be used in situations when little natural retention of the restoration is available, especially in class V cavities. Conventional glass ionomers are composed of a powdered glass-like mixture of aluminosilicate particles and polyacrylic acid mixed with water (Figure 15.39), and although they have a range of shades available, their aesthetics are inferior to composites as they cannot be polished to a high sheen and blend in with the translucency of the surrounding enamel.

Figure 15.39 Glass ionomer cement material.

Various other forms are available, such as mixed with silver to produce a harder wearing posterior restoration, mixed with composite (as a compomer) to achieve a restoration with the advantages of both materials, or mixed with other metals (as cermets) for use in tooth core build-ups (e.g. Vitremer).

Other types of product widely available are the resin-modified glass ionomer cements which, as the name suggests, are able to be set by light-curing due to their resin component. Current examples include

products such as Fuji and Vitrebond. They have several advantages over conventional glass ionomer cements as follows:

- The resin component enables them to bond to dentine and therefore to seal dentinal tubules, helping to reduce/prevent microleakage.
- Their glass ionomer component also enables them to adhere to both enamel and dentine.
- The resin component enables them to command set by light-curing, so they have a longer working time than conventional glass ionomers.
- The chemical changes that occur during light-curing release components that can kill any remaining bacteria within a cavity, helping to prevent recurrent caries.
- Many products are conveniently available in preloaded capsules (Figure 15.40) which can be mixed in a conventional amalgamator and then applied directly to the cavity in a flowable form
- They can be used as:
    - cavity liners (over calcium hydroxide on deep pulp floors)
    - cavity base beneath composite restorations
    - restoration of small lesions, especially class V cavities.

Figure 15.40 Example of a resin-modified glass ionomer cement capsule.

Some glass ionomer products set chemically, others by exposure to the blue curing light as for composites.

Glass ionomer restoration procedure

The procedure for the placement of a glass ionomer restoration is described below. Additional instruments, equipment and materials that may be required for the procedure are shown in Table 15.7.

- All dental personnel and the patient must wear the correct PPE throughout the procedure, especially orange-tinted safety glasses if a light cure material is to be used.
- All caries is removed from the cavity, without breaching the pulp chamber.
- Moisture control techniques are used so that the cavity remains dry, which may involve the placement of a rubber dam.
- Adequate soft tissue retraction is applied, without causing trauma to the soft tissues.
- **Calcium hydroxide lining** is placed in deep cavities; this is not necessary in shallower cavities.

- The cavity has a '**conditioner**' applied, which increases the adhesion of the material to the tooth and improves the marginal seal; the conditioner is either polyacrylic acid or tannic acid.
- This is washed off after about 20 seconds and collected by the high-speed suction, then the cavity is dried.
- Shade is determined and the material is carefully apportioned (using the scoop provided) and mixed, ideally using a waxed paper pad and plastic spatula to do so (Figure 15.41).
- The aluminosilicate particles of the powder are very abrasive and tend to score glass blocks and some metal spatulas during mixing, so these items should be avoided.
- Material is placed into the cavity and allowed to achieve its initial set, or is light-cured.
- **Cervical foil matrix** is used when restoring class V abrasion cavities, to produce a smooth surface (Figure 15.42).
- Excess material is carefully removed, without touching its surface as this will produce a chalky appearance. Glass ionomer materials cannot be 'finished' immediately after placement as other permanent restorations can, unless they are a light-cure type.
- Surface is coated with **varnish** or **unfilled resin** while fully setting, to prevent moisture contamination.
- A typical layout of equipment and materials for a conventional glass ionomer filling procedure is shown in Figure 15.43.

Figure 15.41 Glass ionomer powder, scoop and liquid, ready to mix.

Figure 15.42 Glass ionomer class V matrix system.

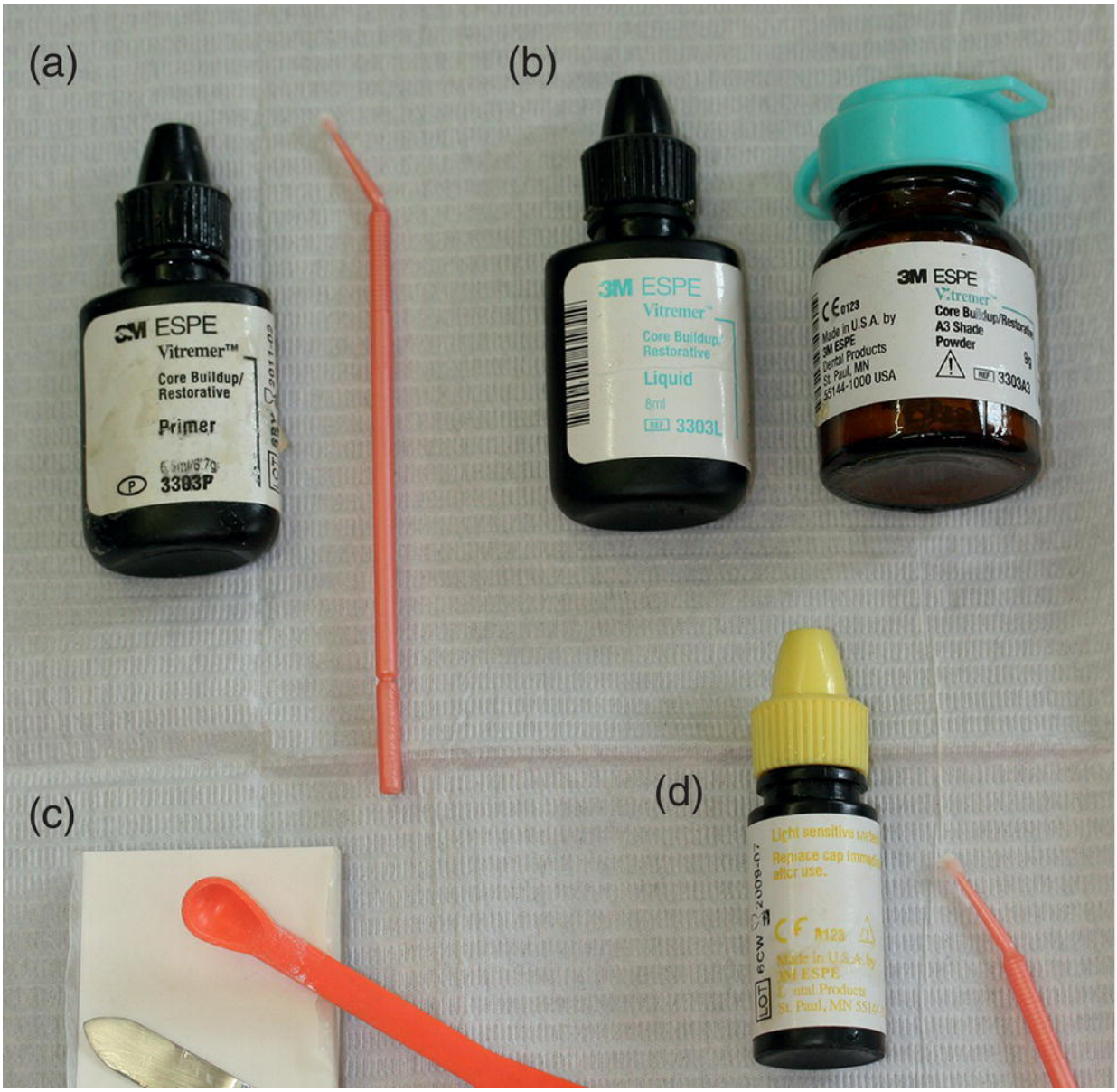


Figure 15.43 Equipment and materials for glass ionomer filling procedure. (a) Conditioning liquid and applicator. (b) Powder and liquid filling material example. (c) Waxed pad, spatula and measuring scoop. (d) Varnish and applicator.

Table 15.7 Additional instruments, equipment and materials that may be required for the glass ionomer restoration procedure.

Item	Function
Liner	Calcium hydroxide, if any is required, to protect the pulp from the acrylic acid
Plastic instruments	To place the glass ionomer and remove any excess material
Cervical matrix	Foil coated and preshaped for use when restoring class V abrasion cavities Cannot be used if the glass ionomer is a light-cured type of material
Finishing materials	Varnish or unfilled resin, wiped over the restoration surface to prevent moisture contamination

The advantages and disadvantages of glass ionomer restoratives over others are shown in Table 15.8.

Table 15.8 The advantages and disadvantages of glass ionomer restoratives.

Advantages	Disadvantages
Adhesive to enamel, dentine and cementum, so minimal cavity preparation is required	Low strength compared to amalgam or composite
Ideal for use with class V abrasion cavities	Very technique sensitive
Good marginal seal, preventing leakage. This can be improved further with the use of conditioners or the use of resin-modified glass ionomer cements	Exact proportions of material and liquid must be used to produce the ideal mix
Release fluoride over time, so very useful when restoring deciduous teeth	Require calcium hydroxide lining in deep cavities, to avoid pulpal damage by polyacrylic acid
Better aesthetics than amalgam	Moisture contamination causes failure of restoration
Addition of metals to some products produces cermets, which are strong enough for use as core build-ups	Require protection from moisture during full setting
Addition of glass ionomer to composites produces compomers, which have better aesthetics plus fluoride release and better adhesion than composite alone	Produce a chalky surface if any attempt at finishing occurs before the material has fully set, and then the restoration must be replaced

Other uses of glass ionomer materials

Glass ionomer cement has many different uses which depend on two outstanding properties.

- It releases fluoride and thereby prevents the recurrence of caries in and around the cavity, making it the ideal restorative material in deciduous teeth and especially younger children, where poor co-operation may prevent full caries removal.

- It chemically bonds directly to enamel, dentine and cementum without acid etching, so that adhesion is excellent and undercuts are not essential for retention of the material in the cavity, therefore making it suitable for the following uses:
    - Unprepared deciduous cavities.
    - Prepared deciduous cavities, where the reduced strength of the material is irrelevant as the teeth will be shed anyway.
    - Fissure sealing.
    - Cavity base.
    - Luting cement for fixed restorations and orthodontic bands.
    - Dentine substitute where excessive loss of tooth substance has occurred, avoiding the use of pinned amalgam restorations.
    - Core build-ups.

Non-surgical endodontics

As discussed above, when a tooth is attacked by bacterial caries a cavity eventually forms. For whatever reason, not all patients will seek dental treatment at this stage so the cavity is allowed to progress, and eventually the bacteria will come close to, or breach, the pulp chamber of the tooth. Once the pulp is involved, the tooth cannot be saved by caries removal and filling alone but must undergo some form of root canal therapy or *endodontic treatment*. The only other alternative is to extract the tooth.

Endodontics is the term used for all forms of root canal therapy. Non-surgical endodontics includes all the following procedures:

- Pulpectomy: conventional root filling.
- Pulpotomy.
- Pulp capping.

The procedure of surgical endodontics is correctly called *apicectomy*, discussed in a separate section below.

Caries is not the only reason for a tooth to require endodontic treatment. Any event that causes significant inflammation of the pulpal tissues, or a breach of the pulp chamber, is likely to need some form of endodontic treatment. Other reasons for endodontic treatment are as follows:

- **Thermal injury**, by heat transmission through unlined restorations or inadequate cooling of the air turbine during restorative treatment.
- **Chemical irritation** from restorative materials.
- **Tooth fracture** following trauma, possibly causing pulp exposure.
- **Severe impact injury** without causing tooth fracture.
- **Irritation** from very deep fillings, over time.
- **Accidental pulp exposure** during restorative procedures, especially during restoration of deep cavities.

Any of these events will result in inflammation of the pulp tissue, and as it is confined within the closed root canal chamber of the tooth, any swelling that occurs will squeeze the pulp contents, cutting off the blood supply to the tooth and ultimately resulting in its death.

The correct term for inflammation of the pulp is *pulpitis*, and this can occur as either of the following events:

- **Reversible pulpitis**: not causing pulp death and treated by a restorative filling of the tooth only.
- **Irreversible pulpitis**: causing partial or full pulp death and requiring one of the non-surgical endodontic techniques listed above to save it.

Any tooth can be affected by irreversible pulpitis at any age, and the tooth involved and when it erupted, as well as the severity of the pulpitis, will determine which of the three non-surgical techniques is used to try to save it.

Deciduous teeth will eventually be resorbed and exfoliate, as a natural progression to the eruption and development of the permanent dentition, so full root canal therapy is not required and either pulp capping or pulpotomy is adequate. When permanent teeth erupt, it can take up to 3 years afterwards for the root apex to close, so these teeth will have a good blood supply during this time and can also be maintained by either pulp capping or pulpotomy. Once the root end has closed, and in the full adult dentition, pulpectomy is required to treat the tooth in an attempt to save it from extraction.

Diagnosis of irreversible pulpitis

The dentist's decision on whether to treat a carious tooth by an ordinary filling, endodontics or extraction depends on the state of the pulp. If it is dead, endodontics or extraction is necessary. If it is alive and unexposed, an ordinary filling will suffice.

The state of the pulp is not always apparent and vitality tests are often required to determine whether it is alive, dying or dead. These tests depend on the painful response of the pulp to temperature extremes or electrical stimulation and are fully discussed in Chapter 12. If the

pulp responds to these stimuli it is vital or dying; if not, it is probably dead.

In addition, a periapical radiograph can also be used as an indicator of the health of the tooth.

- A widened periodontal ligament space indicates some level of inflammatory response, although it may not always result in tooth death.
- A crown fracture or deep cavity may be seen to be in contact with the pulp chamber, or very close to it.
- A root fracture will be visible as a black line across the root.
- A periapical abscess will appear as a radiolucent area around the apex of the tooth (Figure 15.44).

Figure 15.44 Radiograph showing periapical area.

Often, a tooth will have been giving symptoms for some time before deteriorating into irreversible pulpitis, and this is especially true when caries is the cause as it is a progressive infection of the dental hard tissues, rather than a sudden event such as trauma.

The patient usually experiences symptoms that gradually increase in severity until the tooth dies.

- Occasional sensitivity to cold, then to hot and sweet stimulation.
- Develops into spontaneous intermittent spasms of pain.
- Becomes a continuous throbbing pain with time, which prevents use of the tooth for chewing.
- Eventually not affected by hot, cold or sweet stimulation.
- Becomes hypersensitive to vitality testing as the pulp is dying, and then becomes unresponsive as it dies.
- No longer tender to percussion (TTP) when tapped.

Treatment option considerations

There are many factors to be considered by both the dentist and the patient (or their guardian) when discussing treatment involving non-surgical endodontics.

- **Usefulness of the tooth in occlusion**: if the tooth stands alone and is not routinely used for mastication or involved in the retention of a prosthesis, then it could be argued that there is little point in trying to save it from extraction.
- **Tooth restoration possibilities**: if the tooth is badly broken down with little structure remaining for restoration, the possibility of restoring it to full function is lessened.
- **Dental health of the patient**: if this is poor generally, with a lack of good oral hygiene and poor diet control, the tooth is unlikely to survive for any reasonable length of time as it is likely to undergo carious attack in the future.

- **Patient co-operation**: both child and adult patients may refuse the treatment offered for whatever reason, and their right to do so has to be respected by the dental team.
- **Medical history of the patient**: some medical conditions contraindicate endodontic treatment due to the risk of a residual infection occurring.

    Diabetes.

    Acquired valvular heart disease and other heart conditions.

    Congenital heart defects.
- Other medical conditions contraindicate extraction.

    Epilepsy: dentures should be avoided in these patients if possible, to avoid their fracture and choking risk during a seizure.

    Bleeding disorders: especially haemophilia where haemostasis may be difficult to achieve.

    Stroke or at risk of stroke: these patients are likely to be taking powerful anticoagulants for life, and extractions may result in significant bleeding that may require medical intervention.

    Osteoporosis: many patients with this condition may be taking bisphosphonate medication (tablets or intravenously) and extraction may result in bone necrosis of the jaw.

    Cleft palate.
- **Cost of treatment**: successful endodontic treatment often culminates in the tooth being crowned eventually to preserve it for as long as possible, and both treatments can be too expensive for some patients to consider.

All these considerations need to be fully and clearly discussed with the patient, or their guardian in the case of children, before the decision can be made whether to proceed or not. Dental terminology may have to be avoided with some patients, to modify the necessary explanations to their level of understanding or language. However, this must never result in full information not being given, nor the

patient being patronised. It is possible to issue patient leaflets in various languages nowadays to help explain dental treatment, and their availability should be investigated in your local area.

In addition, some specific information about possible complications and procedure details must be given to the patient or guardian to enable them to be fully informed, and therefore give consent to endodontic treatment.

Complications

- The procedure carries up to an 85% chance of success, so extraction may ultimately be necessary in some cases.
- If the roots have more than 15 degrees of curvature, the case may require referral to a specialist endodontist for successful completion.
- Endodontically treated teeth become brittle with time, so long-term restoration is likely to involve a crown to protect the tooth and prevent future fracture, although the advances made in direct composite restorative materials now enables some teeth to be restored successfully without the need for a crown.
- If the root apices are close to underlying nerves (especially the lower molars to the inferior dental nerve), there is a possibility of nerve damage from over-instrumentation or from the medicaments used, especially sodium hypochlorite (bleach).
- If the root apices of upper molars are close to the floor of the maxillary antrum, there is a risk of creating an oroantral fistula by over-instrumentation.

Procedure

- Often involves one or two long appointments, where full mouth opening will be necessary.
- Local anaesthesia will usually be required initially.
- A rubber dam is likely to be used, which may be a new experience for the patient, and not well tolerated by some.
- Antibiotics may be required to control any infection.

- Temporary dressings may be used, and care will be required not to dislodge them.
- Postoperatively, anti-inflammatories may be recommended.
- Patient may experience some tenderness postoperatively and may need to contact the surgery if this worsens.

Pulpectomy: conventional root canal therapy

This is the non-surgical endodontic procedure carried out to try to save a fully formed permanent tooth from extraction, once it has suffered irreversible pulpitis. The aim of the treatment is to remove all the pulpal tissue from the pulp chamber and root canal and replace it with a sterile root filling material. This must be placed to fully seal the whole root canal system and prevent any contamination from causing a recurrent infection at the root apex, so the material used must be insoluble in saliva and tissue fluids.

The aim is achieved by following the treatment principles summarised below.

- Complete removal of the pulpal contents (**extirpation)**.
- Shaping of the root canal to allow thorough irrigation.
- Irrigation with antibacterial disinfectants such as sodium hypochlorite or chlorhexidine.
- Removal of these irrigants and any residual bacteria and debris from the root canal.
- Filling of the root canal with a non-irritant, impermeable material (**obturation)**.
- This seals off any further bacteria from the periapical tissue fluids.
- Restoration of the tooth to full function, either by filling or by cementing a crown or inlay.

The same procedure provides drainage and complete cure of an existing abscess. The root-filled tooth will then function just as well as one with a normal pulp, although it may feel ‘wooden’ to the patient

during chewing. Success depends on achieving a leakproof seal at each end of the root canal, thereby preventing micro-organisms from entering or leaving it.

Pulpectomy is often carried out in two stages: the first to remove the infective material and prepare the canal, the second to ensure the canal is clear of residual contamination before the insertion of the root filling. However, if no difficulties arise during the first stage, the dentist may choose to complete both stages in one visit.

Although the dentist will use many hand instruments during the endodontic procedure that are multifunctional and used in other dental disciplines, there are several instruments used exclusively for root canal therapy and these are detailed in Table 15.9. Their functions are similar whether used as hand instruments or as rotary instruments in the dental handpiece.

Table 15.9 Specific instruments for root canal therapy.

Item	Function
Broach	Plain broach to help locate the entrance to each root canal Barbed broach (Figure 15.45a) to remove (extirpate) the pulpal contents from the canal
Reamer (Figure 15.45b)	Hand or rotary: to enlarge the root canals in a circular shape laterally, down to the root apex
File (Figure 15.45c)	Hand or rotary: to enlarge the canal in its actual shape laterally, smooth the root canal walls, and remove any residual debris from them
Irrigation syringe (Figure 15.46)	Blunt-ended with a side bevel, to irrigate and wash out debris from the root canal without injecting the syringe contents through the root apex Solutions used include chlorhexidine, sodium hypochlorite, local anaesthetic solution
Metal ruler	Used with a file in place, to work out the full length of each root canal by comparing a paralleled periapical radiograph view of the tooth to the established working length
Apex locater (Figure 15.47)	To determine the working length electronically
Spiral paste filler (Figure 15.45d)	Used with the slow dental handpiece to spin sealant material into the root canal
Lateral condenser or finger spreader (Figure 15.48)	Used to condense the root filling points laterally into each root canal, so that no space remains for micro-organisms to return Not required if root filling material used is inserted while hot and flowable

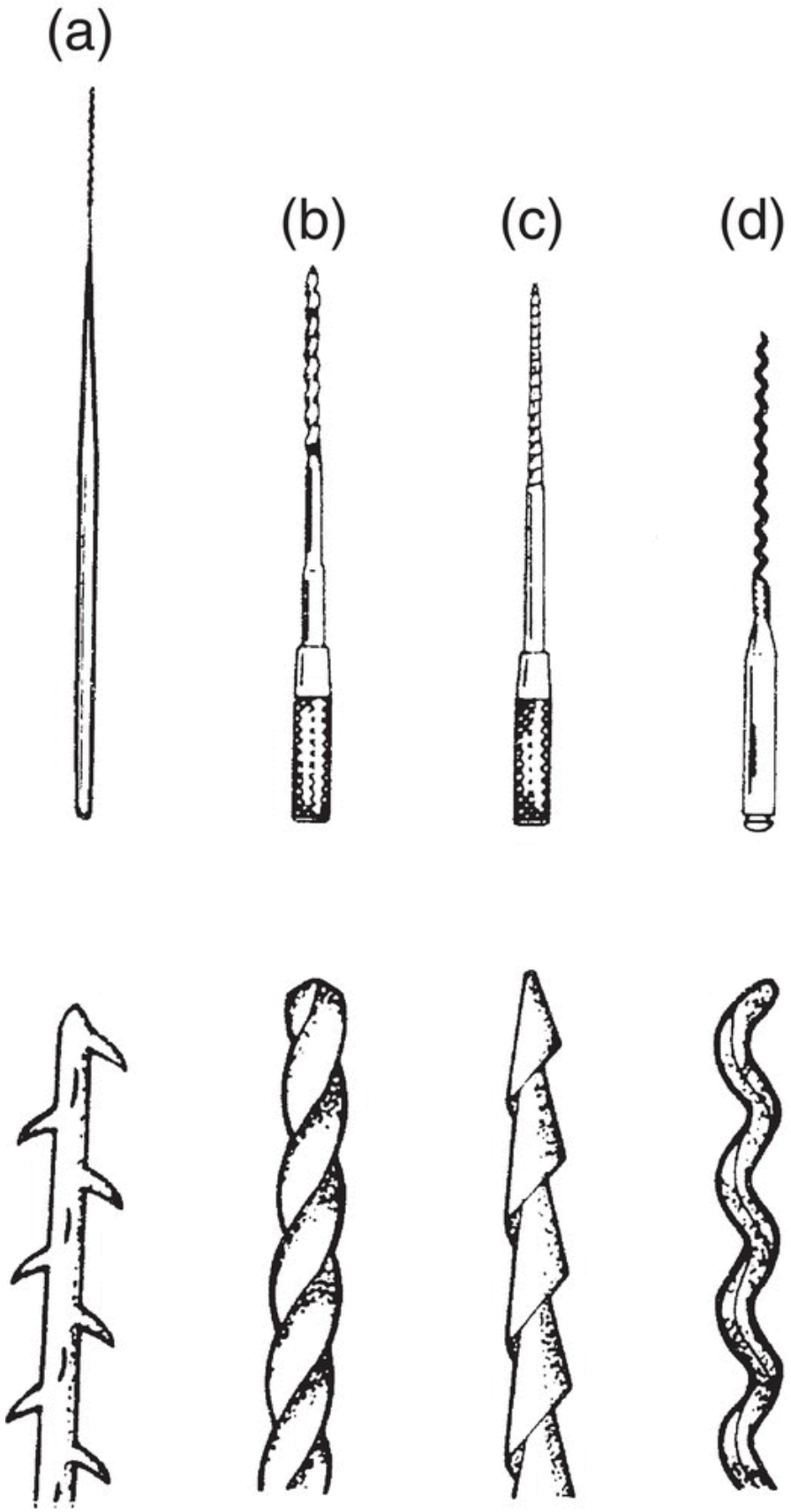

(a)
(b)
(c)
(d)

Figure 15.45 Root canal instruments. (a) Barbed broach. (b) Root canal reamer. (c) Root canal file. (d) Rotary paste-filler.

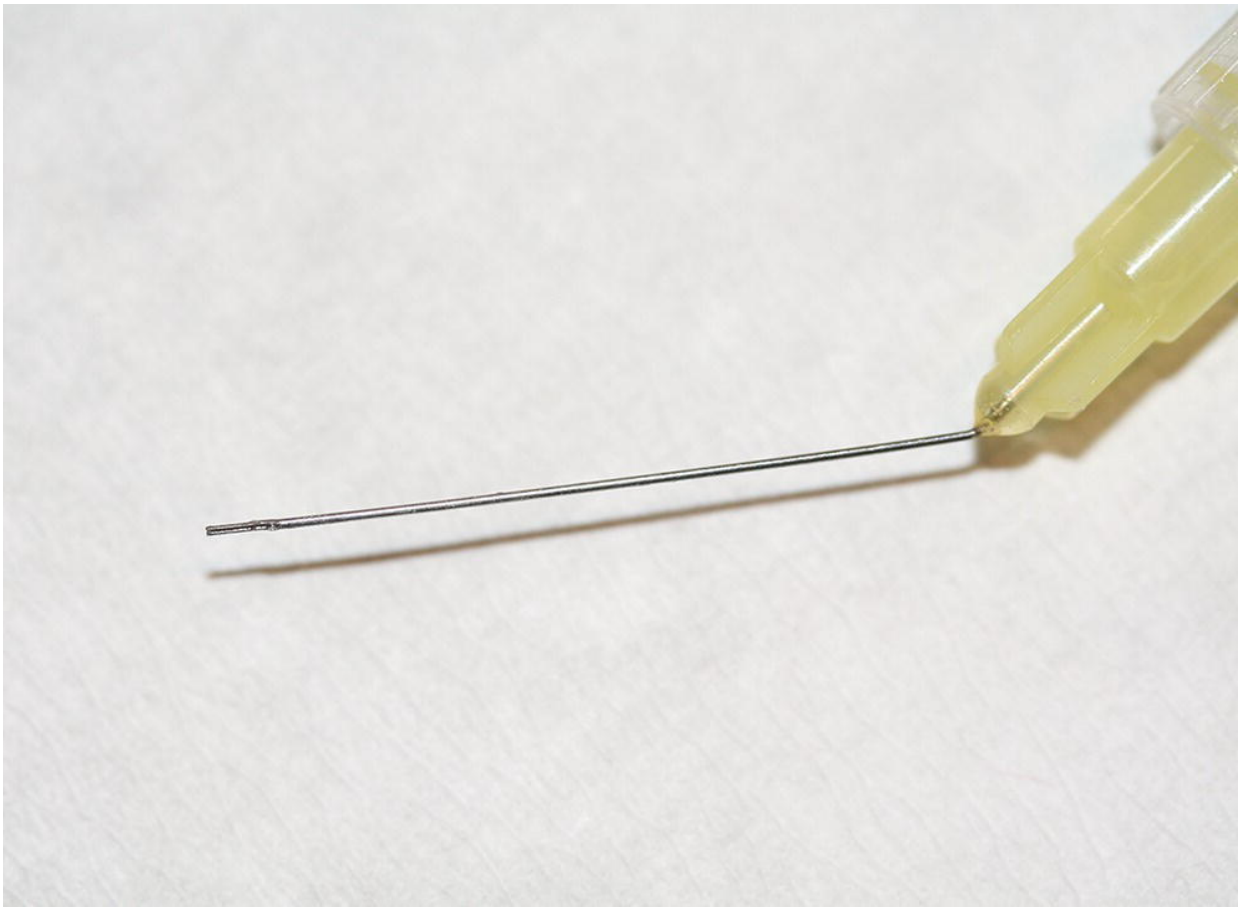


Figure 15.46 Monoject syringe needle end with side bevel detail.

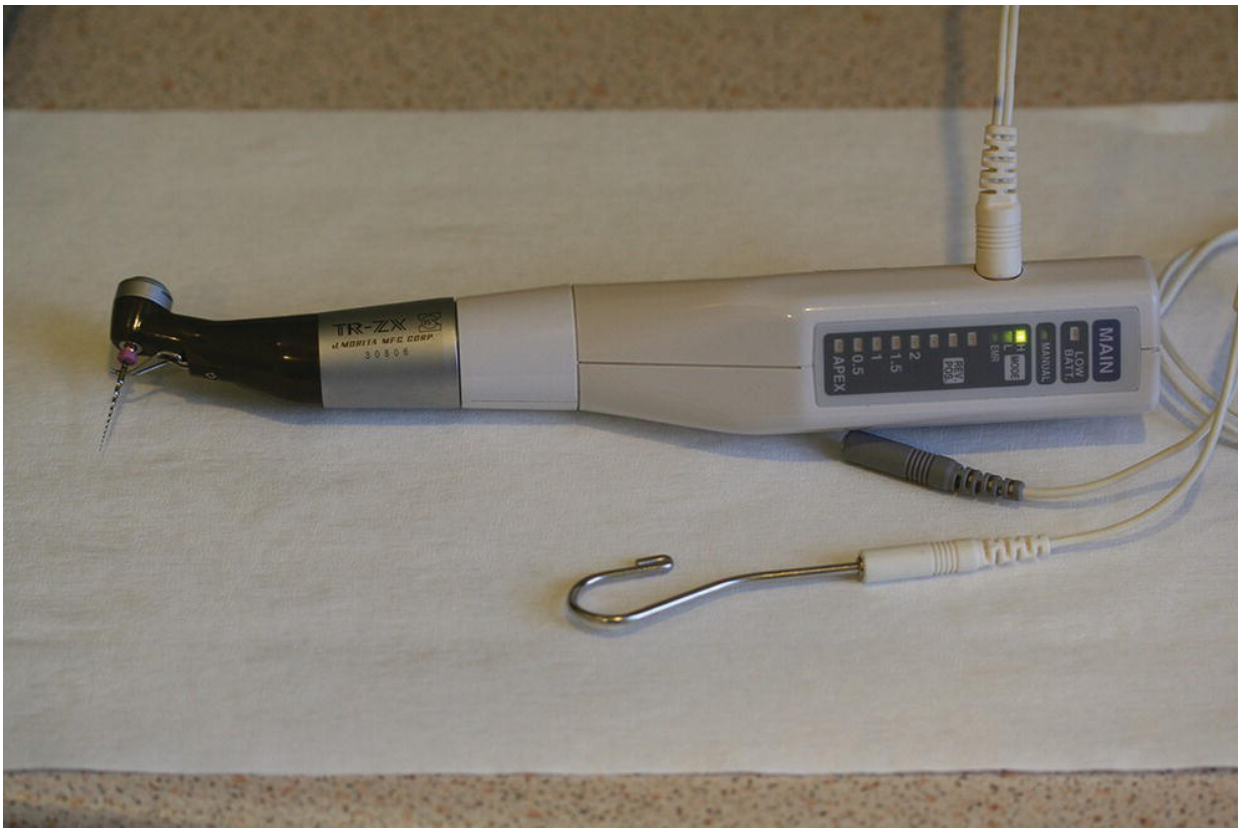


Figure 15.47 Endodontic apex locator handpiece.

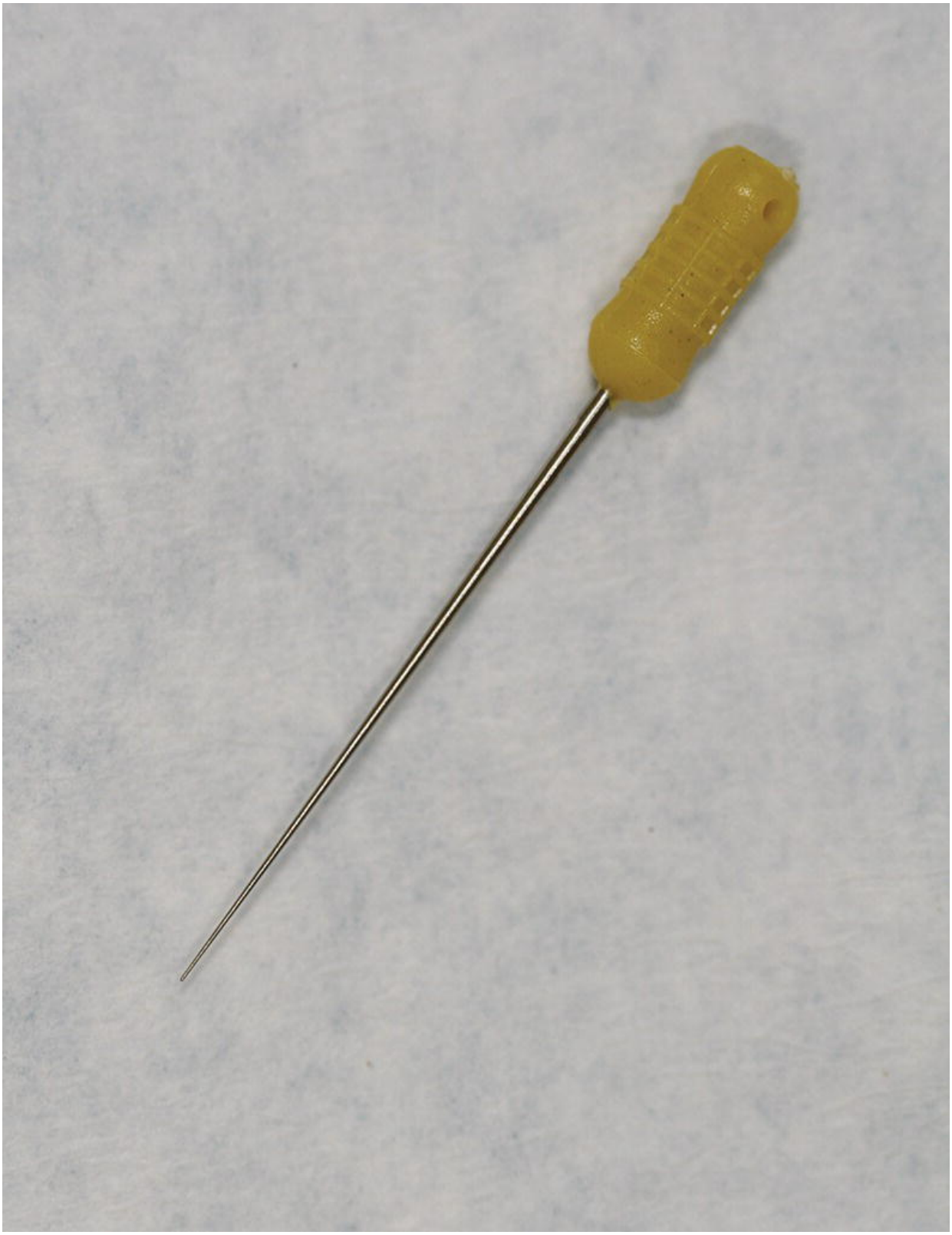


Figure 15.48 Finger spreader.

At the first visit:

- the pulp is extirpated (removed), using a **barbed broach**
- the root canal is reamed and filed to enlarge and shape it using **reamers** and **files**, then cleaned and disinfected to prepare a dry, smooth, empty canal which tapers gradually from the pulp chamber down towards the apex
- an **antiseptic dressing** and temporary filling are inserted to seal the entrance to the empty root canal to kill any residual bacteria and prevent contamination of the canal between visits.

At the second visit:

- the temporary filling and dressing are removed
- if the root canal is still clean and dry, it is **obturated** with **gutta percha** (GP) to seal off the entire canal to within a millimetre of the apex.

Instrument details

Barbed broaches are single-use disposable hand instruments for removing the pulp. They consist of a fine wire with multiple barbs. When the broach is inserted in a root canal and rotated, its barbs snag in the pulp tissue and pull it out of the canal as the broach is removed.

Root reamers resemble wood drills and are used for enlarging root canals in a circular fashion so that a filling can be inserted. They are made in standardised sets, all of the same length but with an increasing range of widths. Each reamer is numbered or colour-coded to indicate its size. The reamer is inserted in the canal and advanced by hand or by specially adapted handpieces for use with rotary endodontic instruments. As very few root canals are exactly circular in shape, reamers have largely been superseded by files.

Root canal files are hand or handpiece instruments which are similar to reamers but are flexible and can be engaged around the walls of any canal shape present in the tooth. They are also made in the same standardised range of sizes and colours as reamers. Their function is to smooth and clean the walls of enlarged root canals and remove debris, and their flexibility allows them to negotiate curved root

canals as well as the more typical oval shape of root canals (rather than circular). They are inserted in the canal and used with a down-twist-and-up filing action against the canal walls. Many practitioners use files exclusively instead of reamers, but in the same sequence of sizes.

Reaming and filing root canals by hand is laborious and time-consuming. However, the introduction of flexible nickel-titanium root canal instruments used with modern variable speed handpieces allows dentists to undertake these procedures far more easily and precisely. They are particularly useful for the curved canals of multirooted teeth.

In addition, some of these specialised handpieces are also electronic apex locators and can be set to give an audible alarm when the tooth apex has been reached – this is called the working length. Once determined, all other files used can then be premeasured to this length so that the root canal is fully obturated. When used correctly, the apex locator is far more reliable at determining the accurate working length of the tooth, and this can be confirmed with a postoperative periapical radiograph.

Irrigation syringes should have a 'screw thread' needle attachment to prevent the needle and syringe coming apart during use. The needle should also have a side-bevel design (see Figure 15.46) so that the irrigation liquid comes out through the side of the needle rather than the tip, and this allows it to wash around the root canal rather than being forced through the apex of the tooth. Solutions such as sodium hypochlorite can cause severe and permanent soft tissue damage if they are accidently forced out of the root canal during endodontic treatment.

Root canal pluggers or *spreaders* have a long, tapered smooth point used to condense the GP filling points against the canal walls and obliterate any gaps. These may also be referred to as lateral condensers, but they all have the same function.

Rotary paste fillers are engine instruments for inserting pastes into a root canal. They consist of a spiral wire which fits in a slow-running handpiece and propels the required material to the full length of the root canal.

As with the use of some specific instruments for endodontic treatment only, there are materials and medicaments used exclusively in non-surgical endodontic treatment too, all of which will have been risk assessed in accordance with COSHH regulations Their potential to cause both the patient and dental personnel harm if misused must be fully appreciated and understood by the whole dental team. Consequently, working safely as a member of the dental team throughout chairside procedures should be second nature to the dental nurse, ensuring that there is no potential for accidents nor mistakes during any treatment session.

The materials and medicaments used in root canal therapy treatments are as follows:

- **Irrigation solution**: used during root canal preparation to lubricate the instruments and wash out any debris. The solution used is an individual choice between sodium hypochlorite (bleach), chlorhexidine (although some patients may be allergic to this), and local anaesthetic solution.
- **Antiseptic paste**: non-setting and containing antiseptic anti-inflammatories, used to dress infected root canals for a time before root filling; an example is Odontopaste (Figure 15.49).
- **Cresophene**: medical-grade creosote used to dress infected root canals for a time, soaked onto paper points before insertion (Figure 15.50).
- **Lubricating gel**: for use with engine files and reamers (those used with a handpiece) to ensure the instruments do not snag on the canal walls and snap during use; an example is Glyde (Figure 15.51).
- **GP points**: varying diameter, tapered rubber points used to fill (obturate) the root canal system, with the same colour-coded width system as files and reamers (Figure 15.52), so if a 'red' (size 25) file or reamer is used as the final canal preparation instrument, then a 'red' size GP point must be used to obturate the root canal, to the same working length.
- **Sealing cement**: setting cement used to aid the insertion of the GP points and to seal off any residual spaces in the root canal;

some contain antiseptics and anti-inflammatories.

- **Restorative materials**: used to restore the tooth to full function and appearance after root filling, as discussed earlier.

Figure 15.49 Odontopaste material to dress infected root canals.

Figure 15.50 Cresophene antiseptic.

Figure 15.51 Glyde endodontic lubricant.

Figure 15.52 Examples of colour-coded gutta percha points.

Pulpectomy preparation

As the root canal must be disinfected before it is filled, all instruments and dressings used must be sterile. A convenient arrangement is to keep a sealed container holding a complete sterilised root canal therapy kit ready for immediate use (Figure 15.53).

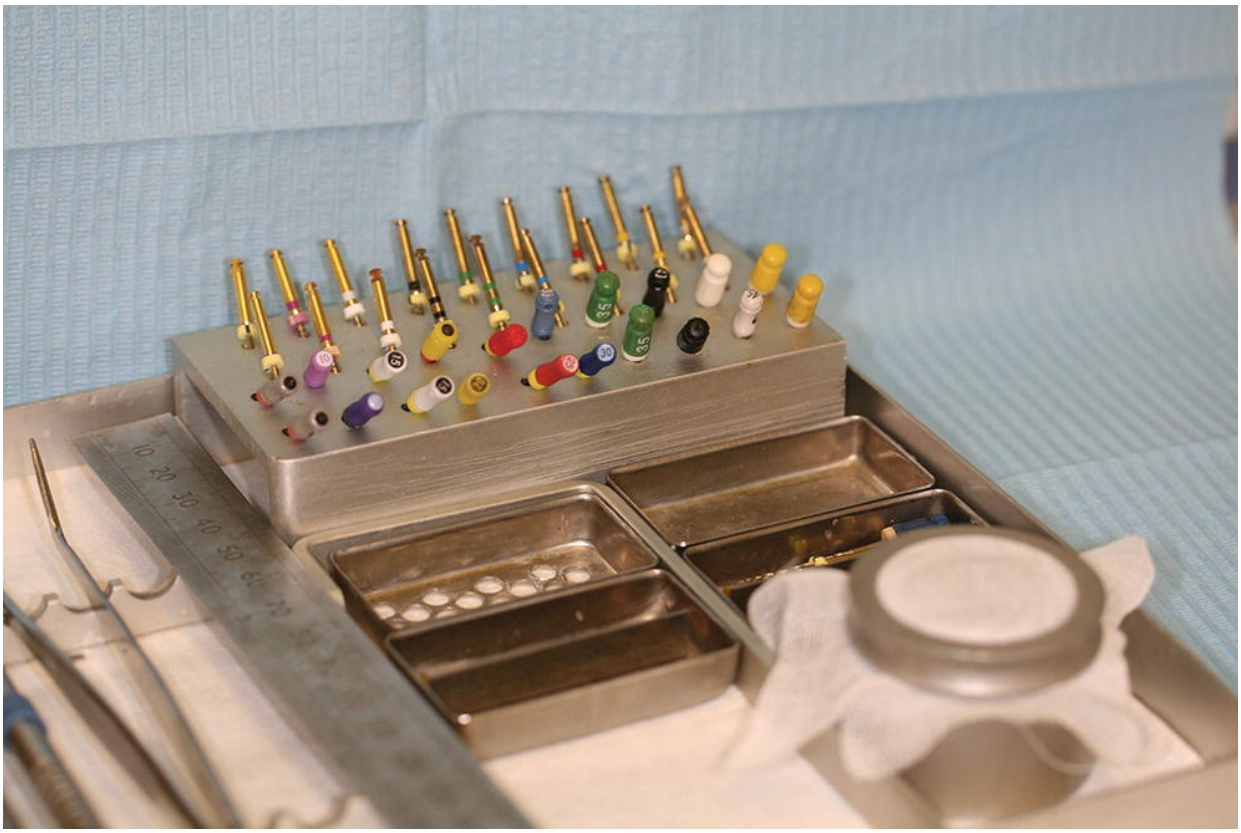


Figure 15.53 Endodontic treatment tray.

Wherever possible, a rubber dam should also be applied to the tooth under treatment before access to the root canal is made, as it is the best method of:

- preventing ingress of micro-organisms from the mouth into the root canal
- preventing accidents such as inhalation or swallowing of small root canal instruments and irrigation solutions
- improving access and visibility for the dentist.

The items required for the application and use of a rubber dam are shown in Figure 15.10. A rubber dam in place before tooth preparation is shown in Figure 15.54.

Figure 15.54 Rubber dam in place on lower molar tooth.

A non-latex purple or blue rubber dam should be available for use on patients who are, or may be, sensitive to latex, otherwise the regular green latex dam sheets are used. If, for whatever reason, use of a rubber dam is impractical, small root canal hand instruments must have a length of dental floss or a *parachute chain* attached, to allow them to be retrieved if they accidentally slip out of the dentist's hand (Figure 15.55). Engine reamers and files will be locked into the handpiece by their latch grip device, in the same way as dental burs are for restorative treatment.

Figure 15.55 File with parachute chain attached.

Procedure

Modern infection control practice stipulates that all endodontic instruments inserted into a root canal must be considered as single use and safely disposed of in the sharps box, unless a two-stage endodontic technique is carried out and the instruments will only be reused on the same patient. Otherwise a new set of instruments must be used on the next patient and disposed of in a similar fashion.

As mentioned earlier, more than one visit may be necessary. The following description is for a two-visit procedure carried out under ideal conditions.

- Local anaesthetic is used if the pulp is still vital.
- A rubber dam is applied, then the area of the tooth is swabbed with a disinfectant such as chlorhexidine.
- Access to the pulp chamber is gained by drilling through the tooth with conventional diamond burs.
- To improve vision in such a small operating field, many dentists use magnifying loupes attached to their glasses to be able to see the root canals more clearly, while some may even use a specialist microscope device.
- Access to each root canal is gained by drilling at the base of the pulp chamber, using a stainless steel bur or a Gates Glidden drill (Figure 15.56).
- Any intact pulp tissue can be extirpated with a barbed broach.
- The length of the root canal must be measured before any further instrumentation is undertaken. This is called the **working length** and is determined by taking a diagnostic periapical radiograph with a root reamer or file of known length inserted in the canal and using a paralleling technique, or by the use of an electronic apex locator.
- Once the radiograph shows the required length of canal preparation (1 mm short of the apex, as the apical foramen is usually located on the side of the apex rather than directly at its end), all subsequent reaming and filing are kept to this length by fitting a stopper to each instrument before insertion. This prevents penetration of the apical foramen or too short a preparation of the canal.
- The walls of the root canal are smoothed and cleaned with files to produce a smooth-bordered canal which tapers from a wide entrance to a narrow apical end. It is achieved by using a wide file at the root canal entrance followed by successively narrower files until the preparation reaches its endpoint, 1 mm short of the apical foramen. This results in a wide entrance to the root canal, with adequate visibility and access for instrumentation, and a progressively narrower taper towards the apex.

- Throughout reaming and filing, the canal is irrigated with a disinfectant such as sodium hypochlorite or chlorhexidine to remove debris and disinfect the canal. A special sterile disposable syringe, with a blunt end and a side bevel (Monoject syringe), is used for this purpose (see Figure 15.46). The side bevel prevents the irrigation solution from being injected through the apex into the surrounding tissues, which is especially undesirable when sodium hypochlorite is used.
- The canal is then dried with absorbent **paper points** (Figure 15.57) and its entrance covered with dry sterile cotton wool; if infection was present before cleaning, an antiseptic-soaked paper point can be left in the canal.
- The pulp chamber is sealed off with a temporary filling to prevent contamination of the empty, clean, dry root canal between visits; suitable materials are Cavit or Kalzinol.
- At the next visit, if the root canal is still clean and dry, or all signs of infection have gone, it is ready for insertion of the permanent filling. A **GP point** of the same colour code as the last file or reamer used is selected. This is called the master point and has to be sealed to the apical end of the canal with cement.
- Various proprietary brands of root canal sealers are available, many being based on a modified zinc oxide–eugenol cement, such as Tubliseal. The canal walls and the end of the master point are coated with sealer and the point inserted into the root canal.
- The gap between the canal walls and the master point is filled by **condensing** successive GP points against the canal walls with a **finger plugger or lateral condenser** until no space is left.
- Warming the spreader softens the GP points and assists condensation against the canal walls. The use of self-locking tweezers facilitates handling of paper and GP points.
- Alternatively, flowable GP can be used before inserting the master point, so that the liquid material is pushed into any lateral canals as the point is inserted.
- Another alternative technique uses preheated GP and pluggers to provide easier and effective sealing by vertical condensation;

examples are Thermafil (Figure 15.58) and Alphaseal.

- Whichever method is used, it must ensure that each end of the root canal has a leakproof seal once obturation is completed.
- A periapical radiograph is taken to ensure that the root filling is satisfactory and then further radiographs to check the subsequent progress of the tooth over the following months/years (Figure 15.59).
- Having completely filled the root canal with GP, the access cavity and pulp chamber are lined with glass ionomer cement and filled with composite or amalgam.

Figure 15.56 Gates Glidden drill.

Figure 15.57 Examples of colour-coded paper points.

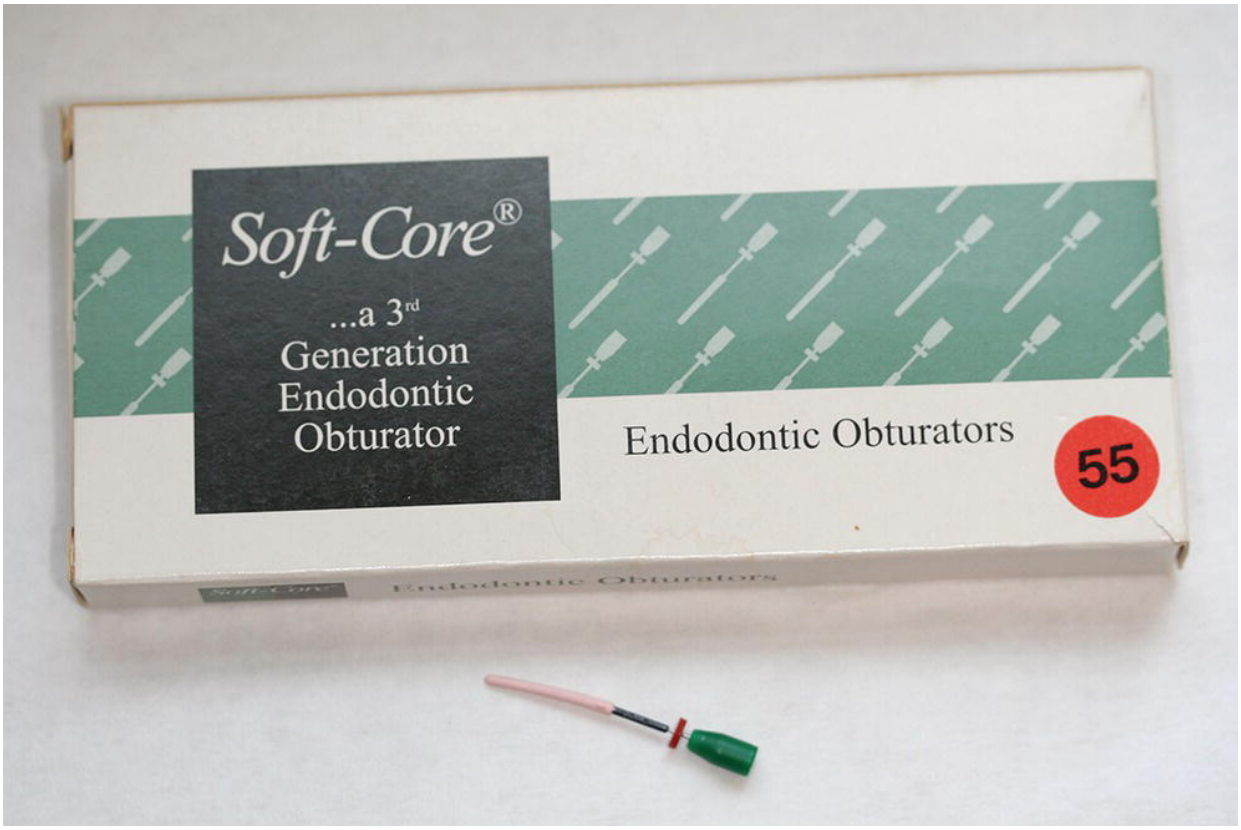


Figure 15.58 Thermafil system.

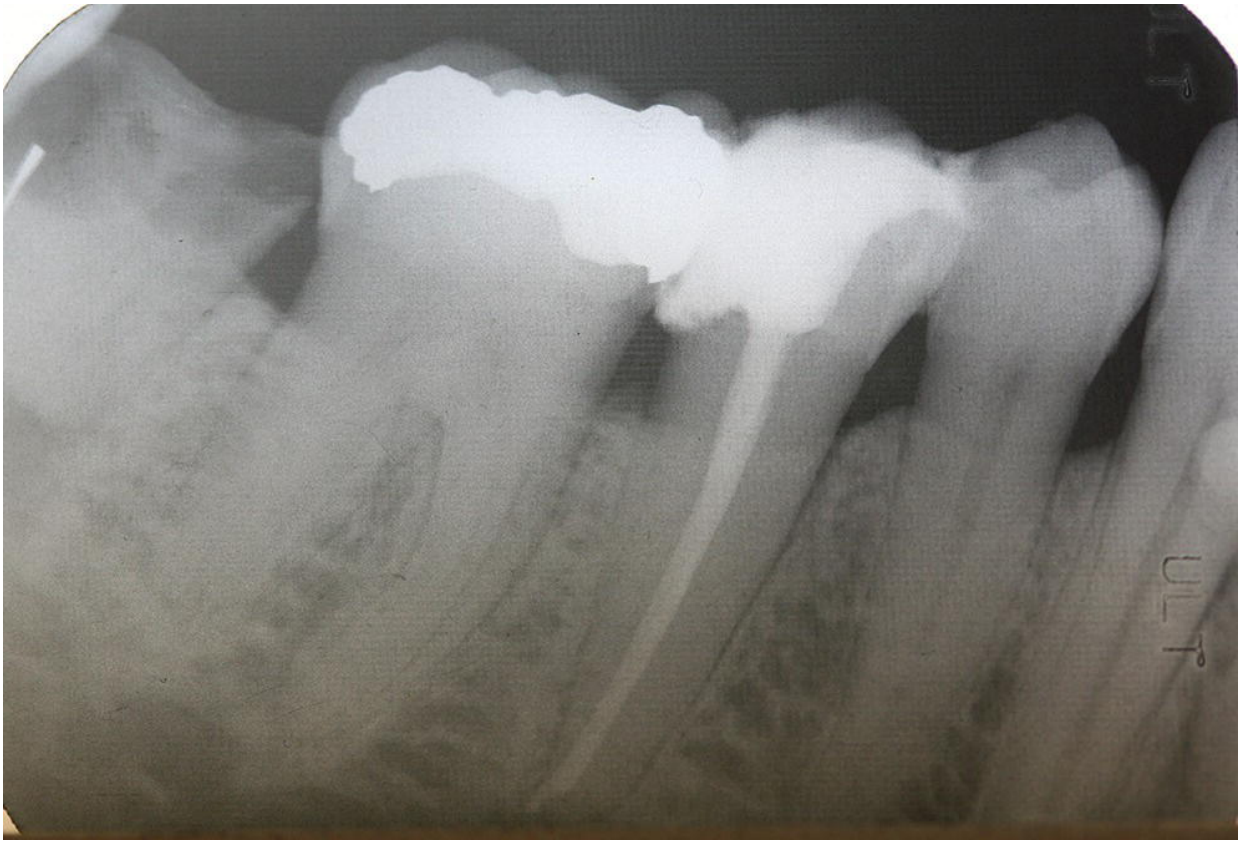


Figure 15.59 Radiograph showing root-filled tooth.

If, at the second visit, the root canal is not dry, it means that apical infection is still present. In that case the canal is debrided again and irrigated with disinfectant, dried with paper points and another temporary dressing is inserted in the access cavity. It should then be ready for a permanent root filling at the next visit. If not, a temporary root dressing of non-setting calcium hydroxide paste is inserted until the next visit. The paste is available as materials such as Hypocal, or it can be made by mixing calcium hydroxide powder with sterile water or local anaesthetic solution. The paste is inserted into the canal with a rotary paste filler.

Pulpotomy

In adults, the conservative treatment of an exposed vital pulp in a permanent tooth is by conventional root filling, as described above. However, in the permanent teeth of children, growth of the root is not complete until up to 3 years after eruption, so an exposed tooth may still have a wide-open apex, instead of the minute apical foramen.

Conventional root filling (pulpectomy) is unnecessary for these teeth as pulp death does not always occur, because the wide-open apex allows blood circulation through the pulp to continue, without being cut off by a build-up of inflammatory pressure. Instead of total removal of the pulp from the chamber and the root, followed by root filling, it is only necessary to remove the infected part of the pulp in the pulp chamber itself, a procedure known as *pulpotomy*. The very rich blood supply through an open apex allows healing to occur. The radicular pulp (that within the root) survives and root growth continues to its natural completion. In fully grown teeth, such healing is rarely possible and that is why the entire pulp must be removed and a root filling inserted.

The procedure in pulpotomy is similar to root filling only insofar as a sterile technique is necessary. The pulp tissue is removed from the pulp chamber within the crown of the tooth only. The amputated pulp stump at the entrance to the root canal is then covered with a calcium hydroxide dressing, or with one of the new biocompatible calcium silicate-based materials such as Biodentine or MTA. These materials stimulate the radicular pulp in the root canal to reduce inflammation, heal, and form a layer of secondary dentine over itself. The pulp is thereby completely sealed off again, as it was before the exposure occurred, and normal growth continues until apical formation is complete. In some cases, it may still be necessary to do a full root filling.

The procedure is as follows:

- All the necessary PPE is placed.
- Local anaesthetic is administered and allowed to take full effect.
- The tooth is isolated from saliva contamination, ideally by the use of a rubber dam but in younger patients this is often not possible.
- The pulp chamber is opened through the exposure site, using a dental bur and handpiece.
- Any potentially contaminated pulp tissue is removed from the pulp chamber only, using sharp sterile hand instruments such as

excavators to separate it from the pulp lying in the root canal, the radicular pulp.

- All bleeding of the pulp stump is stopped using sterile cotton wool pledgets and pressure.
- Once bleeding has stopped, the stump is covered with a calcium hydroxide or other biocompatible material to encourage a reduction of inflammation and the likelihood of dentine repair.
- Any material used as a calcium hydroxide cavity lining or as a biocompatible material for pulp exposure treatment is suitable, although specific products are also available. The essential feature is that the calcium content is used by the tooth to lay down a calcific barrier of secondary dentine over the radicular pulp exposure, isolating it from possible oral contamination and allowing root growth to continue.
- The calcium hydroxide layer (or other material) is sealed beneath a base material such as a resin-modified glass ionomer cement, and then the restorative material used to restore the tooth to function is placed over that.

The tooth will be regularly monitored by the dentist to ensure that tooth development continues.

Open apex root filling

The technique of pulpotomy is only successful if the exposed radicular pulp is vital and can separate itself from the exposure site by laying down a secondary dentine bridge. A dead tooth with an open apex must be root filled as no secondary dentine will form, but this cannot be done in the same way as one with a closed apex, because the GP points will be too small to seal the open apex and will perforate the apical foramen and pass through it instead. In these cases of an open apex, an endodontic technique is used that seals the open apex over time by the successive growth of calcium layers to narrow the open apex, before filling the rest of the root canal conventionally at a later date.

The procedure used is illustrated in Figure 15.60 and is as follows:

- Antibiotic cover and local anaesthesia are given where necessary.
- A rubber dam is applied and the working length of the canal is determined.
- The dead pulp is removed with barbed broaches.
- The root canal is cleaned with hand files and irrigated with sterile saline, taking care not to proceed with any instruments beyond the open apex.
- The prepared canal is dried with paper points.
- A spiral root canal filler is then used to fill the entire canal with a special **non-setting calcium hydroxide paste** (e.g. Hypocal). This disinfects the canal, shows up on radiographs, and does no harm if it goes slightly beyond the open apex.
- The material must be non-setting so that it can be fully and easily removed and replaced at subsequent appointments, while the tooth is under treatment.
- After confirmation of adequate filling of the canal by radiograph, a reinforced zinc oxide–eugenol temporary filling is inserted to seal the root canal entrance.
- After a pulpotomy procedure, the calcium hydroxide in the pulp chamber forms a hard tissue bridge that seals off the root canal entrance, but in the open apex root-filled tooth it only seals off the apex, gradually closing down the size of the apical foramen. This may take 6 months or more to achieve, after which the calcium hydroxide filling is removed and replaced with a conventional root filling.

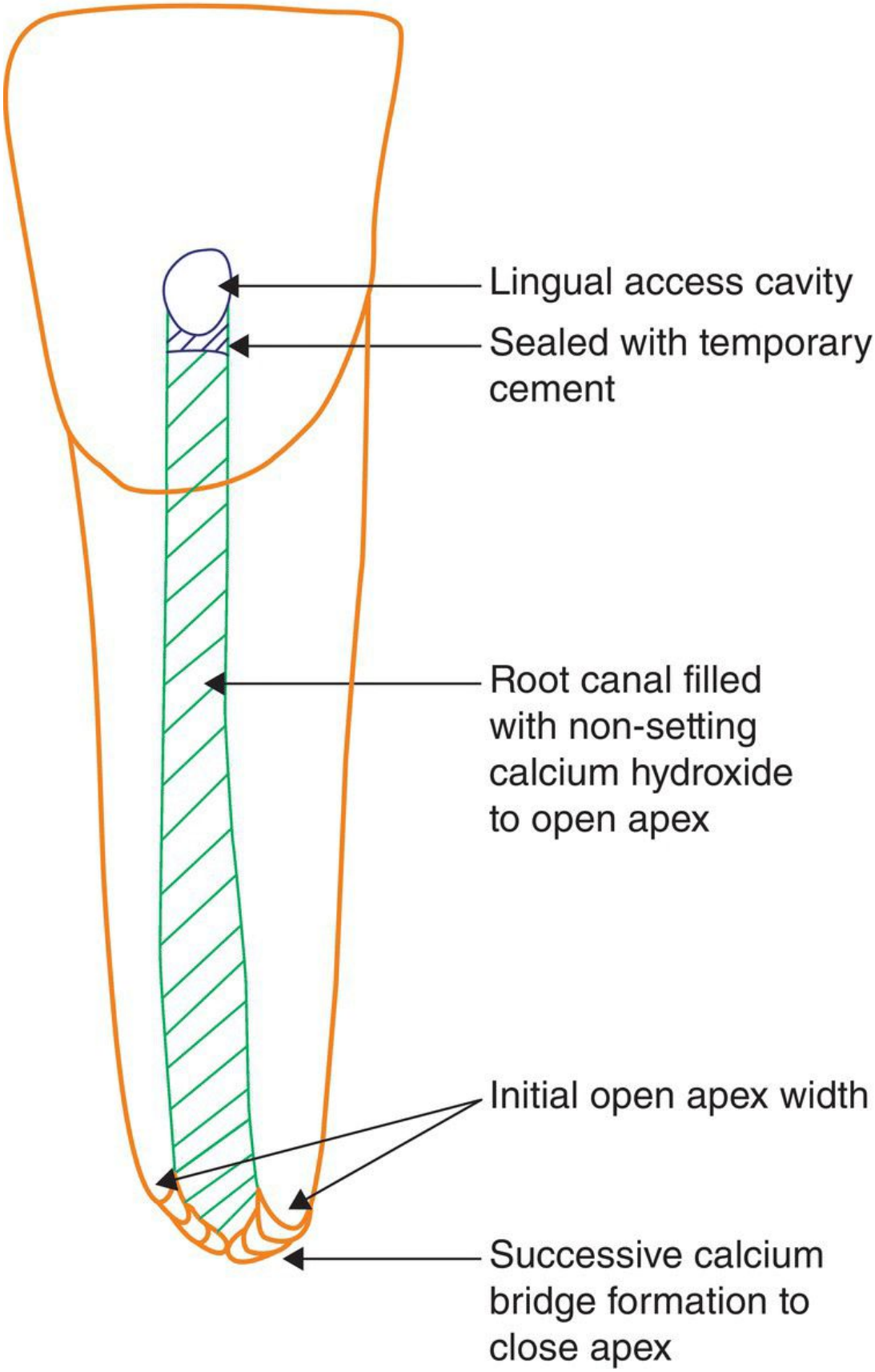

Lingual access cavity
Sealed with temporary cement
Root canal filled with non-setting calcium hydroxide to open apex
Initial open apex width
Successive calcium bridge formation to close apex

Figure 15.60 Open apex root filling.

Pulp capping

This can be carried out in either deciduous or permanent teeth, as a temporary measure before tooth exfoliation in the former or before pulpotomy or pulpectomy in the latter. It is carried out in the following instances:

- When routine restorative treatment produces a small, unexpected pulp exposure in an otherwise healthy tooth.
- When a patient attends as an emergency with a small pulp exposure following trauma.

The aim is to *seal the exposed pulp* from the oral cavity so that no oral micro-organisms contaminate the tooth and cause an infection. This buys time for either the tooth to exfoliate naturally or for the patient to be recalled so that either pulpotomy or pulpectomy can be carried out without them developing pain and/or an infection in the interim.

The procedure used for pulp capping a tooth is illustrated in Figure 15.61 and is as follows:

- All dental personnel and the patient wear suitable PPE.
- Local anaesthesia is administered.
- The tooth is isolated from saliva contamination using moisture control techniques suitable for the situation, and for the patient.
- The pulp exposure is dried with sterile cotton wool, and carefully covered with **calcium hydroxide paste** to promote dentine repair.
- A cap made from a glass ionomer cervical matrix is placed over the calcium hydroxide paste, to prevent excess pressure being applied to the exposure site while the tooth is dressed.
- If a permanent tooth is involved and pulpectomy is planned at a later date, the exposure can be covered with an antiseptic dressing (e.g. Odontopaste) instead.

- The cavity or fracture site is temporarily sealed with a sedative dressing of zinc oxide and eugenol.

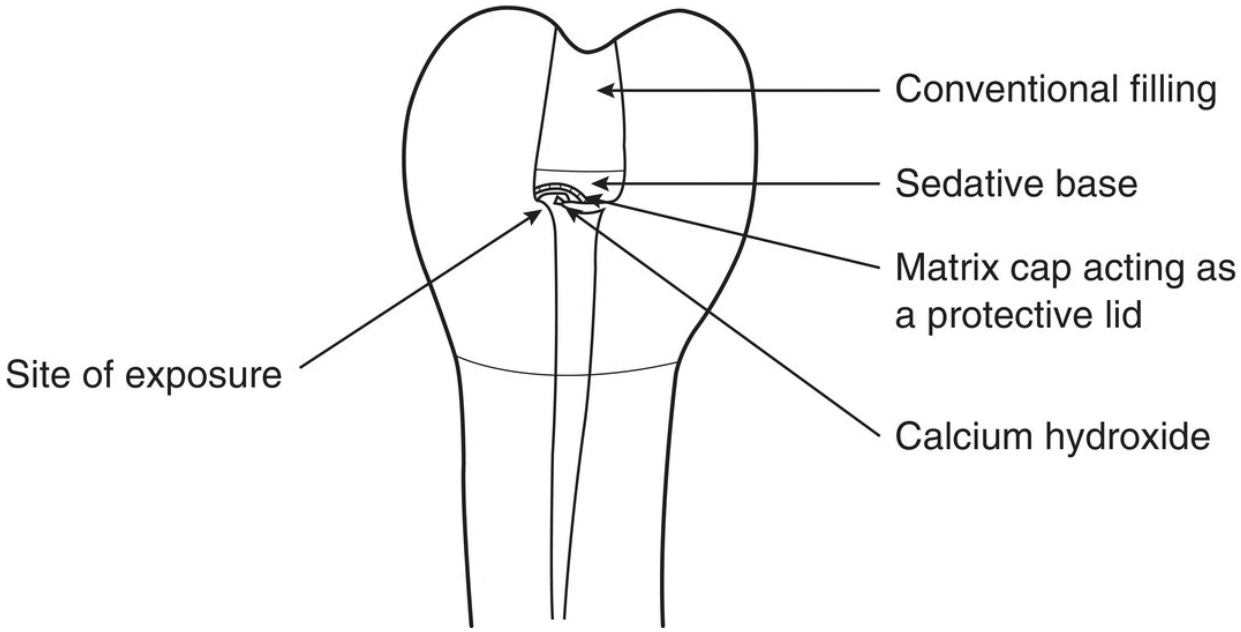


Figure 15.61 Conventional pulp cap procedure.

If a deciduous tooth is pulp capped, it can then be left to painlessly exfoliate naturally. If a permanent tooth is involved, it can be left for some time before any second procedure is carried out, or even just kept under observation by the dentist at 3-monthly intervals, as often no further endodontic treatment is required because the dentine bridge that forms successfully protects the pulp from further damage. Alternatively, and especially where the removal of caries in a deep cavity has potentially resulted in a small pulp exposure, the application of a biocompatible, calcium silicate-based material to the exposure site will often result in the spontaneous and successful repair of the tooth, so that no further treatment is required. Once placed, the material and the rest of the cavity are sealed with a dentine bonding agent (or similar material) to prevent microleakage and then fully restored.

Surgical endodontics

Apicectomy

Apicectomy is a surgical endodontic procedure carried out to remove an infected apex of a tooth, and its surrounding infected tissue. The purpose of apicectomy is to save the tooth in cases where root filling is either unsuccessful or impossible. It is the final alternative to extraction and is carried out for the following reasons:

- Root filling unsuccessful: attempts have been made to save the tooth by root canal therapy, but the treatment has been shown to have failed by:
  - incomplete filling of an inaccessible canal
  - continued pain and infection after pulpectomy
  - continued presence of a chronic sinus tract
  - an enlarging periapical area on subsequent radiographs.
- Root filling is impossible to complete, due to one of the following:
  - canal blocked by broken instrument
  - canal blocked by a pulp stone
  - alveolar abscess on tooth with post crown, so the site of the infection cannot be reached by conventional orthograde access (through the crown of the tooth)
  - persistent periapical area following re-root filling, so the infection source requires direct removal.
- Removal of excess root filling material from the periapical area, which has occurred during root canal treatment and is acting as a source of inflammation.
- Elimination of curved or fractured root apices, which cannot be root filled and which will act as a source of infection.

The procedure is carried out less frequently in general practice nowadays but is still to be seen in specialist dental practices and hospital departments and is an important method of saving a tooth

from extraction. The technique is classed as a type of minor oral surgery procedure (see Chapter 17), as a mucoperiosteal flap is raised and the jaw bone is drilled to gain access to the root apex.

The procedure is as follows:

- The procedure is carried out under sterile surgical conditions, as for other minor oral surgery procedures.
- The patient and all dental personnel must wear suitable PPE.
- Local anaesthesia is administered so that the tooth and all its surrounding soft tissues are numb.
- An incision is made through the gingiva and a mucoperiosteal flap is raised off the bone with a periosteal elevator.
- Using a straight handpiece and surgical burs, a window is cut in the exposed bone to gain access to the infected root apex.
- The apex is separated from the tooth using burs and removed from the bone cavity.
- All infected soft tissue (which will be that forming the chronic abscess which is present) within the bone cavity is scraped out using a **Mitchell's trimmer** or a **surgical curette**, which resembles a large excavator.
- The cut end of the root is then sealed using a permanent filling material, although new materials are currently being developed specifically for this purpose too.
- Debris is removed by syringing with sterile saline using high-speed aspiration and a surgical suction tip.
- The mucoperiosteal flap is sutured exactly back into place.
- Sutures are either self-absorbing or are removed 7 days later and a radiograph is taken for record purposes. By comparing this radiograph with future ones, the progress of healing can be observed.

Use of antibiotics in endodontics

The aim of endodontic treatment is to attempt to save the tooth from extraction. When a patient presents with obvious signs of an acute infection, a course of antibiotic therapy may be required before treatment of the tooth can commence. The signs of an acute infection are as follows:

- The presence of pus.
- A raised body temperature (**pyrexia**).
- Obvious debilitation of the patient.
- Severe pain and loss of function of the affected tooth.
- Swelling, either intraorally or extraorally.

The dentist will attempt to begin treatment and alleviate these symptoms if possible, by either *lancing* the intraoral abscess or opening the root canal and placing the tooth on *open drainage*. At the same time, antibiotics may be prescribed.

- **Amoxicillin 500 mg three times daily**, or **erythromycin** if the patient is allergic to penicillin derivatives.
- **Metronidazole 200 mg or 400 mg three times daily**, given at the same time if a severe infection is present which may involve other types of bacteria too.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

16
Prosthodontics

Key learning points

A **factual knowledge** of

- the various prosthodontic techniques available to restore a damaged tooth
- the various prosthodontic techniques available to replace a missing tooth

A **working knowledge** of

- the various impression materials and techniques used in prosthodontics
- fixed prosthodontic techniques, including instruments and materials used
- removable prosthodontic techniques, including instruments and materials used

A **factual awareness** of

- other removable prosthetic procedures
- fixed and removable orthodontic appliances, including instruments and equipment used
- the use of dental implants in tooth replacement

Prosthodontics is the branch of dentistry that involves the restoration or replacement of damaged or missing teeth by the use of artificially constructed devices. In this specialty, teeth that have been damaged (whether by dental caries, trauma or some other means) are restored by dental techniques other than fillings, namely inlays, crowns and veneers, or they are extracted and replaced. Missing teeth are replaced by dentures, bridges or implants.

Tooth restorations or replacements that are permanently cemented to existing teeth are also referred to as fixed prostheses, while those that

can be removed from the mouth by the patient are referred to as removable prostheses. Implants are a stand-alone category of tooth replacement that are provided by dentists who have undergone specialist additional training in this field. For those dental nurses with an interest in this area of specialist surgical dentistry, the NEBDN now have a post-registration qualification available, the Certificate in Dental Implant Nursing. Further details are available at www.nebdn.org.

All the artificial devices used to restore or replace the teeth are constructed outside the oral cavity by a technician, rather than within it by the dentist or therapist, as for fillings. For this reason, accurate copies of the prepared teeth and/or the dental arches must be taken and provided to the technician for them to create the artificial restoration or replacement. This is then returned to the dentist for placement or fitting in the patient's mouth, at a later date. These accurate copies are made by taking impressions of the teeth, after the necessary tooth preparation has been carried out by the dentist beforehand.

In addition, the occlusion of the individual patient's dental arches must also be recorded accurately, as any disruption to the normal occlusion will be uncomfortable for the patient, sometimes to the point of being painful. This is because the musculature surrounding the temporomandibular joint, especially the lateral pterygoid muscles, will become strained as the teeth attempt to bite in their correct positions, and the patient will experience facial pain as the muscles are stretched, as well as dental pain due to premature contacts on the teeth.

The skill of the dental technician involved in fixed prosthetic dentistry is to construct the restorations with the same tooth morphology as the original tooth, and to fit the restoration into the occlusion of that individual patient. So, each restoration is consequently constructed by hand as a unique artificial device. An inlay or crown made for one specific tooth in one dental arch would therefore fit no other tooth accurately in any other patient. Although the teeth used in denture construction are preformed, the technician involved in removable prosthetic dentistry is equally skilled in constructing prostheses that accurately fit the individual oral anatomy of the patient, as well as

sitting comfortably in the correct occlusion. Again, each removable artificial device is handmade and unique to that patient.

The techniques used to cement fixed prostheses (crowns, inlays, veneers or bridges) to teeth are similar to those used with fixed orthodontic appliances, while the construction of removable prostheses (dentures) is the same for removable orthodontic appliances. Consequently, orthodontic appliances are overviewed at the end of this chapter. Occlusion and malocclusion are discussed in detail in Chapter 12.

Impression materials used in prosthodontics

As mentioned above, all prosthodontic devices are constructed outside the patient's mouth, and impression materials are used to record an accurate copy for that construction to take place. An impression is also taken of the opposing arch of the patient (the dental arch that does *not* contain the tooth to be restored or replaced), and this may involve a different impression material.

The variety of impression materials available for use in dentistry is vast, but they must all have the following properties:

- To be easily mixed: if their correct mixing is too difficult to achieve by the average member of staff, their use will be limited.
- To be cost-effective: certainly within the NHS where treatment costs are fixed, materials that are overly expensive to use routinely will not be cost-effective and are likely to be avoided by the profession.
- To have an adequate working time before setting: the working time is that available to correctly mix the material before it begins to set; if this is too short then the impression will not be in place before it begins to set, and the mix will be unusable.
- To have a relatively short setting time: the setting time is that taken for the material to fully set so that it can be removed from the mouth without any tearing or distortion and needs to be as short as possible for the patient's comfort.
- To record the tooth details accurately: a high level of accuracy must be achieved with every impression, so that tooth morphology, tooth preparation and occlusion can be reproduced correctly.
- To be stable when set: models cast from the impression must be accurate and not distorted, so the material must not deteriorate at normal room temperature and conditions before it is received by the technician and the models are cast up.
- To be elastic: this property ensures that tearing of the impression on removal from the mouth does not occur, while any distortion that does occur as the impression is pulled out of any undercuts

is not permanent, and the impression 'bounces' back into its original shape and maintains the recorded details accurately.

- To be able to be disinfected without affecting the accuracy of the details recorded: this is to avoid cross-infection from the patient to the dental staff and the technician; the impression must be able to withstand the use and concentrations of any recommended disinfectants.

Where no undercuts are present in the mouth, such as in some edentulous patients (those with no remaining teeth), non-elastic impression materials may be used, but they have been largely superseded by the more modern elastic materials. The more commonly used elastic types of impression material fall into one of the following categories:

- **Irreversible hydrocolloids** (alginate).
- **Addition silicones and vinyl polysiloxanes** (from heavy-bodied putty to light-bodied paste).
- **Polyethers**.

A far less commonly used impression material is agar, which is a *reversible hydrocolloid*. This material is used very little now, having been superseded by the more modern alternatives.

Details of the more common materials available are shown in Table 16.1, but some of the more modern ones can be mixed automatically in special machines, rather than by hand. However, impression material mixing is a daily task of the dental nurse in the vast majority of dental workplaces, and all should be proficient in the hand mixing of all commonly used materials. The techniques and skills required should be covered in all good training courses.

Table 16.1 Common impression materials used in prosthodontics.

Name	Type of material	Mixing components and technique
Alginate	Irreversible hydrocolloid	Powder and room-temperature water in equal portions, mixed by spatulating in a bowl
Addition silicone and vinyl polysiloxanes	Elastomer	Base and catalyst, as putty and liquid or two pastes, mixed in equal portions by spatulation, or in preloaded tubes, or in a mixing machine
Polyether	Elastomer	Base and catalyst pastes, mixed in equal portions by spatulation, then loaded into a syringe for direct application
(Agar)	Reversible hydrocolloid	Gel in a sealed tube, becomes fluid by heating the tube and is mixed by manipulation within the tube before use Used in the laboratory to produce duplicate models but obsolete otherwise

Alginate impression material

This is the impression material most commonly used in the dental workplace, as it is easy to mix and relatively cheap. It is suitable for producing impressions for models for the following:

- Opposing arch models for crown, bridge, inlay and veneer construction.
- Models for the construction of full and partial acrylic dentures.
- Models for the construction of removable orthodontic appliances.
- Study models, for any purpose.
- Models for the construction of special trays, bleaching trays, orthodontic retainers.
- Reproduction of models, as more than one cast can be made from a single impression.

However, the set material is not accurate enough to be used to take the working model for crown, bridge, veneer or inlay construction.

It is presented as a coloured dry powder of *calcium salt*, *alginate salt* and *filler*, with a measuring scoop, which is mixed with water at room temperature using a similar measuring cup (Figure 16.1). Once the lidded container holding the powder constituents has been shaken to ensure their even distribution, and then the powder measured out into the flexible mixing bowl using the scoop provided, a 1:1 proportion of water is added and the constituents are mixed together with a large spatula. Correct mixing is achieved by folding the powder into the water initially, then vigorously spreading it against the bowl side – this is called *spatulating* (Figure 16.2). The mix needs to be spatulated thoroughly to be free of air bubbles, and to create a stiff and creamy consistency.

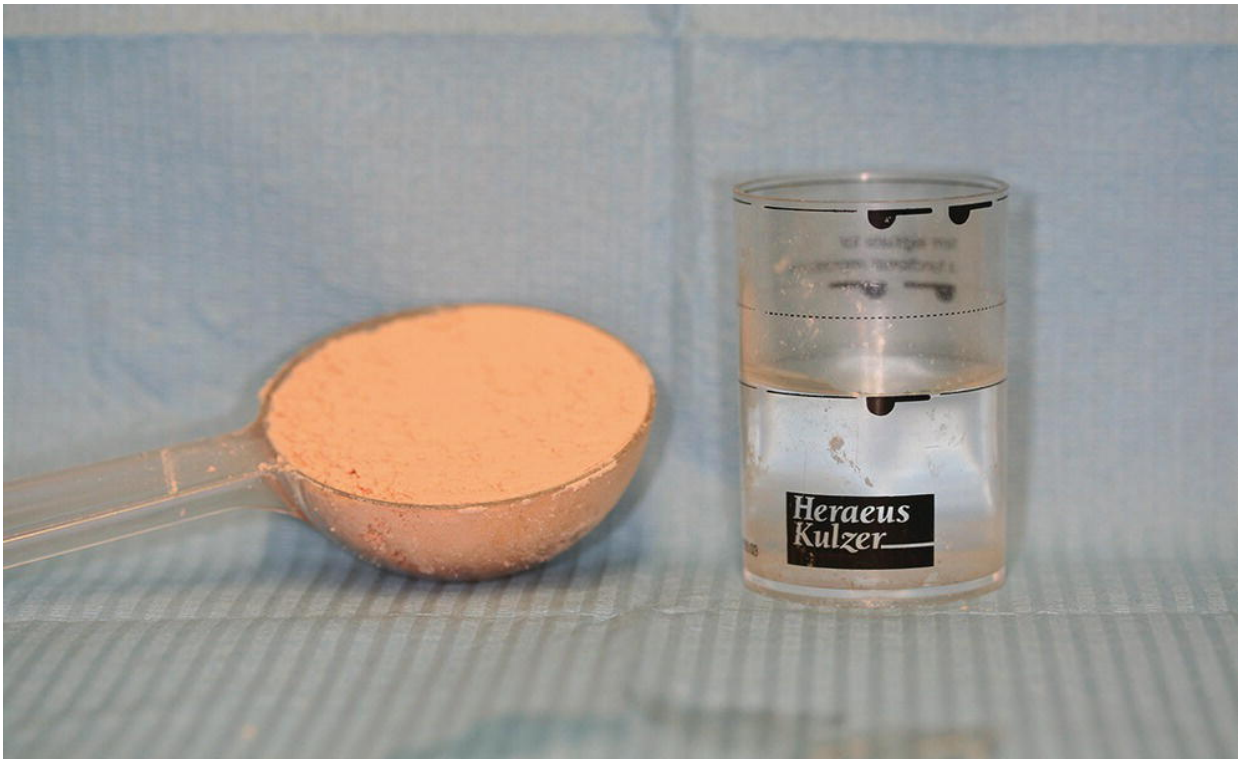


Figure 16.1 Alginate measuring scoop and water measurer.

Figure 16.2 Alginate mixing stages and tray loading.

The mix is then loaded into an impression tray before insertion into the patient's mouth (see later). A set impression is shown in Figure 16.3.

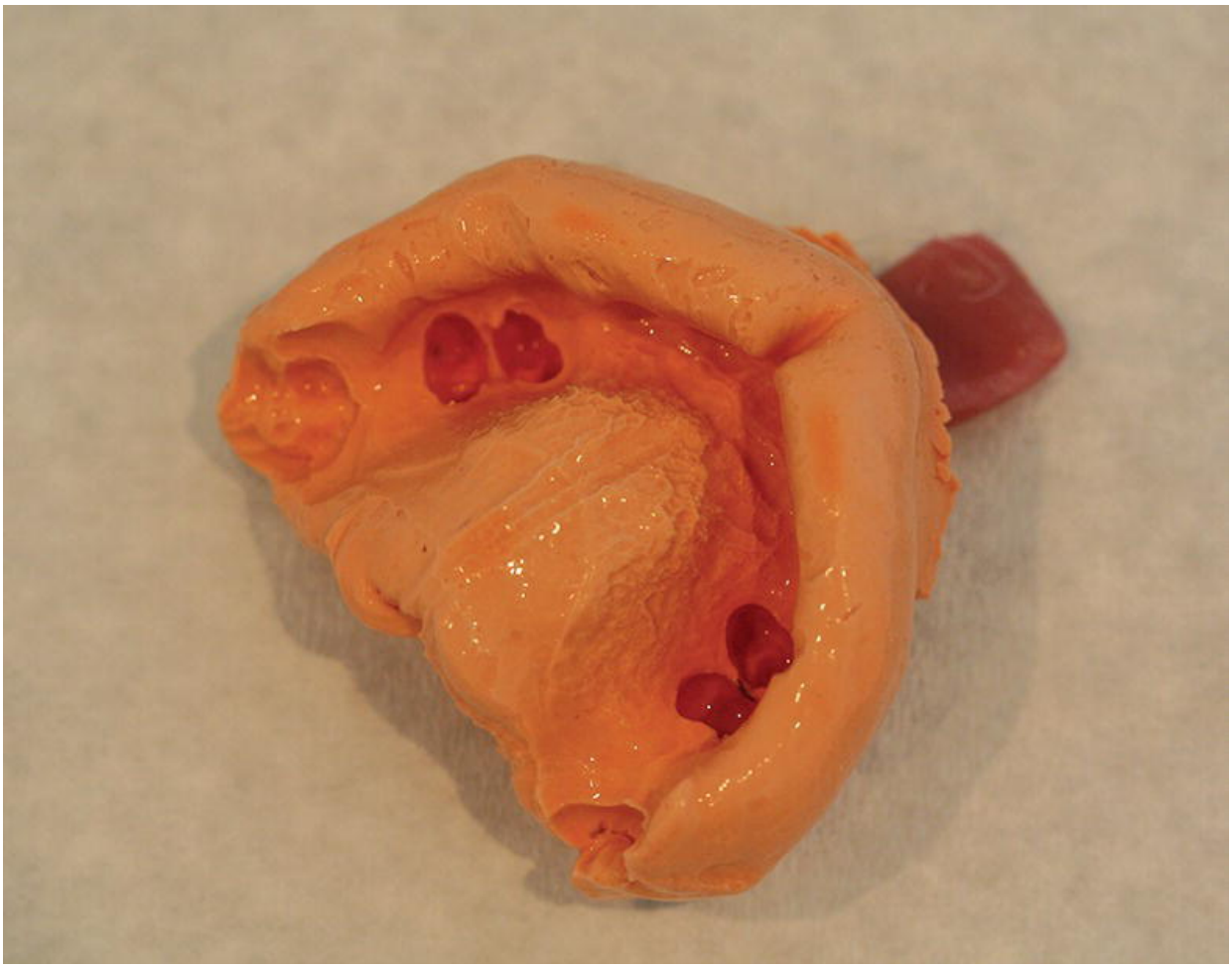


Figure 16.3 Alginate impression set in an upper tray.

The working time of alginate is affected by the temperature of the mixing water used, and the setting time is affected by the room temperature. In both cases, the higher the temperature, the less time is required. Room temperature water and surroundings provide the optimum conditions of use but are not always possible, such as on cold winter days and hot summer days. Some alginates are presented as 'chromogenic' materials which change colour during the mixing and setting stages, so that the tray can be loaded and the impression taken at the optimal points of the procedure. So, an initial white powder changes to pink during the working time, and the tray is loaded and inserted into the patient's mouth. Once the material has changed to a purple colour it is set, and the impression can be removed from the patient's mouth.

The uses and advantages of alginate are listed above. Its disadvantages are as follows:

- Can undergo dimensional changes in the presence or absence of water.
  - If left immersed in water, the impression expands.
  - If allowed to dry out, the impression shrinks.
- Ideally, then, the model should be cast immediately after disinfection.
- When this is not possible, the impression should be wrapped in a damp gauze and sealed in an airtight plastic bag before sending to the laboratory.

Addition silicone impression material

This is one of the elastomer impression materials and is highly accurate when set. It is used specifically for all fixed prosthetic work and some removable prosthetic work. It has a variety of presentations.

- Tubs of heavy-bodied putty with liquid or paste activator, a chemical which starts the reaction to produce the impression material (e.g. Express; Figure 16.4).
- Tubes of light-bodied paste with liquid or paste activator (e.g. Xantopren; Figure 16.5).
- More recent preloaded gun syringes which mix the constituents automatically (e.g. Express; Figure 16.6).

Figure 16.4 Express heavy-bodied putty material.

Figure 16.5 Xantopren paste and liquid wash material.

Figure 16.6 Express light-bodied material in delivery gun.

As with alginate, measuring scoops are provided for accurate mixing, but it should be noted that it is possible for the mixing and setting times to be affected by some types of rubber PPE gloves. If mixing is to occur by hand, it is advisable that vinyl gloves are worn.

When putty materials are being mixed, equal numbers of measured scoops are laid out ready for hand mixing; when lighter-bodied materials are being mixed, either similar measured lengths of paste or the correct number of liquid drops are laid out ready for spatulation on the mixing pad. Those products which are available in side-by-side tubes are dispensed via a gun syringe with a specific mixing nozzle to combine the base and activator together as they are squeezed out (Figure 16.7). Many of the materials can also be measured out and mixed in an automatic mixing machine. As each component is usually highly coloured, adequate mixing can be seen to have occurred when a non-streaky mix is produced. Unlike alginates, silicones are not affected by temperature.

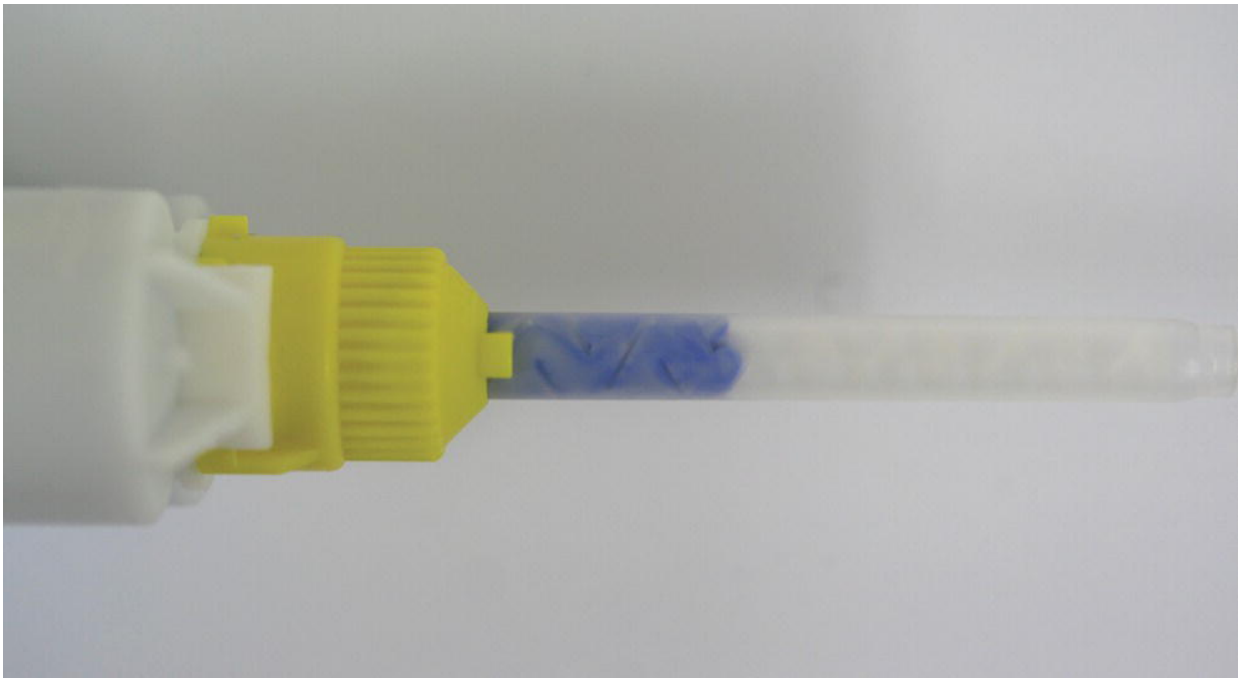


Figure 16.7 Detail of self-mixing of the activator and base while passing through the mixing nozzle.

The silicones can be used either in a one-stage technique (the most widely available, and using addition cured silicones) or a two-stage technique (using condensation cured silicones).

With the former, both the heavy-bodied putty and the light-bodied paste are mixed at the same time. The putty is mixed and loaded into the impression tray by the dental nurse while the paste is either syringed onto the prepared tooth or placed onto it using a flat plastic instrument by the dentist. The loaded tray is inserted into the patient's mouth where both materials then set and are removed together in the tray.

With the latter, the putty is mixed, loaded into the tray, inserted into the mouth and allowed to set first. It is then carefully removed and spaced in the area of the preparation, while the mixed paste is syringed or wiped onto the tooth. The set putty and tray are reinserted and the whole is removed when the paste has set.

While the one-stage technique is obviously quicker, the two-stage method ensures that adequate paste remains around the prepared tooth during tray insertion and gives a very accurate impression, whereas it can be displaced by the putty during tray insertion in the

one-stage method. Adhesive is usually supplied by the manufacturer to ensure the putty material remains in the tray while being removed from the mouth, rather than pulling out of the tray, but perforated trays can also be used which allow some material to squeeze through the perforations and then lock the set impression in place.

Setting time for the silicones is usually 4 minutes or more, so adequate moisture control to maintain patient comfort is of great importance during this period.

The advantages of silicones are as follows:

- Are dimensionally stable in the presence of moisture.
- Mixing techniques prevent the formation of air bubbles so that the impression is highly accurate.
- Have excellent elasticity, strength and accuracy that allow for:
    - use in deep undercuts, without tearing of the impression
    - undistorted final impression for model casting, as their elasticity allows the material to 'bounce' back to its original shape once it has been removed from the mouth
    - several tooth preparations to be recorded accurately in one impression, without tearing.
- Suitable for use for all types of denture construction, as well as for fixed prostheses.

The disadvantages of silicones are as follows:

- More complicated and time-consuming technique of impression taking than for alginate.
- More expensive materials.
- Longer setting time may be too uncomfortable for some patients to tolerate.
- Paste materials are particularly sticky before setting and need to be carefully handled to avoid causing an unnecessary mess.

Polyethers

These are also highly accurate impression materials, used specifically for fixed prosthetic work and certain removable prosthetic work. An example of this type of impression material is Impregum (Figure 16.8).

Figure 16.8 Impregum base and catalyst paste material.

They are presented as two pastes which are usually different colours to ensure that uniform mixing occurs. They are mixed in equal proportions by spatulation on a waxed paper pad, and then collected into special syringes for administration to the prepared tooth (Figure 16.9).

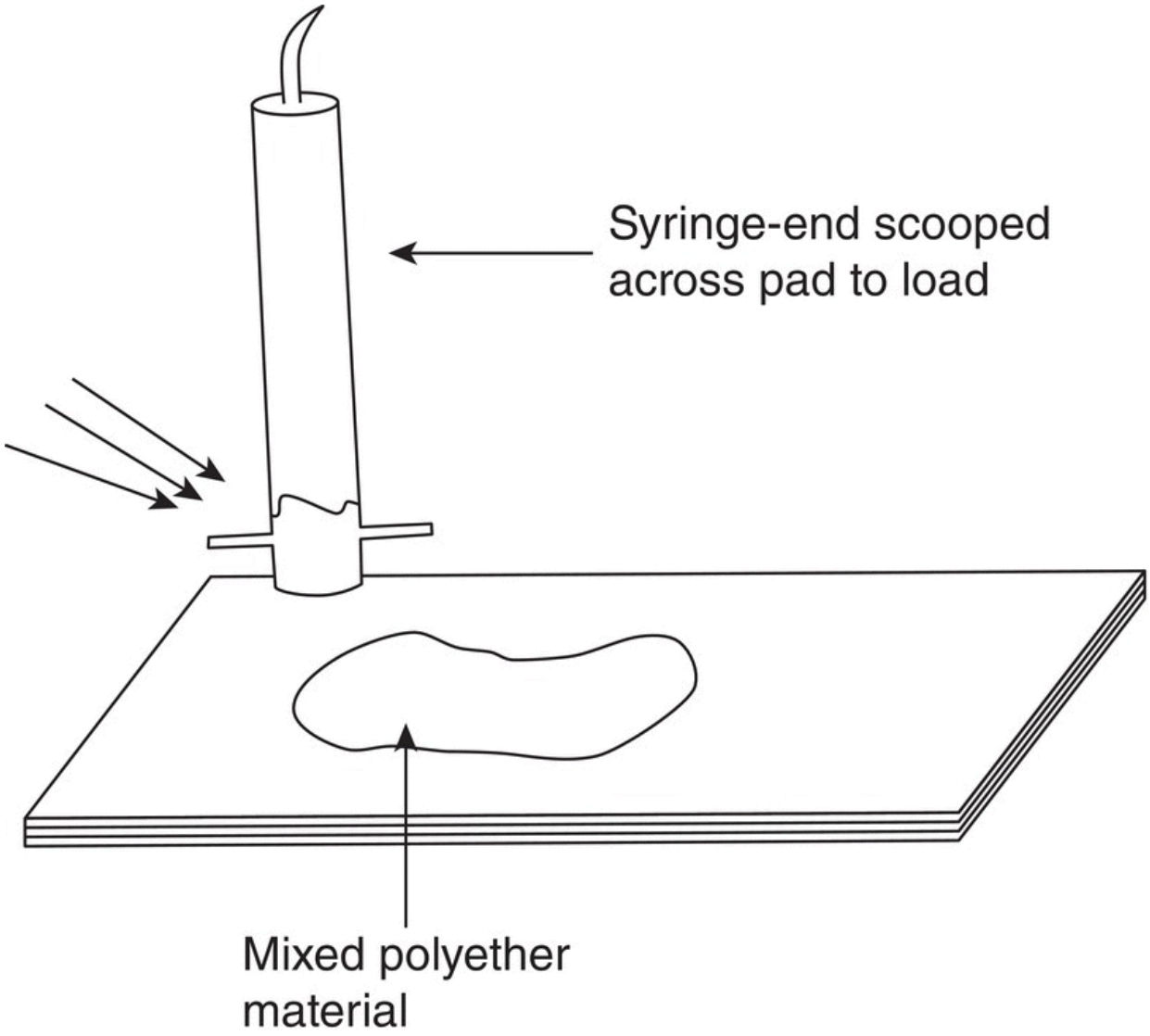


Figure 16.9 Polyether collection technique.

The remaining material is loaded into the impression tray. Again, adhesive is supplied by the manufacturer to ensure the set impression remains in the tray while being removed from the mouth. Polyethers have a similar setting time to silicones but set more stiffly than other elastomers, and therefore need to be removed with a sharp displacing action from the mouth, otherwise they can be difficult to remove. Their advantages and disadvantages are as for silicones, except that they are slightly less dimensionally stable when moist.

Impression handling

As all the impressions taken have been inside the patient's mouth, they will obviously be contaminated by their saliva and perhaps even their blood. To avoid cross-infection from the patient to either staff or the technician, the impressions (and bite records) must be disinfected immediately after their removal from the mouth. This is done as follows:

- Rinsed under cold running water to remove any visible debris.
- Fully immersed in a disinfectant bath of a recommended impression disinfectant, such as a solution of up to **10% sodium hypochlorite** (bleach) or products such as Proforma (Figure 16.10).
- Immersed for up to 10 minutes, depending on the manufacturer's instructions.
- Rinsed under cold running water again, to remove the disinfectant solution.
- Alginate impressions: covered with wet gauze and sealed in an airtight bag.
- Elastomer impressions: blown dry using the triple syringe and then sealed in an airtight bag.
- All stored at room temperature or below before transportation to the laboratory.
- Work ticket enclosed, detailing dentist, patient name and age, prosthesis to be constructed, material to be used, shade, additional features, date of delivery for fitting, disinfection details. The work ticket details should also be recorded on the patient's record card or computer notes.

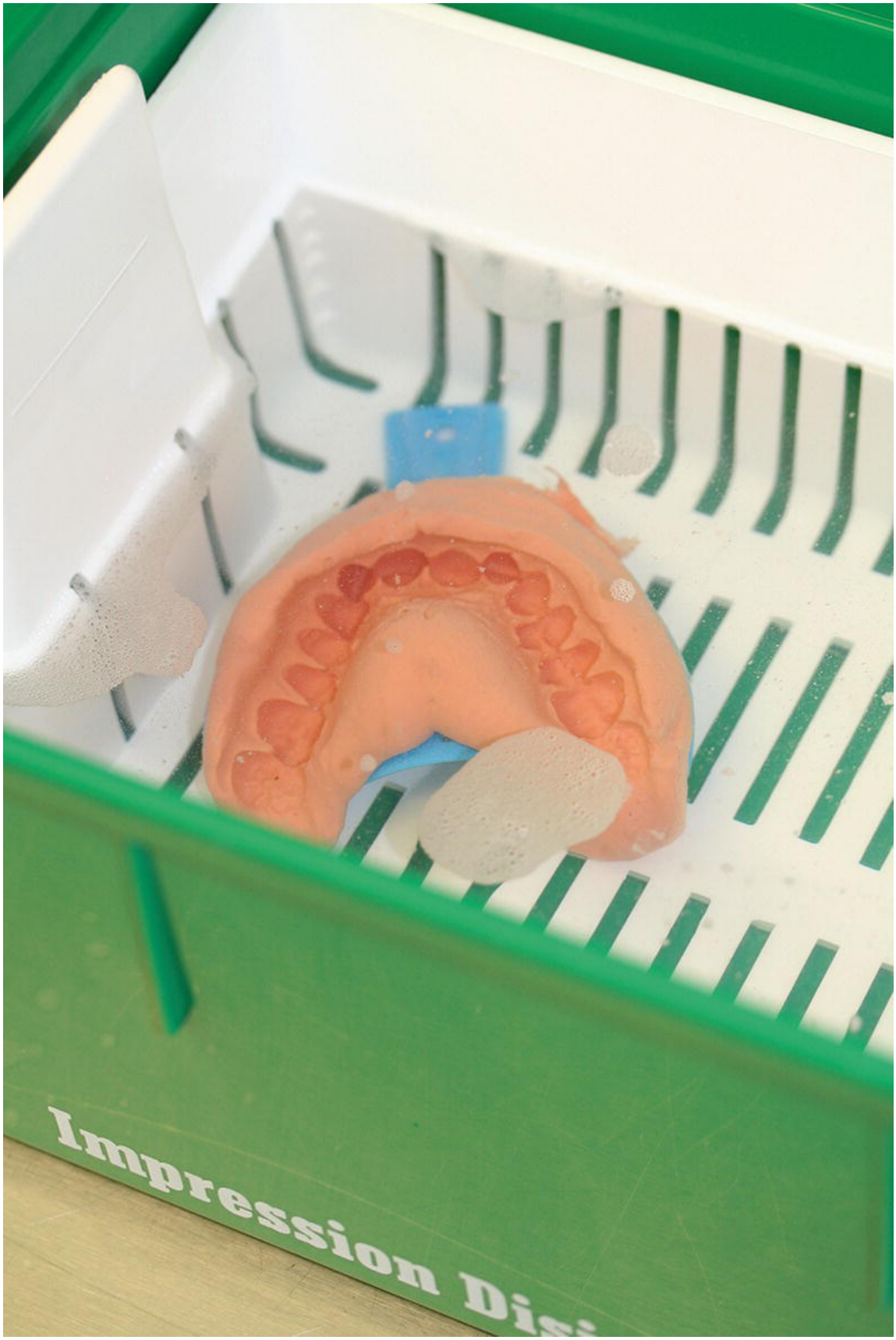

Impression Disi

Figure 16.10 Impression immersed in disinfectant bath.

As indicated, the majority of impressions are sent away to a laboratory and this can take some considerable time, especially if they are posted. During this period, they must remain stable so that the cast models eventually produced are accurate, otherwise the fixed prostheses will not fit onto the patient's tooth or into their mouth accurately. For this reason, impressions should not be exposed to any heat sources or chemicals, and alginate impressions must be kept moist and not allowed to dry out, otherwise they will distort and any models cast from them will be useless. Where simple study models are required, they can be cast up at the dental workplace rather than being sent to a laboratory and the casting technique is one of several skills that can be acquired by the dental nurse as an extended duty. Further details are given in Chapter 18.

Impression trays

Impression trays are devices used to hold the semi-solid impression material in the shape of a dental arch, so that it can be inserted into the patient's mouth and held in place without dripping, while it sets over the teeth and other oral structures. The tray then holds the set impression in a horseshoe shape while it is removed from the mouth, inspected and disinfected, then sent to the laboratory for model casting.

The trays are available for use with edentulous patients (Figure 16.11) and dentate patients (Figure 16.12), the latter examples being referred to as 'boxed trays'. They can be plastic and single use, or metal and autoclavable for reuse. As many impression materials are not adhesive to plastic or metal, the trays are either perforated so the set material locks itself into the tray or are unperforated and require the use of an adhesive so that the impression sticks to the tray. Obviously, the shape of upper and lower trays differs by the inclusion of the palatal coverage required in the upper trays.

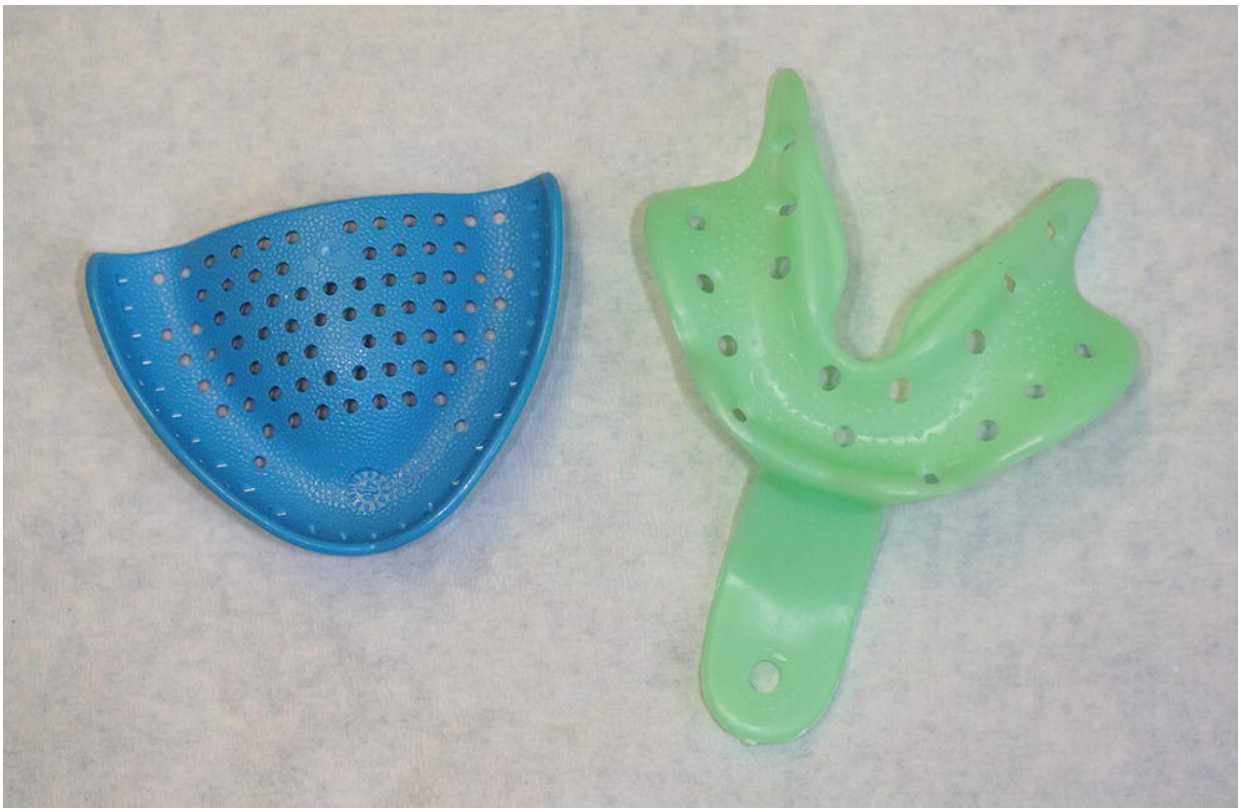


Figure 16.11 Edentulous impression trays.

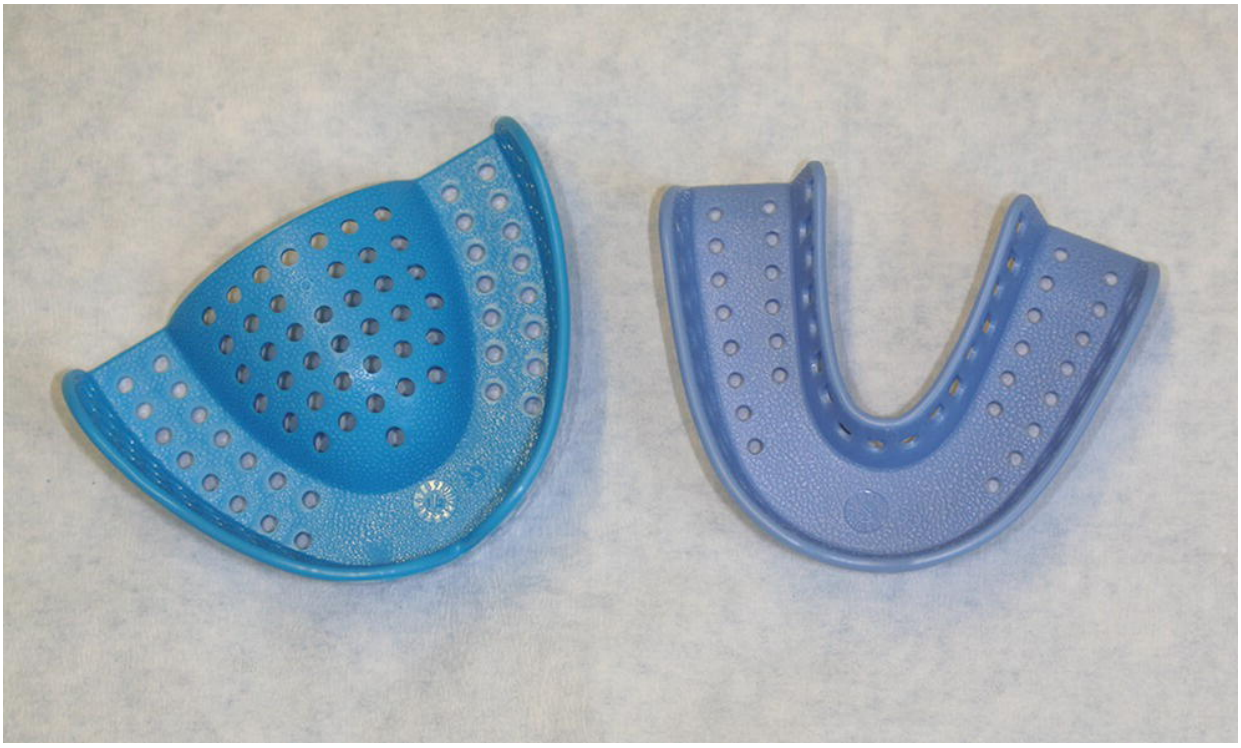


Figure 16.12 Boxed impression trays.

Those impression trays available in a variety of child and adult sizes and preformed by the manufacturer are called ‘stock trays’, while those handmade in acrylic by the technician from an initial study model are called ‘special trays’ (Figure 16.13). These are custom-made and individual to the patient and are used when a high level of accuracy is required, such as when chrome-cobalt dentures are being constructed.

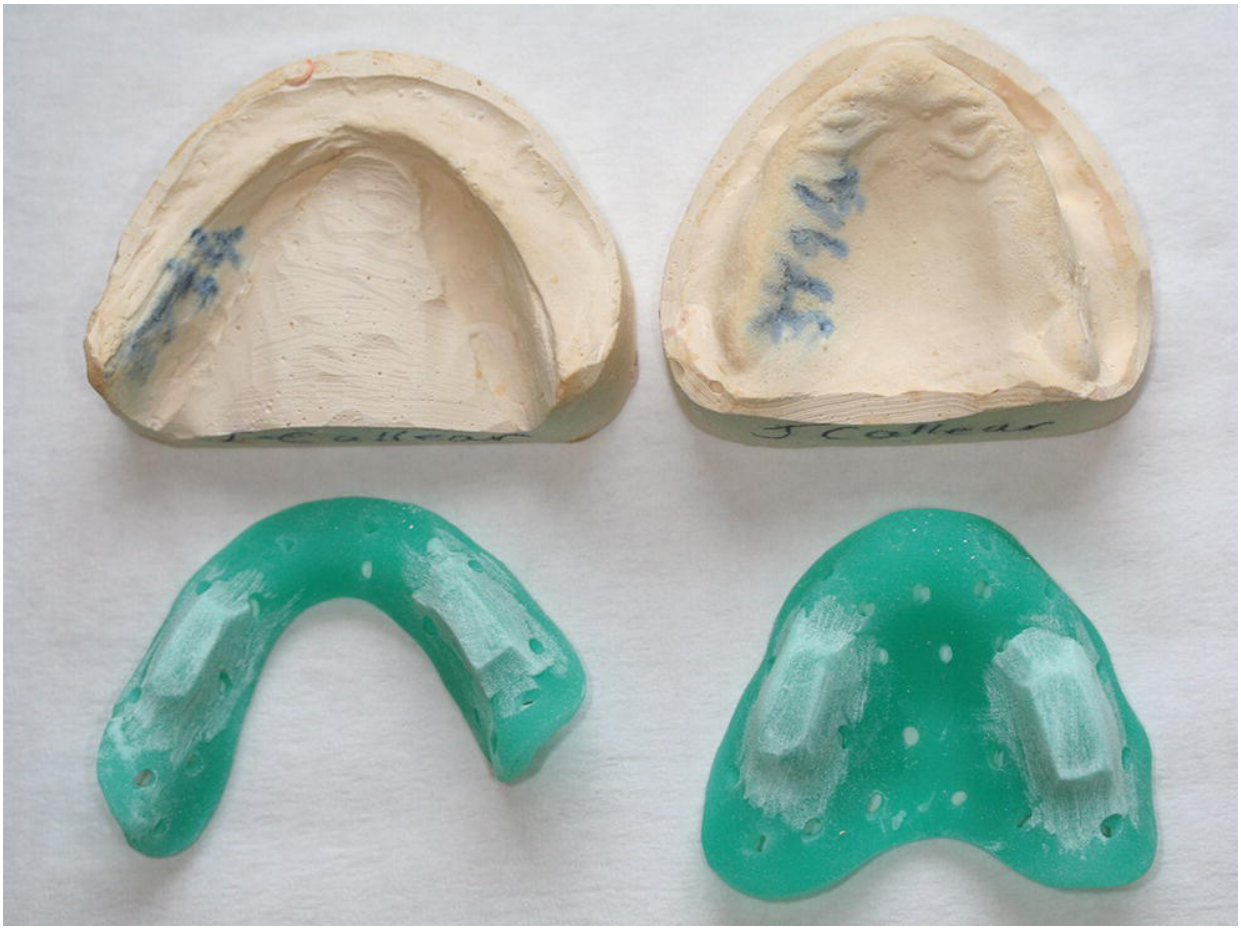


Figure 16.13 Special trays with models.

A final type of tray is that used for fixed prosthodontic work, which records a partial section of both dental arches and the occlusion of the area in one impression. Examples are the *triple trays* shown in Figure 16.14, which are discussed later.

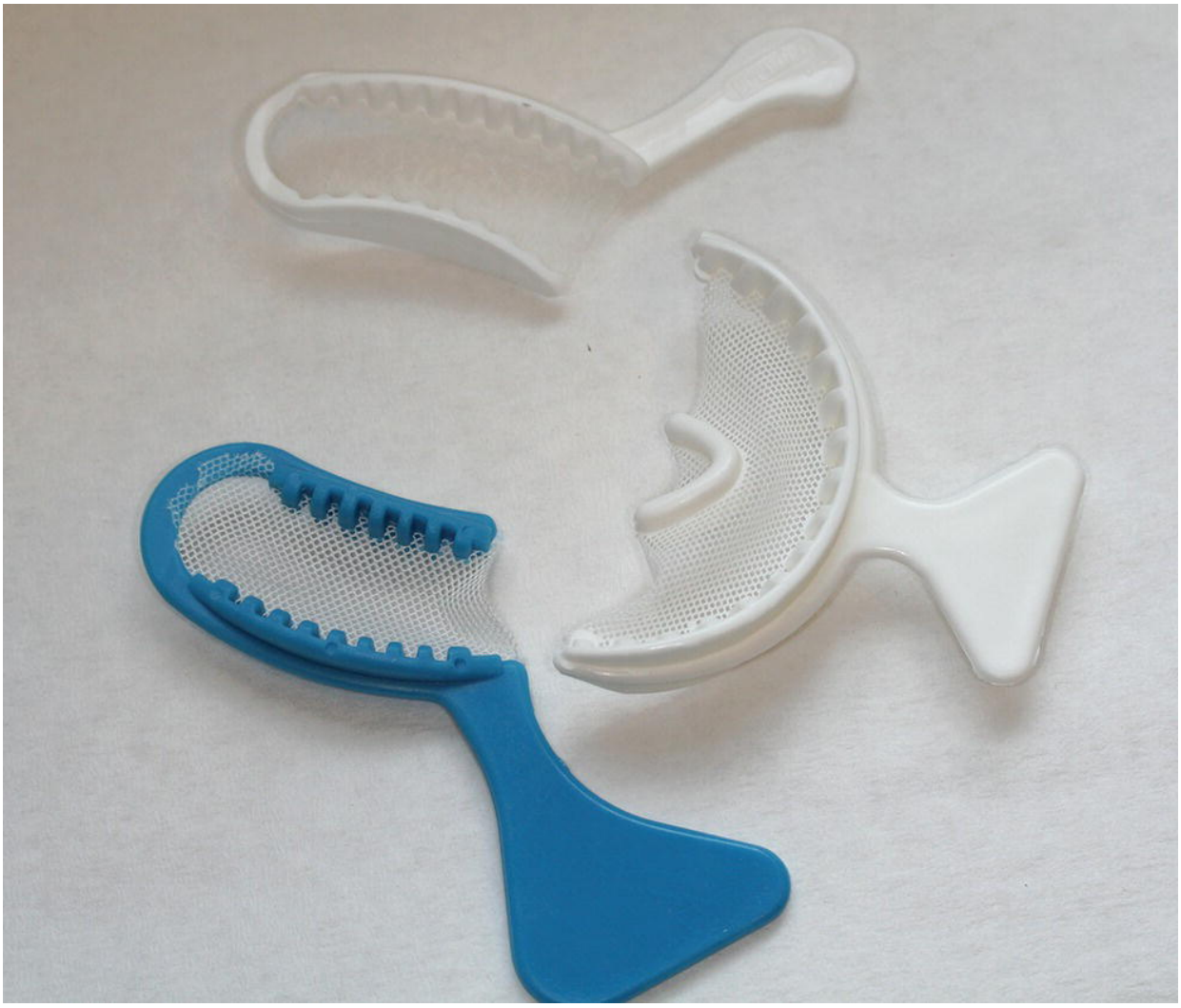


Figure 16.14 Examples of triple trays.

Fixed prosthodontics

These tooth restorations or replacements are cemented within, or onto, a tooth and include the following prostheses (Table 16.2):

- **Temporary or permanent crown**: a cap or shell-like device made to cover three-quarters to the whole surface of a single tooth.
- **Temporary or permanent bridge**: two or more crown-like units joined together as a single device, at least one of which is to replace a missing tooth.
- **Veneer**: a facing made to fully cover the labial surface of a tooth.
- **Inlay**: an insert into a tooth cavity that has been constructed in a laboratory.

Table 16.2 Types of fixed prostheses available.

Fixed prosthesis	Purpose of prosthesis	Construction materials
Temporary crown (Figure 16.15)	To cover the prepared tooth while awaiting a permanent crown As an emergency restoration	Preformed acrylic or polycarbonate Cold-cure acrylic
Permanent crown (Figure 16.16)	To protect a heavily filled or root-filled tooth from fracture during chewing Aesthetics Tooth shape change	Porcelain ceramic All ceramic Bonded porcelain to metal Precious metal alloy Non-precious metal alloy
Temporary bridge	To cover prepared teeth and replace missing teeth while awaiting the permanent bridge To temporarily replace missing teeth after extraction while resorption occurs	Acrylic Resin-based materials
Permanent bridge (Figure 16.17)	To replace missing teeth Aesthetics	All ceramic Bonded porcelain to metal Precious metal alloy Non-precious metal alloy
Veneer (Figure 16.18)	Aesthetics, to cover the labial surface of an anterior tooth when it is discoloured or misshapen	Porcelain

Fixed prosthesis	Purpose of prosthesis	Construction materials
Inlay (Figure 16.19)	To restore a cavity in a tooth with a material stronger than conventional filling materials	All ceramic Precious metal alloy Non-precious metal alloy

Figure 16.15 Temporary polycarbonate crown forms.

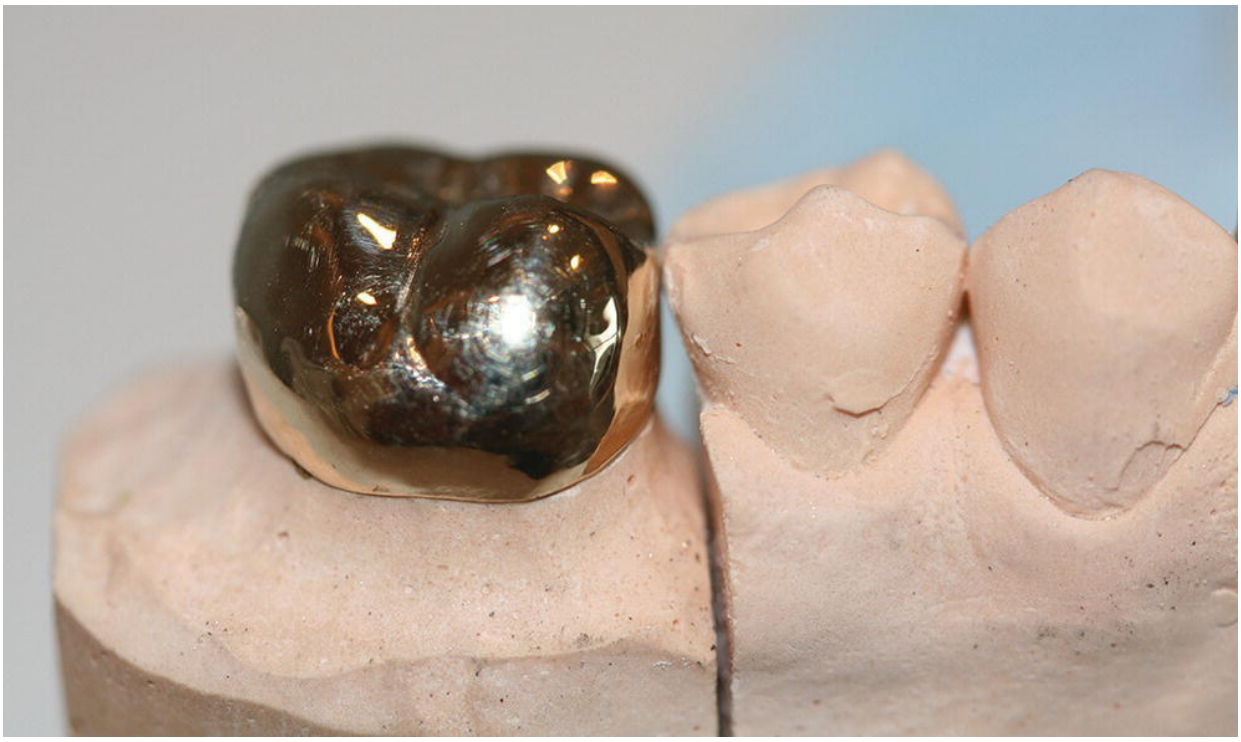


Figure 16.16 Full gold crown on model.

Figure 16.17 Permanent two-unit bridge on model.

Figure 16.18 Porcelain veneers on six upper anterior teeth.

Figure 16.19 Cemented gold inlay.

All are provided for varying reasons but involve the use of similar impression and cementation materials, and similar instruments. The material used depends on the following considerations:

- Tooth involved: are high chewing forces likely to occur?
- Aesthetics: is an anterior tooth involved?
- Longevity: is the prosthesis temporary or permanent?
- Occlusion: is the patient's bite unusual in any way?

Although some temporary crowns and bridges can be constructed at the chairside, using either stock crown forms (see Figure 16.15) or preoperative impressions to construct them, all other fixed prostheses are sent to a laboratory for construction by the technician.

Crowns

A crown is a laboratory-constructed artificial restoration which replaces at least three-quarters of the natural crown surface of the tooth. There are several different types, made of various materials, and they usually require at least two visits for the tooth preparation, crown construction and fitting to be completed. However, the use of modern three-dimensional imaging techniques in the workplace which can scan the tooth preparation and construct the crown that day, or the use of newer composite materials (such as Luxacrown) which can be used to construct crowns at the chairside, has enabled patients to receive treatment much more quickly.

The surgery procedure for the conventional tooth preparation is summarised below.

- All staff and the patient are provided with suitable PPE.
- Unless the tooth is non-vital, **local anaesthetic** is administered to anaesthetise the tooth to be prepared.
- An **alginate impression** of the opposing arch is taken, using the appropriate impression tray.
- An **occlusal registration** is taken, using softened wax which the patient bites into, or with the use of a specific occlusal registration material such as Blu-Mousse or Express Bite registration putty and catalyst (Figure 16.20).
- In more complicated cases where several crowns are being constructed in the same arch, a **face bow technique** is carried out to enable the technician to articulate the models at the laboratory.
- The **tooth is prepared** by reducing its overall dimensions by 1 mm for metallic or ceramic crowns or 1.5 mm for bonded crowns, using tapered diamond burs which produce near-parallel sides to provide optimum retention, but without producing undercuts (Figure 16.21).
- The prepared tooth shape to be achieved is illustrated in Figure 16.22.
- To ensure accurate recording of the crown preparation margins, **gingival retraction cord** can be pushed into the gingival

crevice and removed immediately before the impression is inserted. This is cord soaked in either adrenaline or alum, both of which cause the gingivae to retract and pull away from the tooth, thus allowing impression material to flow into the crevice created and accurately record the prepared tooth margins.

- An **elastomer impression** is then taken of the working arch, using a silicone or polyether material.
- When satisfactory impressions have been produced, a **temporary crown** is made at the chairside and cemented temporarily to the prepared tooth (see later).
- A **shade** of the tooth is taken by comparing the adjacent teeth to a suitable shade guide (Figure 16.23) and ensuring that any surface characteristics such as root darkening or hypomineralised spots are also mimicked. This stage may be carried out at any point in the procedure.
- All relevant details are **accurately recorded** on the laboratory slip, which is sent to the laboratory with the disinfected impressions and occlusal registration for construction of the permanent crown.
- A correct return date should be given, to coincide with the patient's next appointment for fitting of the crown.

Figure 16.20 Bite registration record using Express bite registration putty and catalyst material.

Figure 16.21 Examples of tapered diamond crown preparation burs.

Figure 16.22 Crown preparations of three upper right teeth.

Figure 16.23 Shade guide.

Laboratories vary in the time required for the conventional crown to be custom made, and the period may range from a few days to 2 weeks. Accurate and detailed information provided on the laboratory slip will ensure that unnecessary delays are avoided, and a professional and trusting relationship between the practice and the laboratory technician often allows for a speedier completion on occasion.

The surgery procedure for the fitting of the crown is summarised below.

- Provide suitable PPE for the patient and all staff.
- Local anaesthesia is administered, unless the tooth is non-vital.
- At this point, some dentists may choose to apply a rubber dam to the prepared tooth, so that it is isolated from possible oral contamination.
- Removal of the temporary prosthesis, using specific crown removal instruments or a bur in the high-speed turbine to cut the temporary prosthesis off the tooth.
- Try-in of the permanent prosthesis onto the tooth (or teeth).
- The marginal fit of the crown will be checked for accuracy, along with the occlusion and the shade of the prosthesis.
- Occlusion will be checked using articulating paper: high spots will leave a coloured mark to indicate the point that needs reducing.
- Reduction is carried out using burs in the high-speed handpiece, and polishing burs or stones to smooth the area afterwards.
- When the dentist and patient are happy with the aesthetics and the fit, the prosthesis can be cemented into place using one of a variety of luting cements. These materials are summarised below and discussed in detail in Chapter 15.
- If the fit is poor or the occlusion is completely incorrect, the dentist will take new impressions and bite registration and request a remake of the prosthesis.

Instruments and materials required

The majority of dentists have a normal ‘conservation tray’ set up as the basic instruments required for crown preparation and fitting, and some may work under a rubber dam too. The additional equipment and materials specifically required are shown in Table 16.3.

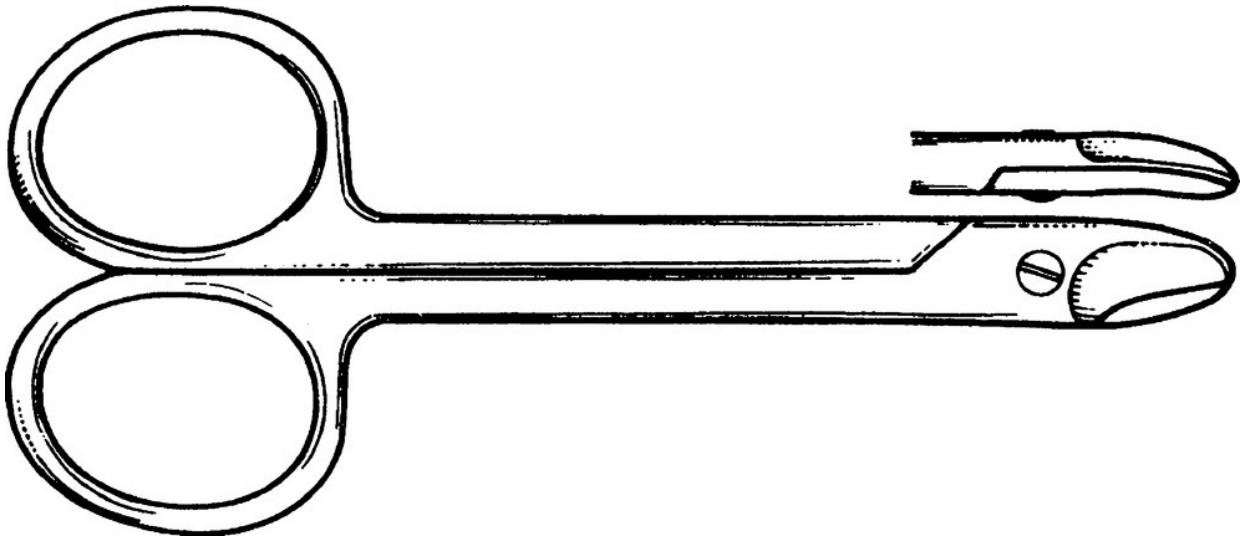


Figure 16.24 Beebee crown shears.

Table 16.3 Crowns: additional equipment and materials.

Item	Function
Diamond burs (see Figure 16.21)	Tapered so that no undercuts are produced on the prepared tooth or teeth, otherwise the fixed prosthesis will not seat fully onto the tooth
Retraction cord	Cord soaked in an astringent solution (adrenaline or alum) that is then packed into the gingival crevice to cause shrinkage of the gingiva away from the prepared tooth. This provides a definitive tooth margin which is reproduced in the impression and also the cast model
Impression trays (see Figures 16.12 and 16.14)	Variety of plastic or metal boxed trays, sized to fit fully over the dental arch: upper and lower styles Also triple tray system which takes both part-arch impressions and the bite registration in one procedure
Crown former (see Figure 16.15)	Preformed plastic or polycarbonate tooth-shaped formers, in a variety of sizes and available for each tooth shape
Beebee crown shears (Figure 16.24)	Short beaked shears for cutting and shaping the margins of temporary crowns Alternatively, acrylic burs can be used to adjust the temporary crown margins
Shade guide (see Figure 16.23)	Shaded teeth in holder, to determine the required shade of the prosthesis by comparing each example to the adjacent teeth and determining the best match available When all-ceramic crowns are to be constructed, both the core and tooth shade must be recorded using special shade guides (Figure 16.25)

Figure 16.25 All-ceramic core and tooth shade guides.

The fixed prosthesis is permanently cemented to the prepared tooth using a luting cement. These are adhesive to the dentine of the tooth and are mixed to a creamy consistency so that the prosthesis can be seated fully onto the tooth before the cement sets. Types available are discussed fully in Chapter 15 and summarised in Table 16.4.

Table 16.4 Types of luting cement.

Type	Action	Mixing
Self-cure resin	Chemical bonding between tooth and prosthesis	Double syringe mix
Light-cure resin	Light-cure bonding between tooth and prosthesis	Double syringe mix
Dual-cure resin	Combination of self-cure and light-cure bonding between tooth and prosthesis	Double syringe mix
Polyester resin	Chemically adhesive, and inert in saliva	Waxed pad and spatula
Glass ionomer	Chemically adhesive to tooth and inner surface of prosthesis	Waxed pad and spatula
Zinc polycarboxylate	Chemically adhesive to tooth and inner surface of prosthesis	Glass slab and spatula
Zinc phosphate	Mechanically adhesive to rough inner surface of prosthesis, and surface of tooth	Glass slab and spatula

Modern types of cement tend to be provided in double syringe form with little or no mixing necessary, but older types (such as phosphate, polycarboxylate and some glass ionomer cements) require correct proportioning and thorough mixing before use.

All can be mixed on a cool glass slab with a small spatula, by incorporating increments of powder into the relevant liquid and spatulating thoroughly until a smooth, creamy mix is produced.

The types of permanent crown available can be summarised as follows:

- Porcelain jacket crown (PJC): an early type of all-porcelain crown used for anterior teeth only, to provide good aesthetics when the

only other alternatives were metal crowns.

- All-ceramic crown: the modern successor to PJCs, constructed of stronger ceramic materials than porcelain alone (such as zirconia), and therefore able to be used both anteriorly and posteriorly to give a more 'tooth-like' appearance than other crowns. They also require less tooth removal during preparation than a conventional bonded crown. An example of this type of crown is the Emax (Figure 16.26) which mimics the translucency and shine of enamel far better than porcelain or bonded porcelain and appears much more tooth-like.
- Porcelain bonded crown (PBC): these consist of a substructure of metal for strength with a buccal or labial face of porcelain for better aesthetics than an all-metal crown (Figure 16.27); these crowns were popular for years before the advent of the stronger and more aesthetic all-ceramic crowns. They appear less opalescent than the all-ceramic crowns and their porcelain can be cracked off the underlying metal in patients with a heavy bite.
- Full gold crown (FGC): these can be made of yellow gold (see Figure 16.16) or a mixture of precious or non-precious metals to give a silvery appearance, and are the strongest of all crowns available, making them ideal for posterior teeth, especially in patients with a heavy bite. However, their aesthetics are poor compared to bonded crowns and all-ceramic crowns.
- These can be made as full coverage crowns or three-quarter crowns which leave the buccal or labial surface of the tooth intact but cover the rest of the tooth. This gives better aesthetics while still providing adequate coverage of the tooth cusps, so providing strength to the device.
- Three-quarter crowns have tended to be superseded by bonded crowns, which provide both good aesthetics and strength in the same situations.

Figure 16.26 Example of an all-ceramic molar crown with tooth-like aesthetics.

Figure 16.27 Porcelain bonded crowns cemented to three upper right teeth.

Post crowns

As discussed in Chapter 15, when teeth die and are preserved by root filling and restoration, the remaining tooth structure often becomes brittle with time and fractures. Sometimes the fracture is so extensive that there is not enough tooth structure left to restore it without the use of additional support. This support is often achieved by the placement of a metallic post and core structure which is then shaped to hold a conventional crown – these restorations are called post crowns (Figure 16.28).

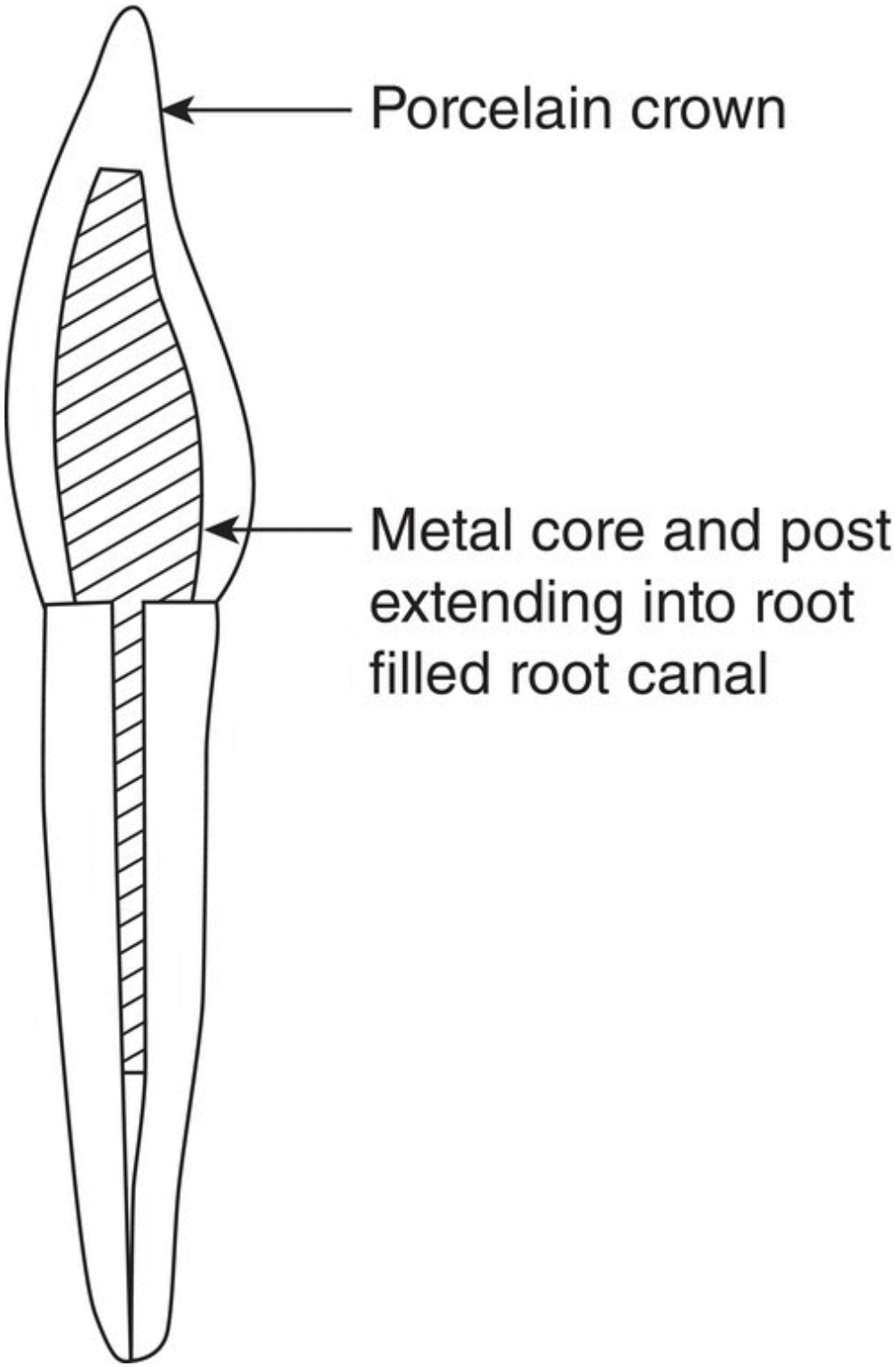


Figure 16.28 Illustration of a conventional metal core and post crown.

The metallic post and core system can be constructed from preformed posts, such as Paraposts or Dentatus posts with a core constructed at

the chairside, or the prepared root forms part of the crown preparation impression, and the post and core are handmade by the technician, along with the crown.

The chairside procedure differs only in the preparation of the post hole in the root, and the chairside post and core placement or impression technique, as follows:

- The root face margins of the fractured tooth are shaped as for a conventional crown preparation.
- The root-filling material in the root canal is carefully removed to a suitable depth using Gates Glidden drills (see Figure 15.56).
- The post needs to be as long as possible to provide adequate support for the new crown, but drilling should not be so deep that there is a risk of root fracture.
- The canal is then prepared widthways, using drills specific to the type of post to be placed, so that a parallel-sided hole is produced. This will give the maximum retention for the post, once cemented.
- A prefabricated post is then either screwed into the canal (Dentatus system) or cemented into the canal (Parapost system, Composipost system) using one of the usual luting cements. Examples of the post systems are shown in Figure 16.29.
- Alternatively, a wax post is placed in the hole and forms part of the impression to be sent to the technician for post crown construction.
- Using this technique, the post hole must then be retained as an unblocked channel while the post crown is under construction, often by the insertion of a temporary post.
- If a prefabricated post has been placed at the chairside, its top end is then used as the retainer for the core to be suitably shaped to hold the eventual crown itself.
- Suitable materials for core construction are hardened glass ionomer cements such as Vitremer.
- Once the impression has been taken, the core then holds the temporary crown in place while the final crown is under

construction.

- Otherwise the technician will construct the post and core as a single structure, and then the crown as a separate structure to be cemented onto it at the fitting appointment.
- More recent developments in this area of prosthodontics include the development of titanium posts, which can be bent and customised to fit into individual root canals and require no drilling of the post hole before fitting, thus eliminating the potential for root fracture during preparation. Other developments include glass fibre posts which are cemented into the post hole using self-adhesive resin cements before a core is constructed using a bulk-fill composite material. Examples of each include Filpost and RelyX Fibre Post, respectively.

Figure 16.29 Parapost, Composipost and Dentatus post systems.

Temporary crowns

Temporary crowns are placed for a limited time only while the permanent crown is being constructed and are used for the following reasons:

- To maintain the appearance.
- To prevent sensitivity of the prepared teeth between the preparation and fitting visits.
- To maintain the correct space between adjacent teeth so that the permanent crown fits. Sometimes the adjacent teeth tend to tip into the space once the crown preparation has been carried out,

as the contact points between the teeth are removed during the procedure.

- To maintain the correct occlusion between opposing teeth. The opposing tooth to the prepared tooth will have no occlusal contact after the crown preparation procedure and may therefore tend to overerupt.

Temporary crowns can be handmade at the chairside on the day of crown preparation, or prefabricated types can be adjusted to fit the individual tooth.

Those handmade on the day are created as follows:

- An impression of the tooth is taken before crown preparation begins, using an elastomeric material which sets firmly, such as a silicone putty.
- A cold cure acrylic material (such as ProTemp) is then mixed and placed in the impression after crown preparation and reinserted into the mouth over the prepared tooth.
- This material contracts during setting and will not easily be dislodged, even without the use of a cement. Indeed, this 'shrink-fit' technique often requires a smear of lubricating jelly such as Vaseline to be coated onto the tooth preparation first, otherwise the temporary crown can be very difficult to remove.
- The material takes just minutes to set and produces a temporary crown of exactly the shape of the original tooth.
- Shades are rather restricted, so colour matching is as accurate as can be expected.

Temporary crowns placed using a prefabricated product are made by fitting a *crown form* over the prepared tooth. For anterior teeth a clear plastic crown form such as an Odus pella (see Figure 15.37) may be used. It is trimmed with crown scissors (see Figure 16.24) and filled with a material which matches the teeth, such as composite. The filled crown form is placed over the tooth preparation and the filler is set, usually by light-curing. The plastic crown form is then peeled off, leaving the underlying temporary crown in place over the tooth preparation. Alternatively, tough tooth-coloured *polycarbonate*

crown forms are used, such as Directa (see Figure 16.15) and these only need trimming with acrylic trimming burs in the slow handpiece before being filled with either a temporary cement or a 'shrink-fit' material such as ProTemp and fitted onto the prepared tooth to set (Figure 16.30). Both techniques (handmade and prefabricated) can be successfully used for posterior teeth.

Figure 16.30 Prefabricated temporary crowns in place on the upper left incisors.

Trimmed prefabricated temporary crowns can be cemented with a material which is adhesive to the tooth but easily and cleanly removed for fitting the permanent crown, for example Temp Bond.

Metal crown forms made of aluminium, nickel-chromium or stainless steel can be used on posterior teeth (Figure 16.31), but they have largely been replaced by more aesthetic temporary crowns, either prefabricated or handmade.

Figure 16.31 Examples of prefabricated metal posterior temporary crowns.

Stainless steel crown forms, often referred to now as preformed metal crowns (PMCs), are still often used as the best restoration for caries management in deciduous molars instead of a conventional filling, via the Hall technique, as well as in cases of non-carious tooth surface loss (such as erosion) and trauma.

The Hall technique involves the cementation of a PMC onto a carious deciduous molar tooth, without removing any caries or preparing the tooth under local anaesthetic beforehand. By isolating the caries bacteria under the crown and away from any further food debris nutrients, the bacteria are unable to continue attacking the tooth and the cavity is unable to progress further. Research shows that the technique has equal success rates to those where caries removal and tooth preparation are carried out under local anaesthetic and is therefore a useful treatment alternative for young and anxious patients. Providing successful restorative treatment to anxious young patients, without the need for local anaesthetics and tooth preparation, should result in compliant, healthy adult patients in the future.

Bridges

A bridge is a laboratory-constructed artificial device which is composed of two or more units, one of which will replace a missing tooth. Essentially, a conventional bridge is composed of one or more units which are each exactly the same as a single crown, but as a bridge they are all joined together to make one structure. Within that structure will be one or more units that lie over the dental ridge where a tooth is missing, while the other units sit over the prepared teeth that will hold the bridge in place. The unit replacing the missing tooth is called a *pontic*, the units holding the bridge in place are called *retainers*, and the teeth that they are cemented onto are called *abutments*. A conventional bridge is illustrated in Figure 16.32.

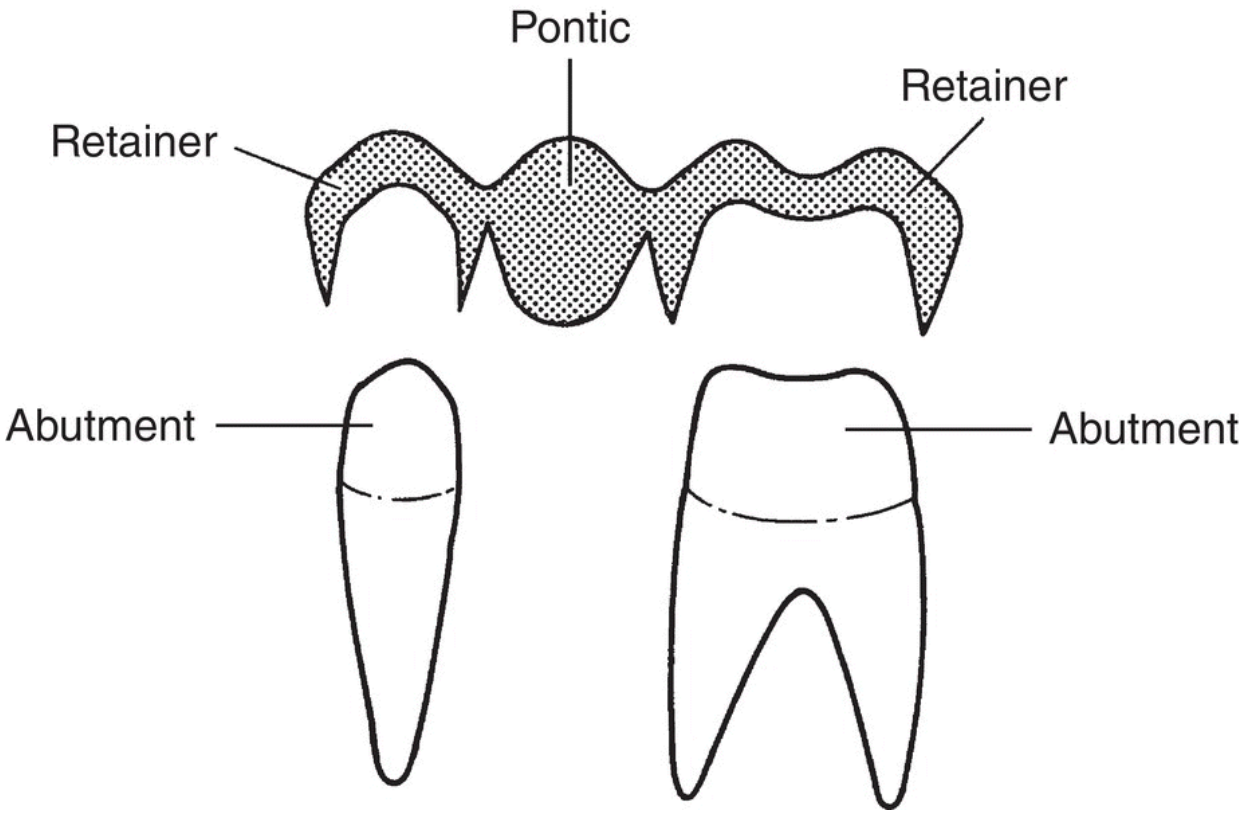


Figure 16.32 Conventional bridge components.

Bridges have several advantages over removable prostheses (dentures), which may also be used to replace missing teeth.

- There is no embarrassment of a loose prosthesis falling out, as bridges are fixed to the teeth permanently.
- Overall, their aesthetics are superior to dentures.
- They are more hygienic than dentures, because there is no involvement of any teeth except the retainers and therefore fewer stagnation areas.
- Usually only two appointments are required for their provision, while denture construction may require up to five visits.
- The materials used in their construction are better able to resist occlusal forces than the acrylic used to construct many dentures.
- The shades available can be customised in any way by the laboratory technician to mimic the patient's other teeth, whereas

those available for dentures are mass produced in a finite shade range and are unalterable.

- They solve the problem of patients with a strong gag reflex who require tooth replacement, and who usually cannot cope with a denture.
- They are also better tolerated because of the minimal amount of soft tissue coverage involved.

However, good oral hygiene control postoperatively is of paramount importance with bridges, as they produce stagnation areas unlike any others in the mouth (that is, under the pontics), and therefore require special techniques for effective cleaning to be carried out. Due to the complexity of their design and construction, as well as the cost of the materials used in their manufacture, bridges also tend to be far more expensive than dentures.

Several different types of bridges have been developed, but all designs rely on retaining teeth (abutments) to hold the bridge permanently in place, and they are joined to the missing teeth (pontics) in one structure as follows:

- **Fixed–fixed bridge** where retaining teeth are involved to either side of the missing teeth, as one solid design (Figure 16.33).
- **Fixed–moveable bridge** where a joint is incorporated in the design to allow some degree of flexibility to the bridge (Figure 16.34).
- **Cantilever bridge** where the retaining tooth or teeth are to one side of the pontic only.
    - **Simple cantilever** design where retaining teeth are those immediately to one side of the pontic only (Figure 16.35).
    - **Spring cantilever** design where the retaining teeth are to one side but several teeth away from the pontic (Figure 16.36).
- **Adhesive bridge** where the retaining teeth undergo minimal tooth preparation and retention is provided by lingual or palatal metal wings only (Figure 16.37).

Figure 16.33 Fixed–fixed bridge replacing upper right central incisor.

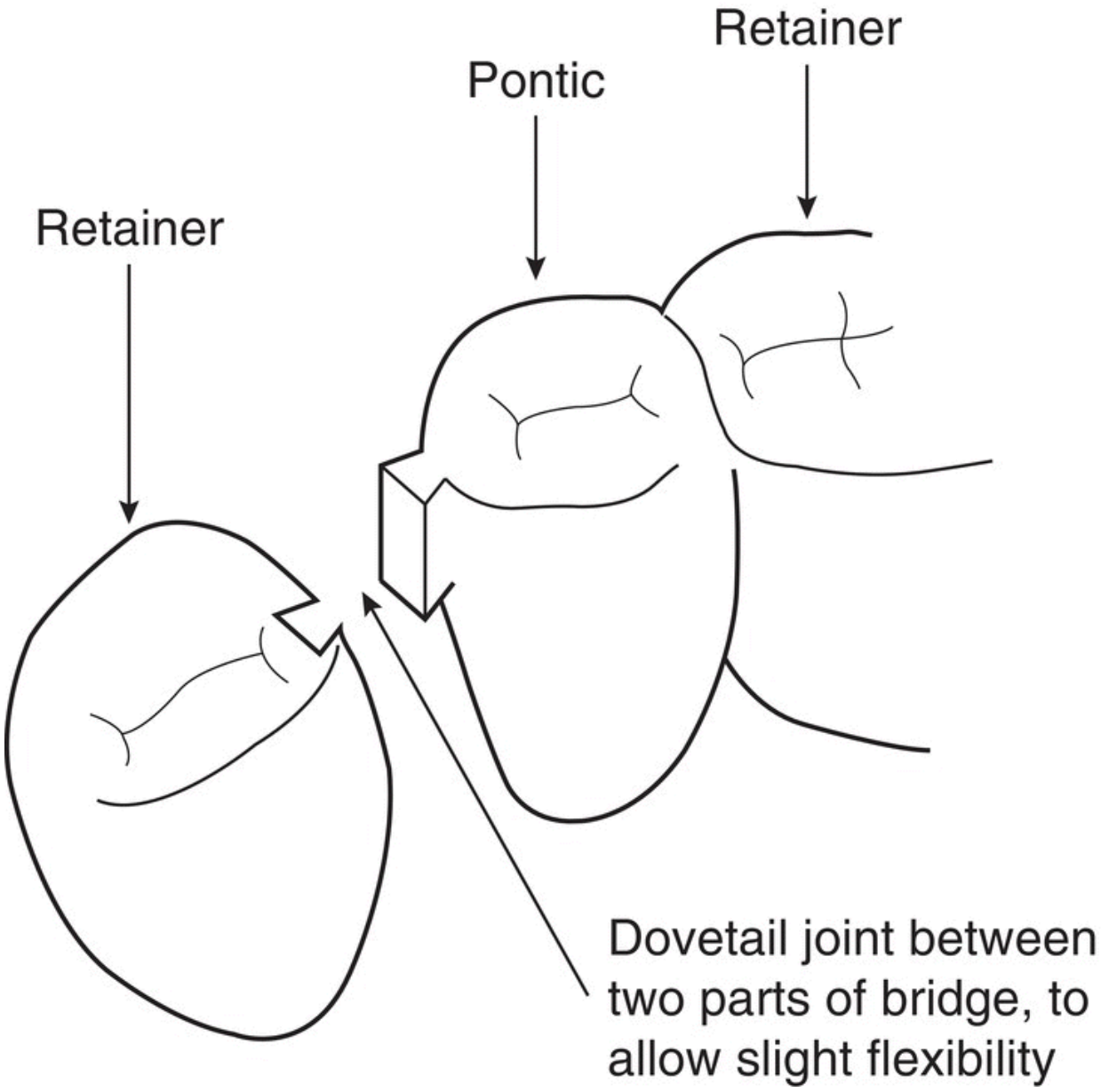


Figure 16.34 Fixed–moveable bridge.

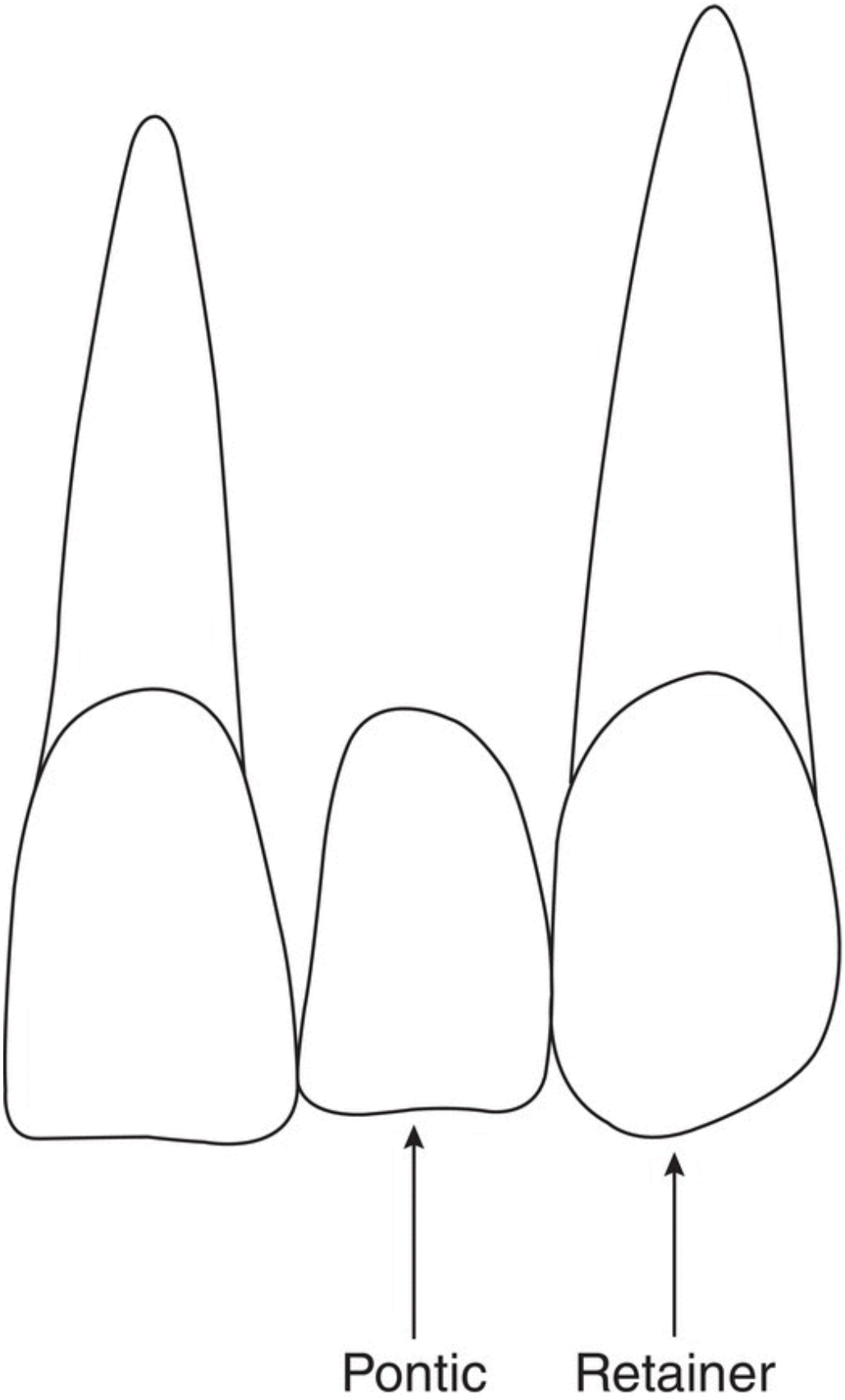

Pontic
Retainer

Figure 16.35 Simple cantilever bridge replacing the lateral incisor off the canine tooth.

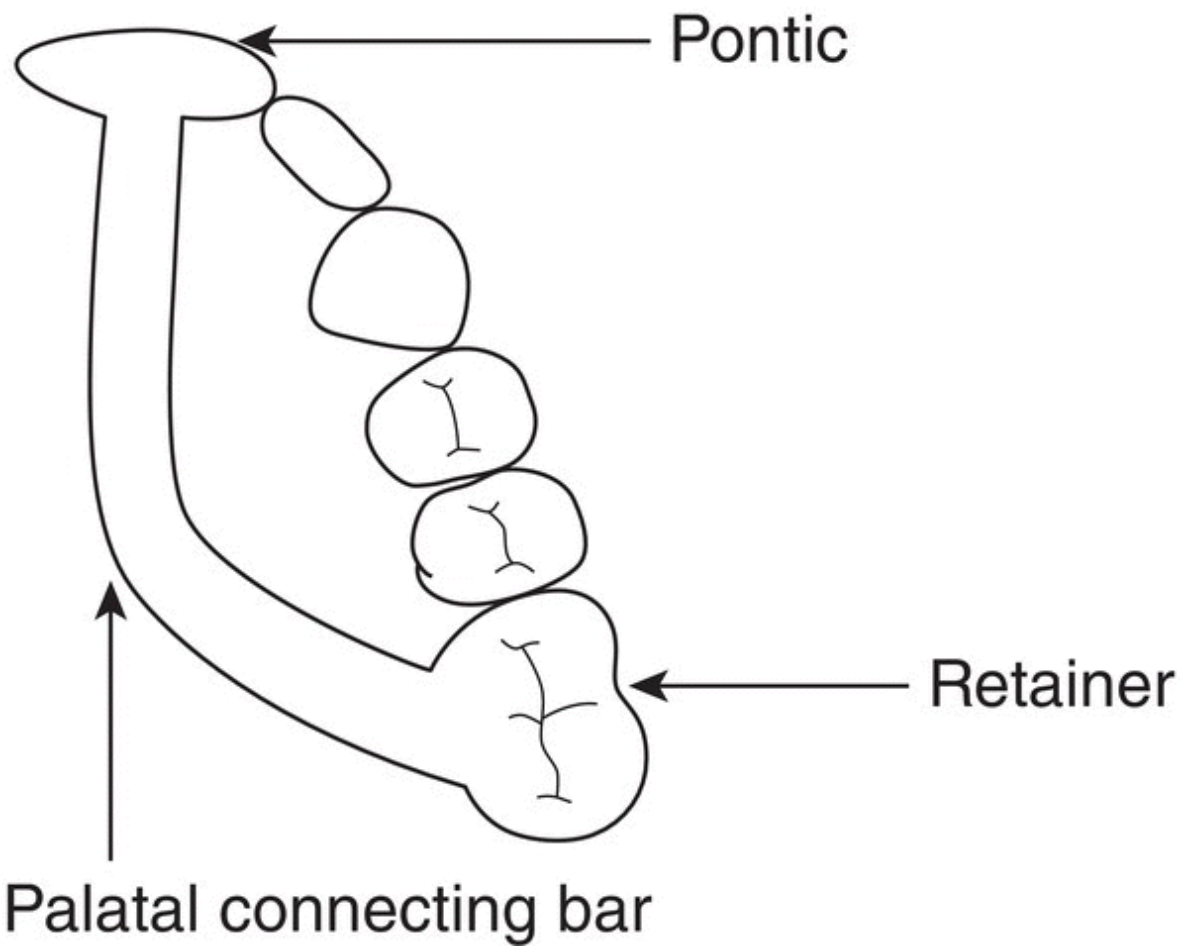


Figure 16.36 Spring cantilever bridge replacing the upper left central incisor off upper left first molar tooth.

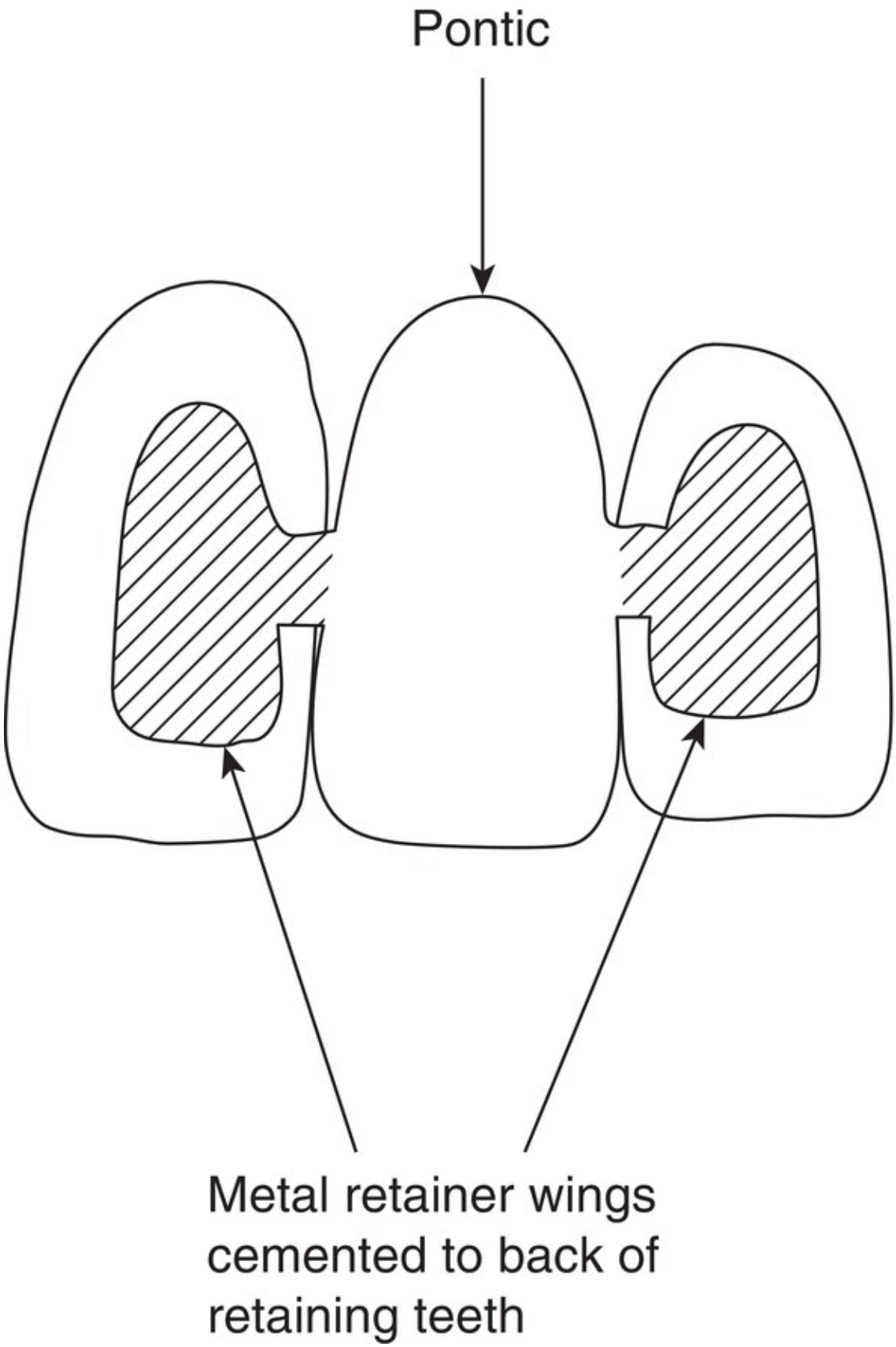

Pontic
Metal retainer wings
cemented to back of
retaining teeth

Figure 16.37 Adhesive bridge replacing the left central incisor.

The choice of which type of bridge is used depends on several factors.

- Whether an anterior or a posterior tooth is being replaced, as the latter usually experience heavier occlusal forces, so full crown retainers are generally required.
- Like crowns, bridges can be constructed of all-metal or all-ceramic materials and obviously the former would not be provided anteriorly.
- Fixed–fixed bridges tend not to be used so frequently nowadays, as their inflexibility during use can cause damage to retaining teeth: their solid structure, especially with long bridge spans, allowed occlusal forces on one end of the bridge to gradually loosen the other end from the abutment tooth. While undetected, this would allow caries to seep under the retainer and eventually destroy the abutment tooth.
- Wherever possible, adhesive bridges are used, as they involve minimal tooth preparation.
- If a patient has natural spaces between the teeth, only a spring cantilever design can be used so as to maintain the spaces and give good aesthetics.
- The health of the abutment teeth is of paramount importance to the success of the bridge; if there is any cause for concern, an adhesive type of bridge is advisable so that any problems would result in its dislodgement rather than causing damage to the abutments.

All types of bridge except adhesive ones rely on the retaining teeth being of full crown coverage. Indeed, the tooth preparation is exactly the same as for a single crown, as are the instruments and impression materials used.

Some additional procedures and techniques are used when constructing and fitting a bridge.

- While radiographs are always taken to determine the health of any tooth involved in fixed prosthodontics, study models are

often also taken before bridge construction, so that:

  - the occlusion can be checked from all angles
  - the bridge design can be visualised and decided upon
  - any potential undercuts of adjacent teeth can be identified.

- With bonded bridges, the metal substructure is often tried on the abutment teeth before proceeding with the porcelain work so if the fit is then found to be incorrect, a full remake will not be required.
- Ensuring the correct occlusion is present with a multiunit bridge is a complicated process and needs to be checked and finalised before the bridge is cemented onto the abutments. It is best carried out as follows:
  - High spots are identified by the patient closing onto a fine film of articulating foil or Mylar (shimstock).
  - Alternatively, fine coloured articulating paper may be used (that used for removable prosthodontics is too thick).
  - The foil or paper can be held in place using Miller forceps (Figure 16.38) which can be slid gently into the buccal or labial sulcus without compromising the occlusion.

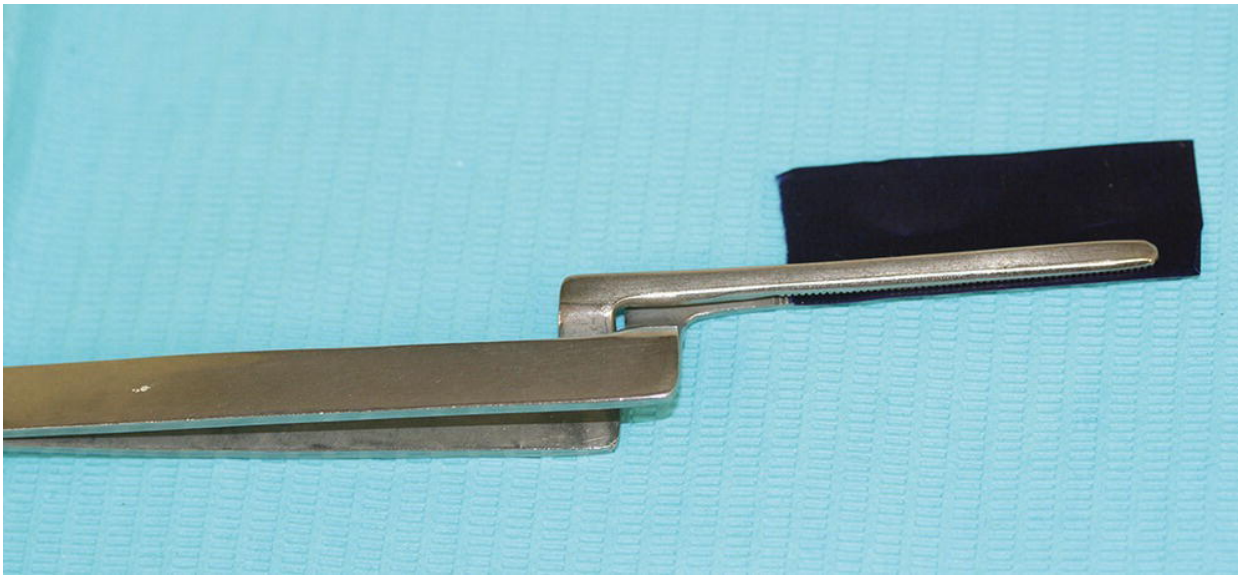


Figure 16.38 Miller forceps with articulating paper in place.

Adhesive bridges

These bridges are primarily used to replace just one or two front teeth, although modern luting cements and advances in preparation techniques are now enabling their use posteriorly in carefully chosen cases. The pontic has a porcelain-bonded facing while the metal backing has wing-like flanges which rest against the palatal or lingual surface of the abutments and are bonded directly to their acid-etched enamel.

These Maryland-type bridges (see Figure 16.37) conserve tooth tissue, as the only preparation required is to roughen the palatal/lingual enamel where the flanges will adhere, and possibly prepare a defining ridge in the enamel to help the technician to determine the margins of the flanges. Adhesive bridges are accordingly ideal for younger patients, who are more likely to have few if any restorations present. They are far quicker to make and can be replaced much more easily than conventional bridgework, as they do not have to be cut off the abutment teeth. However, they will not withstand heavy occlusal forces without becoming dislodged, so suitable cases have to be chosen carefully. The ideal cases are younger patients with a minimal overbite, or even an open bite, where the pontic is likely to experience little if any occlusal loading.

When used posteriorly, the palatal or lingual preparation of the abutments is more defined and may extend over the full surface or even up over the palatal or lingual cusps. However, this is still far less tooth preparation than for a conventional bridge and worth considering for suitable cases requiring only one tooth replacement. Ideal cases for posterior adhesive bridges include patients with no opposing teeth to the bridge, or a denture is present as the opposing teeth so that occlusal forces are lower than if natural teeth were present.

The adhesive bridge requires special dual curing resin cements with primers, to provide a strong chemical bond between the retaining teeth and the metal wings of the bridge. The fitting surface of the flanges is made retentive by acid etching and sand blasting, and a chemical-cure adhesive resin, such as Panavia Ex, which bonds to both metal and enamel, is used as a luting cement.

Temporary bridges

A temporary bridge is necessary between the bridge preparation and fitting visits to prevent tooth sensitivity, space closure and tipping or overeruption of the abutment teeth. It may be made directly in a similar fashion to that of a chairside constructed temporary crown.

- Before the abutment teeth are prepared, the gap of the missing tooth is filled with a piece of cotton wool roll, to mimic the presence of the missing tooth.
- A putty or heavy-bodied elastomer impression of the bridge area is then taken, the cotton wool discarded, and the impression put aside.
- The abutments are then prepared and an impression for the permanent bridge is taken.
- The first impression is now used to make a temporary bridge.
- A composite-type resin (such as Temphase or ProTemp) is placed in the part of the impression containing the abutment teeth and pontic area, and the impression is then reinserted over the prepared teeth until the resin sets.
- On withdrawal of the impression, the temporary bridge is removed, trimmed and cemented back into place with a temporary cement until the permanent bridge is cemented at another visit.

Alternatively, temporary bridges may be used as tooth replacements for up to 6 months after the extraction of a tooth, to allow bone resorption to occur before a permanent bridge is constructed. The abutment teeth are prepared in the same way and the impression is taken and sent to the technician. The abutment teeth have a temporary crown-like covering placed. The technician then removes the tooth to be extracted from the working model and constructs the temporary bridge to replace it, using composite-type resin materials or acrylics.

Once the temporary bridge is returned, the abutment covers are removed, the tooth is extracted and the prosthesis cemented to the abutment teeth. Bone resorption can then progress without leaving

unsightly gaps beneath the pontic of a permanent bridge. Any gaps that do become apparent under the temporary bridge can be closed using composite materials, until the risk of further resorption is over, usually around 6 months post extraction. The permanent bridge can then be constructed to replace the temporary bridge.

Oral hygiene instruction for crowns and bridges

No matter how well fitting the crown or bridge is to the tooth, microscopically the junction between the two is a potential stagnation area for plaque to gather. Thorough brushing at the margins of the crown will ensure that plaque does not accumulate and cause recurrent caries or periodontal problems.

The general oral health messages to be relayed to the patient following crown or bridge cementation are:

- regular and thorough toothbrushing daily
- use of fluoride toothpaste and medium-textured toothbrush, ideally a good-quality electric toothbrush
- regular flossing or interdental brushing to clean crown margins interproximally
- careful use of floss so as not to dislodge crown
- attend for dental examinations so that margins can be checked professionally
- sensible diet, low in free sugars
- regular use of good-quality mouthwash, to reinforce plaque control.

In addition, bridges provide a challenge to the patient with regard to adequate oral hygiene, as they are fixed prostheses producing stagnation areas actually beneath the pontics, where conventional brushes and floss cannot be used.

As well as the oral hygiene instructions for crowns, patients with bridges need to be instructed in the use of Superfloss (Figure 16.39). This is a type of dental floss with a stiff end, which can be threaded under the pontic and then drawn through to a sponge part which is

used to clean beneath the pontic. When used regularly, it keeps this region of the bridge plaque-free and prevents caries undermining the retainers, with catastrophic consequences. Alternatively, a correctly sized interdental brush can be used to clean under the pontic by being gently inserted into the area from the labial or buccal side.

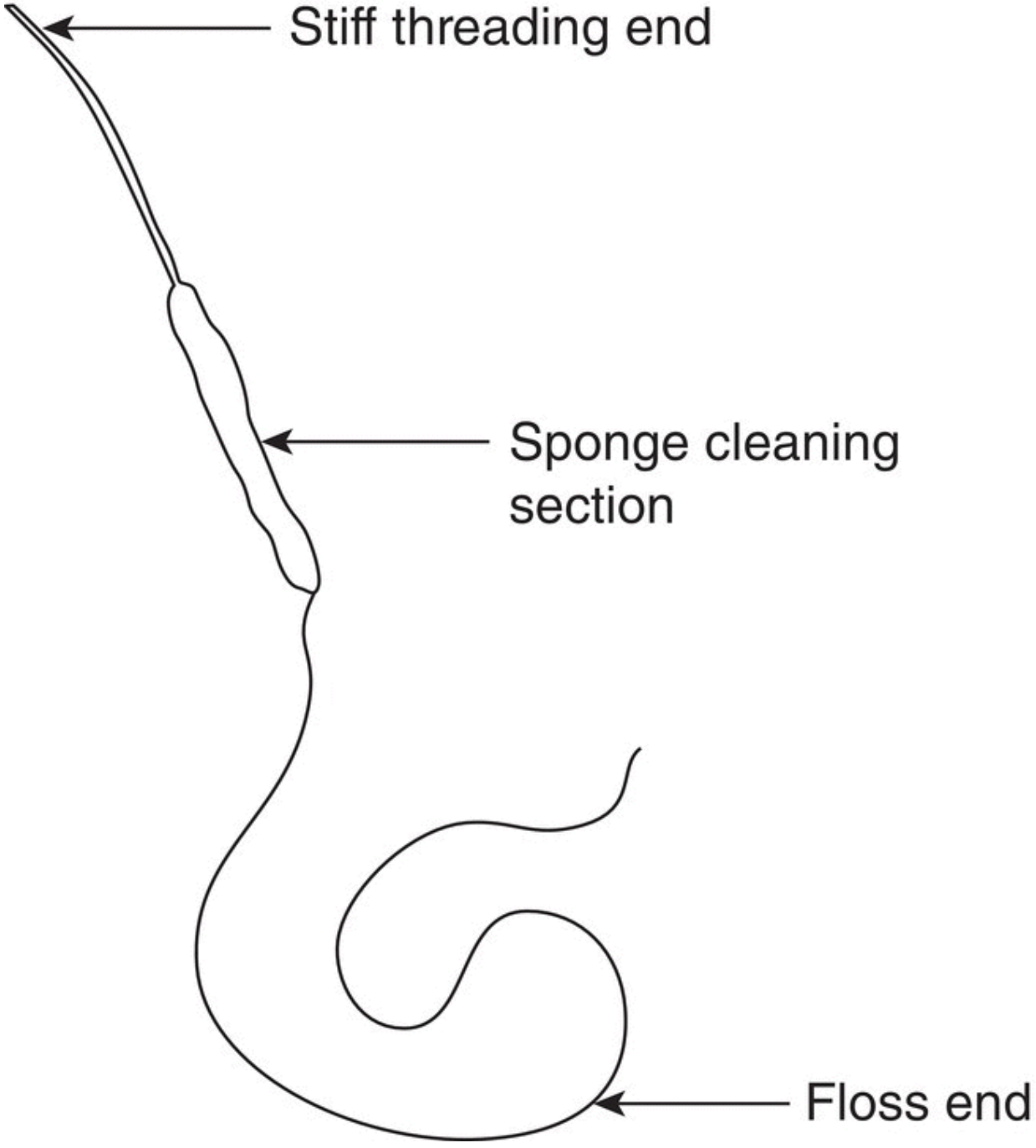


Figure 16.39 Illustration of Superfloss.

More recently, the use of sonic toothbrushes has been shown to provide excellent cleaning in these areas, without dislodging the bridge, and these are being recommended more frequently in these cases.

Veneers

Conventional crown preparation requires the removal of a significant amount of dentine from the tooth, involving all of the tooth surfaces. While this may be harmless in fully developed adult teeth, it could result in pulpal damage in younger patients as the pulp chambers are larger in recently erupted teeth. In other cases, it may be felt that labial enamel defects in incisors that require a restoration to improve appearance do not justify a full jacket crown preparation, and the teeth are more suitable for restoration by veneers.

Veneers are either a composite or porcelain facing made to cover the labial surface of anterior teeth. Where composite is used, the dentist carries out the restorative procedure at the chairside, as for a routine filling with this material. Porcelain veneers require the input of a technician to construct each one by hand, in the laboratory. They are used in the following situations:

- To mask a **discoloured tooth** (such as with tetracycline staining).
- To mask a root-filled tooth that has become darkened with time.
- To **close diastemas** between teeth and improve the appearance.
- To **change the shape** of rotated teeth so that they appear aligned.
- To change the shape of malaligned teeth so that they appear aligned.
- To **correct poorly shaped teeth**, such as peg laterals.
- As a **cosmetic procedure**, to lighten the whole labial segment, although this has been largely superseded by the use of tooth-whitening techniques.

Porcelain veneers are fragile once constructed and can break if the patient is careless with them. Ideally, they are only fitted to patients with low incisal edge forces and they are sometimes constructed so as not to cover the incisal edge of the tooth at all but finish just in line with it.

The instruments and impression materials used for porcelain veneer construction are the same as for crowns and bridges, but often no opposing arch impression is required as veneers rarely encroach on the occlusion.

The surgery procedure for veneer preparation is as follows:

- Unless the tooth is non-vital, local anaesthetic will be required.
- On the rare occasion that an opposing arch impression is required, this is taken in a stock tray using alginate.
- The labial surface of the tooth is prepared by removing enough enamel to allow the technician to construct the veneer; this is especially important if the veneer is to give the appearance of an improved alignment to the tooth (Figure 16.40).
- An impression is taken of the labial segment using one of the highly accurate elastomer materials, as for crowns and bridges.
- The prepared tooth is covered temporarily for appearance and sensitivity reduction, using composite material etched just to the centre of the tooth, so that it can be removed easily at the veneer fit appointment. This stage may not always be necessary when minimal tooth preparation has been carried out.
- An accurate shade is taken, recording all tooth characteristics for the technician, as for crowns and bridges.

Figure 16.40 Veneer tooth preparations of all six upper anterior teeth.

As with all fixed prostheses, veneers are custom made in the laboratory by a highly skilled technician. The shades taken in the surgery will be accurately replicated as the veneer is constructed by hand from porcelain, before the final firing in an oven to produce the surface glaze. The fitting surface of the veneer will be abraded and chemically roughened using hydrofluoric acid in the laboratory, to produce a rough surface for cement adhesion. The finished product is then returned to the surgery for fitting.

The veneer fitting procedure is as follows:

- Again, local anaesthetic may be required.
- The temporary veneer is removed, by flicking it off carefully with a hand instrument, such as a flat plastic or an excavator.
- The veneer is carefully tried onto the tooth and the fit and shade are checked.

- Special light-cure or dual-cure luting cements are used for veneer cementation, such as RelyX. They contain little filler content and are often available in different shades so that the final veneer appearance can be further matched to the adjacent teeth.
- If the fit and shade are satisfactory, the fitting surface of the veneer is coated with a **silane agent**, which allows the luting cement to chemically bond to it for good adhesion.
- The tooth is isolated with either a rubber dam, celluloid matrix strips, or with PTFE tape (Figure 16.41) stretched over the adjacent teeth and then etched, washed and dried.
- The dual-cure resin bond and cement are applied to the tooth and the veneer is carefully pushed onto it with a paddling action, in the correct position.
- Excess cement is carefully removed before full light curing occurs, without disturbing the position of the veneer.
- Flecks of cement trapped interproximally can be removed using abrasive diamond strips, otherwise they will act as stagnation areas and hold plaque.

Figure 16.41 PTFE tape used to isolate a tooth under treatment.

The final appearance possible is shown in Figure 16.18.

Inlays

These are fixed prostheses used to restore a cavity in a tooth, rather than to cover the whole or part of the surface of a tooth, as the other fixed prostheses do. Unlike fillings, though, which are also used to restore cavities, inlays are constructed indirectly in a laboratory by a technician rather than placed directly into the tooth by the dentist or hygienist.

They are constructed of gold alloy, porcelain or a special type of composite which contains more filler than usual and is therefore stronger than conventional composite filling materials that are placed at the chairside. However, the advent of modern composite materials, especially the bulk-fill varieties, has reduced the general usage of indirect composite inlay techniques as the results now possible at the chairside with newer materials is as good as the inlays, but less time-consuming.

The purpose of using an inlay rather than a filling is to produce a restoration of higher strength than that possible with conventional plastic materials, and of a more permanent nature, although with the continual improvement of filling materials, gold alloy inlays are being provided less frequently nowadays. They are generally confined to teeth which have lost cusps, undergo heavy occlusal forces or are otherwise too weak to be satisfactorily restored with amalgam. Small uncomplicated cavities do not usually warrant the extra time and expense of restoring them with inlays. Their use in anterior cavities has also declined with the development of better aesthetic anterior filling materials.

As the inlay is inserted into the tooth rather than cemented onto it, less tooth preparation is also necessary than if the tooth were restored using a conventional crown. The equipment, materials and impression techniques are the same as for other fixed prostheses.

Inlay preparation is as for a conventional filling, with the full removal of all carious tooth tissue to sound dentine, but then the resultant cavity preparation is adjusted to ensure that the sides are not undercut but *parallel* (Figure 16.42). This may involve any undercut

walls being filled in with plastic materials, such as glass ionomer cements. This allows the inlay to be inserted fully, without becoming stuck on an undercut. The maximum retention possible is produced, by ensuring that the inlay fits snugly against all the cavity walls. Only a fine cement layer will then be required, which reduces the risk of cement dissolution in saliva with time, and the gradual loosening of the inlay.

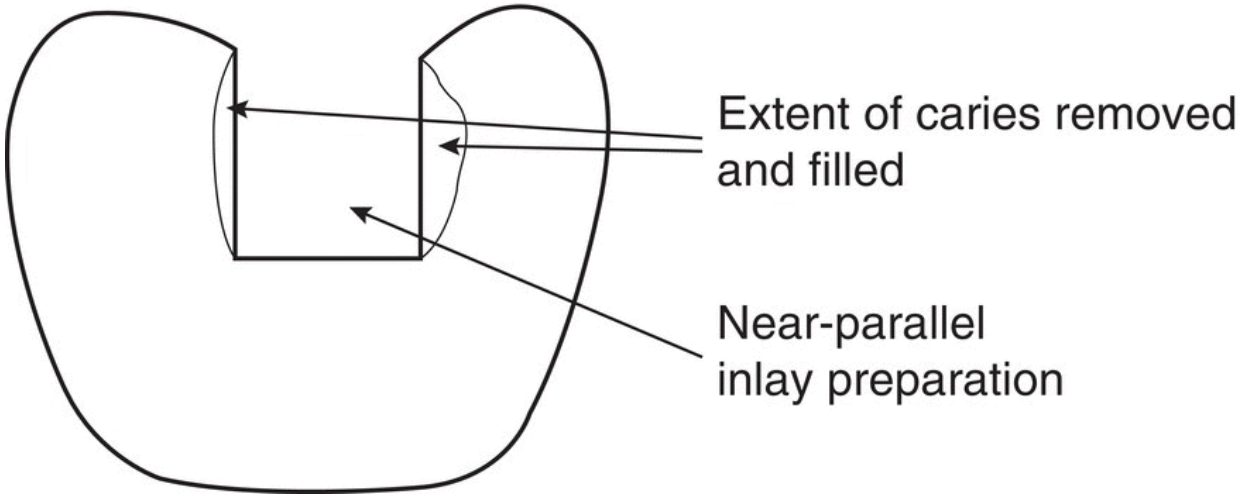


Figure 16.42 Illustration of an inlay preparation.

Once the cavity has been suitably prepared, the necessary impressions and occlusal registrations are taken. Gingival retraction cord may be used to ensure that deep cavity margins are sufficiently exposed for an accurate impression to be taken. The tooth is restored with a temporary filling while the inlay is being constructed.

At the fit of the inlay, the occlusion is checked as for crowns and when correct, the inlay is cemented into place using any of the luting cements available.

Gold alloy inlays have their margins well adapted to the tooth by *burnishing* at the fit stage, so that the wafer-thin edge of the gold is pressed firmly against the cavity wall. This prevents ingress of saliva and reduces the possibility of the cement being dissolved out (*dissolution*), with subsequent loss of the inlay.

Removable prosthodontics

Removable prostheses are all types of dentures – appliances that are made in the laboratory in various stages to replace missing teeth. They can be removed from the mouth by the patient, for example for cleaning, and reinserted again easily, without the use of cements. Generally, removable prostheses are made to replace several missing teeth rather than just one or two, as bridges do, or even to replace all the teeth in some patients.

When there are no teeth left in a jaw, it is said to be *edentulous* (edentate) and the artificial replacement is called a *full* or *complete denture*; if some teeth are still present, the replacement is called a *partial denture*. The majority of dentures are made completely of acrylic, although many may also be constructed with a base of chrome-cobalt metal.

Teeth may need to be replaced by a removable prosthesis (or indeed by a bridge or an implant) for the following reasons:

- Prevent excessive masticatory forces on the remaining teeth, which may cause their eventual fracture.
- Prevent overeruption of the opposing teeth, which may cause occlusal problems.
- Prevent tilting of the adjacent teeth into the edentulous spaces, causing stagnation areas.
- Prevent soft tissue trauma of the alveolar ridges during mastication.
- Allow adequate mastication and avoid digestive problems and malnutrition, especially in the elderly.
- Provide good aesthetics, especially if anterior teeth are missing.

Not all patients are suitable for tooth replacement by the use of dentures, and the following points are considered for every case before treatment commences.

- Is there any previous denture experience, and was it successful or not?

- If not, is there a cause which can be remedied?
- Is the shape of the patient's mouth naturally retentive for full dentures, with good ridges and a high palate, or might preprosthetic surgery be necessary?
- Are there any potential retention problems for partial dentures and, if so, can they be remedied by tooth shape adjustment?
- Might the patient's occlusion cause problems with the provision of a denture? Is there enough clearance without premature contact onto the denture?
- Are there any medical contraindications to dentures, such as epilepsy or an adverse reaction to the acrylic material?
- Are there other dental problems which need addressing first, such as caries or periodontal disease?
- If the teeth have been lost within the previous 6 months, bone resorption is likely to occur and this will affect the fit of a denture adversely.
- Good co-operation and perseverance by the patient are paramount to the success of dentures. If there is any doubt about these then the treatment is likely to fail.
- Can the patient afford the treatment?

Full and partial acrylic dentures

These are the most common types of denture: full ones (Figure 16.43) for edentulous patients and partial ones (Figure 16.44) for patients with any number of missing teeth up to one tooth short of being edentulous. The material used for their construction, and that of removable orthodontic appliances too, is either pink or transparent acrylic.

Figure 16.43 Full upper denture.

Figure 16.44 Partial upper denture on model.

Acrylic consists of a powder called a *polymer* and a liquid called a *monomer*. When mixed together, they form a plastic mass which has the consistency of dough. This sets into a hard acrylic by a process called *curing*. Curing is effected by heating the dough slowly in a special flask in an oven, or by adding a catalyst which allows it to cure at room temperature. These two methods of curing are known respectively as *heat curing* and *cold curing*.

Heat-cured acrylic is used for dentures and orthodontic appliances, and the curing process is carried out by a technician in the laboratory. Cold-cured acrylic (also called self-cured or autopolymerised acrylic) can be used by the dentist at the chairside to make temporary crowns, and to carry out denture repairs. It is also used by the technician for the construction of special trays to take accurate second impressions.

As dentures are removable prostheses, their retention must be adequate to keep them in position in the mouth during speech and chewing, but weak enough so that the patient can easily remove the

device from their mouth as they wish, say for cleaning purposes. The level of retention achieved relies on the following factors:

- A **suction film** of saliva developing between the denture and the patient's soft tissues, especially the palate.
- A **post-dam** along the back border of the upper denture, to help the suction film to develop.
- An **accurate design and fit** of denture, to allow the film to develop adequately.
- Use of any **natural undercuts** in the patient's mouth, such as the alveolar ridges or any suitably shaped natural teeth.
- Use of **stainless steel clasps** around standing teeth with partial dentures, to increase the retention of the denture by the clasps gripping the teeth and preventing it from being dislodged by normal soft tissue movements (Figure 16.45).

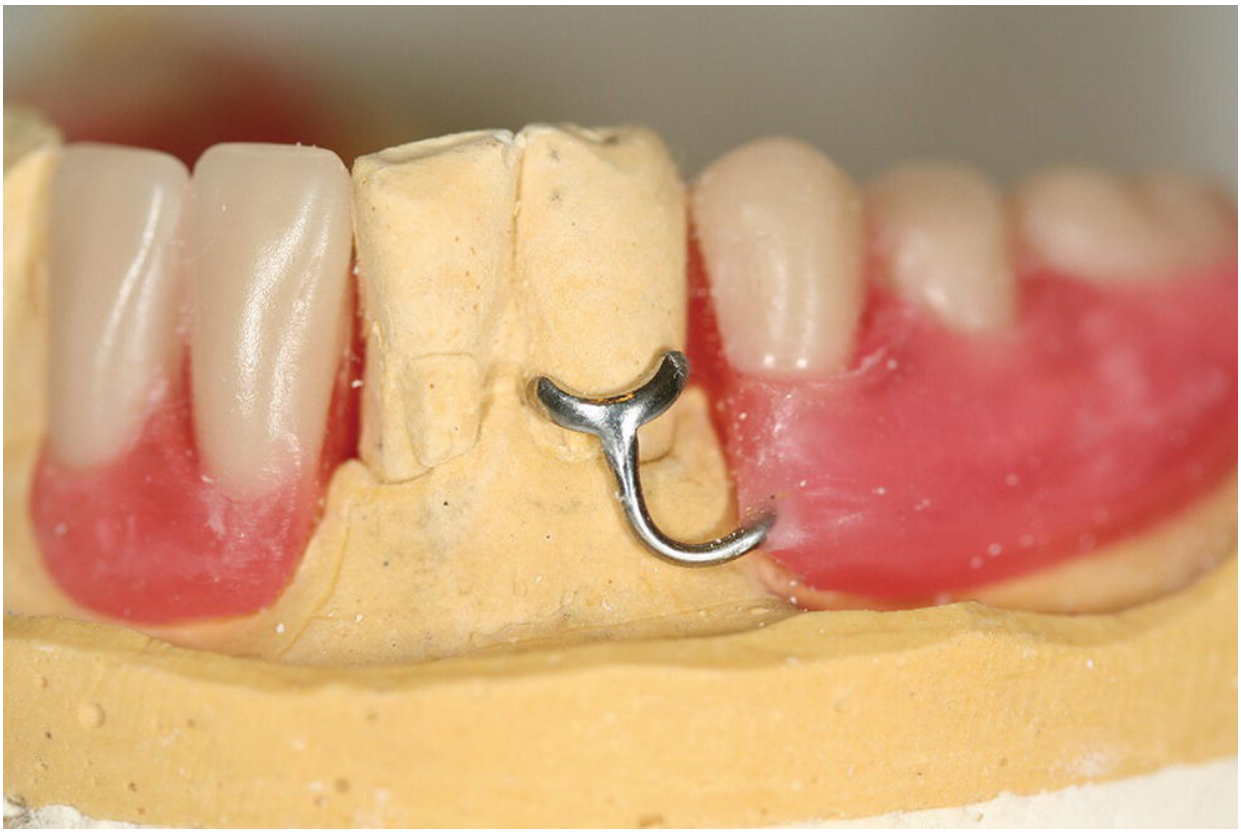


Figure 16.45 Denture clasp example.

Sometimes no natural undercuts are present in the patient's mouth so their own teeth are adjusted to provide them, in the following ways:

- Use of a crown to change the overall shape of the tooth.
- Use of composite build-ups to provide a retentive area for clasps to engage.
- Shape change of an existing restoration for similar reasons.

With edentulous patients, the alveolar ridges can be changed surgically, to improve retention and comfort.

- **Alveoplasty**: changing the shape of the existing ridge, such as by the removal of gross undercuts which would prevent the denture being seated.
- Flat ridges can be built up by the addition of **artificial bone substitutes** under the mucoperiosteum, to increase natural retention by creating a ridge that the denture can sit on.
- **Alveolectomy**: the surgical removal and smoothing of sharp ridges to allow comfortable wearing of the denture.

More recently, a special type of denture acrylic material has been developed which becomes flexible when warmed by insertion in warm water, so that it can be flexed while being inserted into the mouth. This enables any undercut ridges to be utilised in the retention of the flexible appliance, whereas a denture constructed of conventional acrylic (which is rigid, not flexible) would not be able to be inserted into the undercuts. The warmth of the oral cavity enables the flexible denture to be removed again, but otherwise it stays in place during chewing and speech. An example of this material is Valplast resin.

Denture construction

Usually, acrylic dentures are made in four or five stages, with each stage being returned to the technician at the laboratory between patient appointments. The dentist prepares and records the details of the patient's oral cavity, and the technician uses these records to construct the dentures to fit that patient's mouth. Each laboratory stage is returned to the dentist for the next clinical stage to be

recorded in the patient's mouth, until the end result – the acrylic dentures, with or without clasps, are produced for fitting.

The stages are as follows, although not every stage is required in every case.

- **First impressions**: using stock trays and alginate impression material (see Figure 16.3); the tooth shade and shape (mould) are often decided at this stage too. The impressions are correctly disinfected, as described previously, and suitably wrapped for dispatch to the laboratory.
- **Laboratory**: study models are cast in plaster of Paris from the impressions, and special acrylic impression trays are custom made from them if required; in simple cases, the first impression may be accurate enough for denture construction to proceed.
- **Second impression**: using special trays and either alginate or elastomer impression material to produce a very accurate impression, and the tooth shade and mould may be chosen at this stage if not already recorded.
- **Laboratory**: working models are cast in dental stone and wax occlusal rims are constructed on them. Alternatively, the special tray and wax rims are both provided at a second-stage appointment (Figure 16.46).
- **Bite registration**: the existing, or required, occlusal face height of the patient with an edentulous arch is measured using a Willis bite gauge (Figure 16.47) and recorded on the occlusal rims by warming them or using bite registration paste to stick them together. Patients with some teeth present in both arches are guided to their usual occlusal position with the rims in place to record their normal occlusal face height and tooth contacts. The rims then hold the models in the correct position and angulation for the dentures to be constructed (Figure 16.48).
- **Laboratory**: models in their recorded face height positions are mounted onto an articulator, so the technician can construct the wax try-in dentures in these correct horizontal and vertical positions.

- **Try-in**: wax try-ins with the actual acrylic teeth mounted in them (Figure 16.49) are inserted and checked for accuracy of fit and occlusion, as well as shade; any major inaccuracies will result in new records being taken and a retry being requested.
- **Laboratory**: stainless steel clasps are added as necessary, then the try-ins on their models are sealed into flasks and the wax is replaced by heat-cured acrylic to form the final dentures, which are then cleaned and polished to provide a shiny outer surface to the denture.
- **Fit**: acrylic dentures are inserted in the patient's mouth and checked for comfort, fit and aesthetics, then specific denture care information is given.

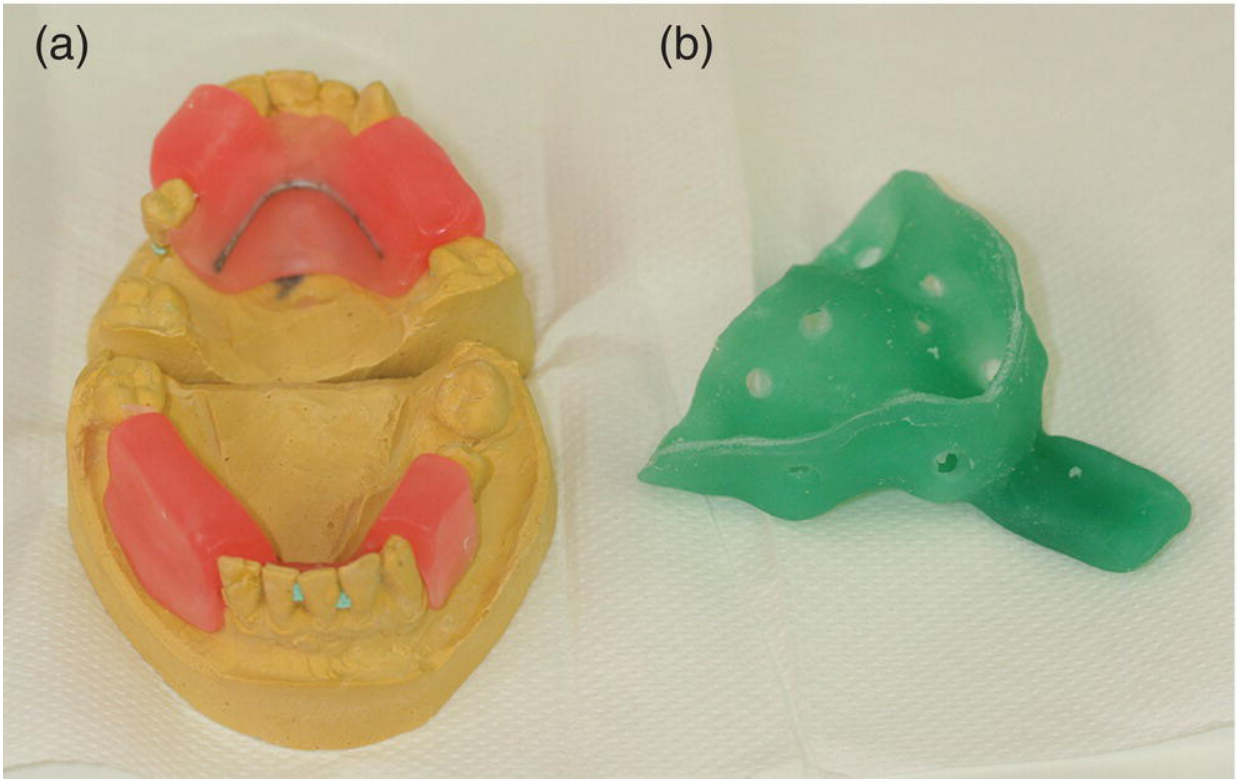


Figure 16.46 Second stage of denture construction: (a) wax bite rims on models; (b) special tray.

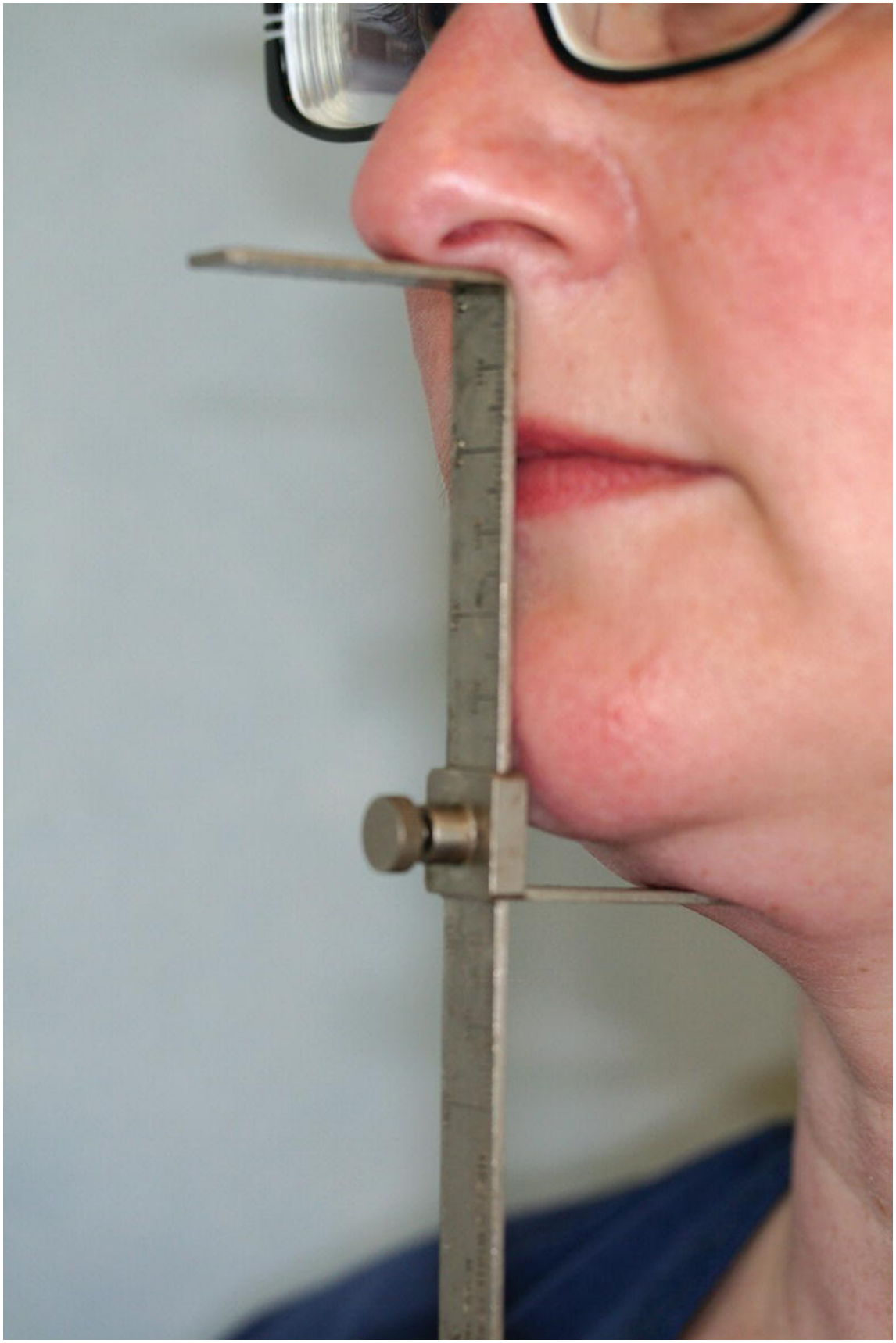


Figure 16.47 Willis bite gauge in position to record occlusal face height.

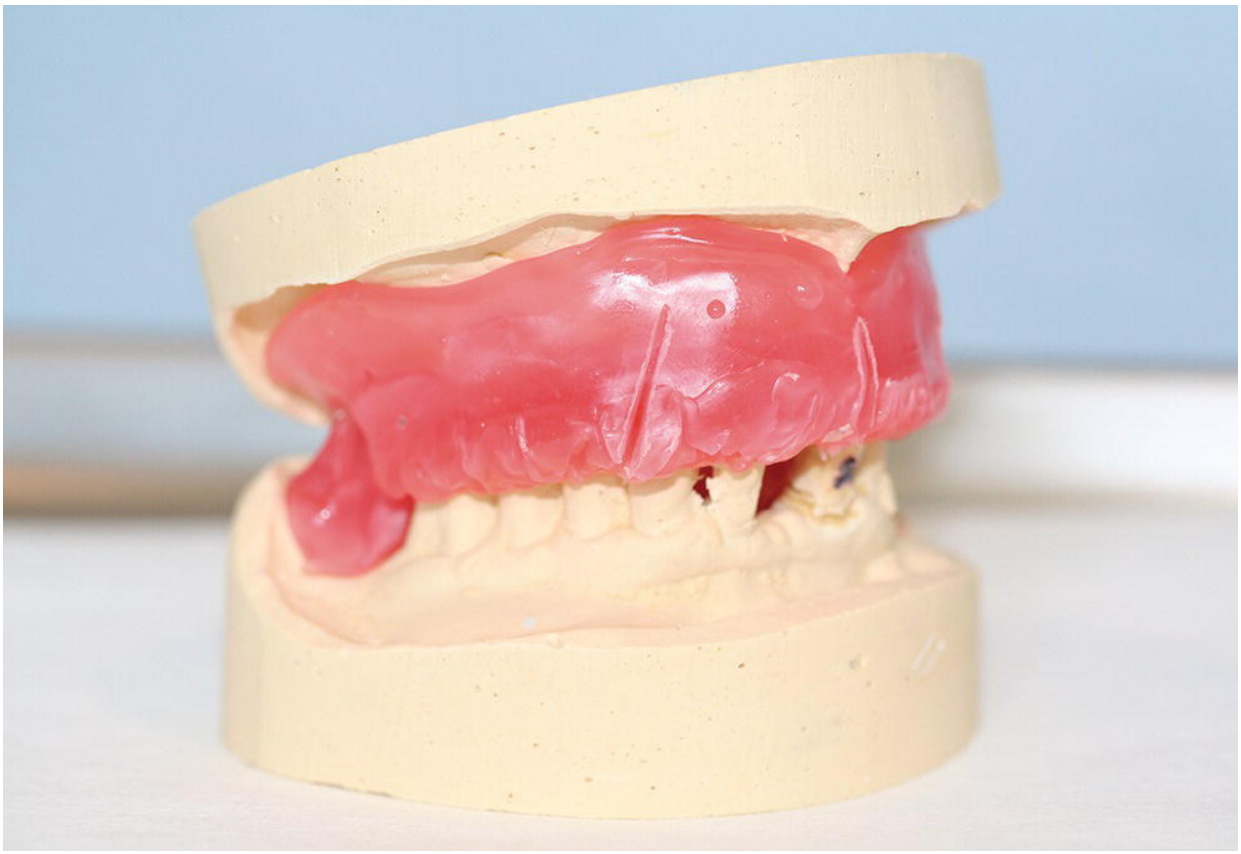


Figure 16.48 Wax rims on working models.

Figure 16.49 Try-in stage of lower full denture.

Each stage of denture construction in the surgery involves the use of specific instruments, materials and equipment which the dental nurse must be able to recognise and lay out at each appointment. These are summarised in Tables 16.5–16.9.

Table 16.5 First impressions: instruments, materials and equipment.

Item	Function
Stock impression trays (see Figures 16.9 and 16.10)	To be sized and used to take the initial impressions, so that special trays can be constructed; they may be upper and/or lower, and edentulous or dentate
Alginate impression material and room-temperature water	To be mixed, loaded into the trays and inserted to produce the initial impressions
Shade and mould guides	To determine the colour and shape of the denture teeth, to be as close in appearance to any remaining teeth as possible
Work ticket or docket (Figure 16.50)	To record the patient and dentist details, the denture design and base material to be used, the tooth shade and mould, the type and position of any clasps, and the return date

Table 16.6 Second impressions: instruments, materials and equipment.

Item	Function
Study models and special trays	To take the more accurate second impressions where required, to produce the working models
Alginate or elastomer impression material	To take the more accurate second impressions
Work ticket	To record the next stage request and the return date

Table 16.7 Bite registration: instruments, materials and equipment.

Item	Function
Wax bite rims	Adjusted in height so that correct face height of the patient can be recorded
Wax knife (Figure 16.51a)	To remove or add additional wax to the rims, as necessary
Bite registration paste (optional)	To be mixed and applied to the rims, so that they are held in the correct position once set
Pink sheet wax (Figure 16.51a)	For addition to the rims, as necessary
Willis bite gauge (Figure 16.51b)	To record the desired occlusal face height in edentulous patients, where no natural teeth remain as a guide
Heat source (Figure 16.51c)	To warm the hand instruments and rims for adjustment
Work ticket	To record the next stage request and return date

Table 16.8 Try-in.

Item	Function
Try-in prostheses	To determine if fit, occlusion and aesthetics are correct before finishing the dentures
Heat source	To warm the wax and make adjustments, as necessary
Le Cron carver (Figure 16.51a)	To make fine adjustments to the try-in, as necessary
Wax knife	To warm and smooth the wax after adjustments, as necessary
Shade and mould guides	To check or alter the shade or mould, as necessary
Pink sheet wax	For addition to the try-in, as necessary
Patient mirror	To allow the patient to view the try-ins and decide if they are happy with the appearance, before completion of the dentures
Work ticket	To record any changes required for a retry, or to record the fit return date

Table 16.9 Fitting.

Item	Function
Completed removable prostheses	To fit, to the patient and dentist's satisfaction
Straight handpiece and selection of trimming/polishing burs (Figure 16.52a)	To remove any acrylic pearls or occlusal high spots before polishing and smoothing the adjusted area for comfort
Patient mirror	To allow the patient to view the completed prostheses
Articulating paper (Figure 16.52b)	To identify occlusal high spots, for adjustment as necessary
Pliers (Figure 16.52c)	To adjust clasps as necessary
Pressure relief paste	To identify high spots on the denture fitting surface, for removal as necessary

ACME DENTAL LABORATORIES LTD. M.H.R.A. REF. CA 008044
136 WATERLOO ROAD, BURSLEM, STOKE-ON-TRENT ST6 3HB
Telephone: 01782 817621 Fax: 01782 824142

DAMAS

DAMAS

Dentist _____ Job No. _____

Surgery Address _____

THIS IS A CUSTOM MADE DEVICE FOR THE EXCLUSIVE USE OF

Patient Mr./Mrs. _____

Special U ☐ Acrylic ☐ Shade ☐ Mould ☐ Teeth ☐

Trays L ☐

RETURN DATES *Please tick box*

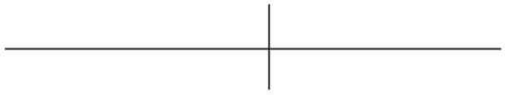
Bite _____ Received _____ PVT ☐

Try in _____ Received _____ IND ☐

Retry _____ Received _____ N.H.S ☐

Finish _____ Received _____

DENTURES



Notes I.D.Names ◯

NON STERILE DEVICE LABORATORY FEE _____

STATEMENT. This device conforms to the relevant requirements set out in Annex I of the Medical Devices Directive

Inspected and Signed by

Figure 16.50 Denture laboratory docket.

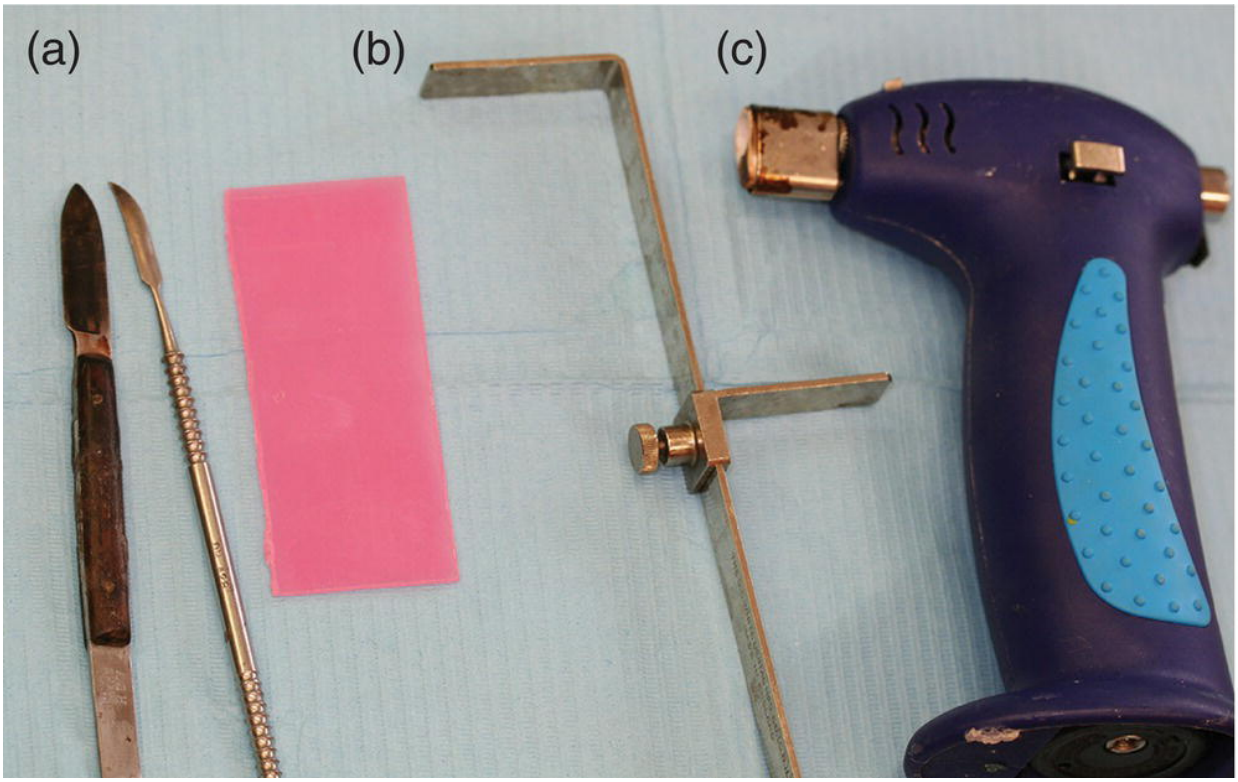


Figure 16.51 Equipment and materials for bite recording and try-in stages. (a) Wax knife, Le Cron carver and pink wax. (b) Bite gauge. (c) Heat source.

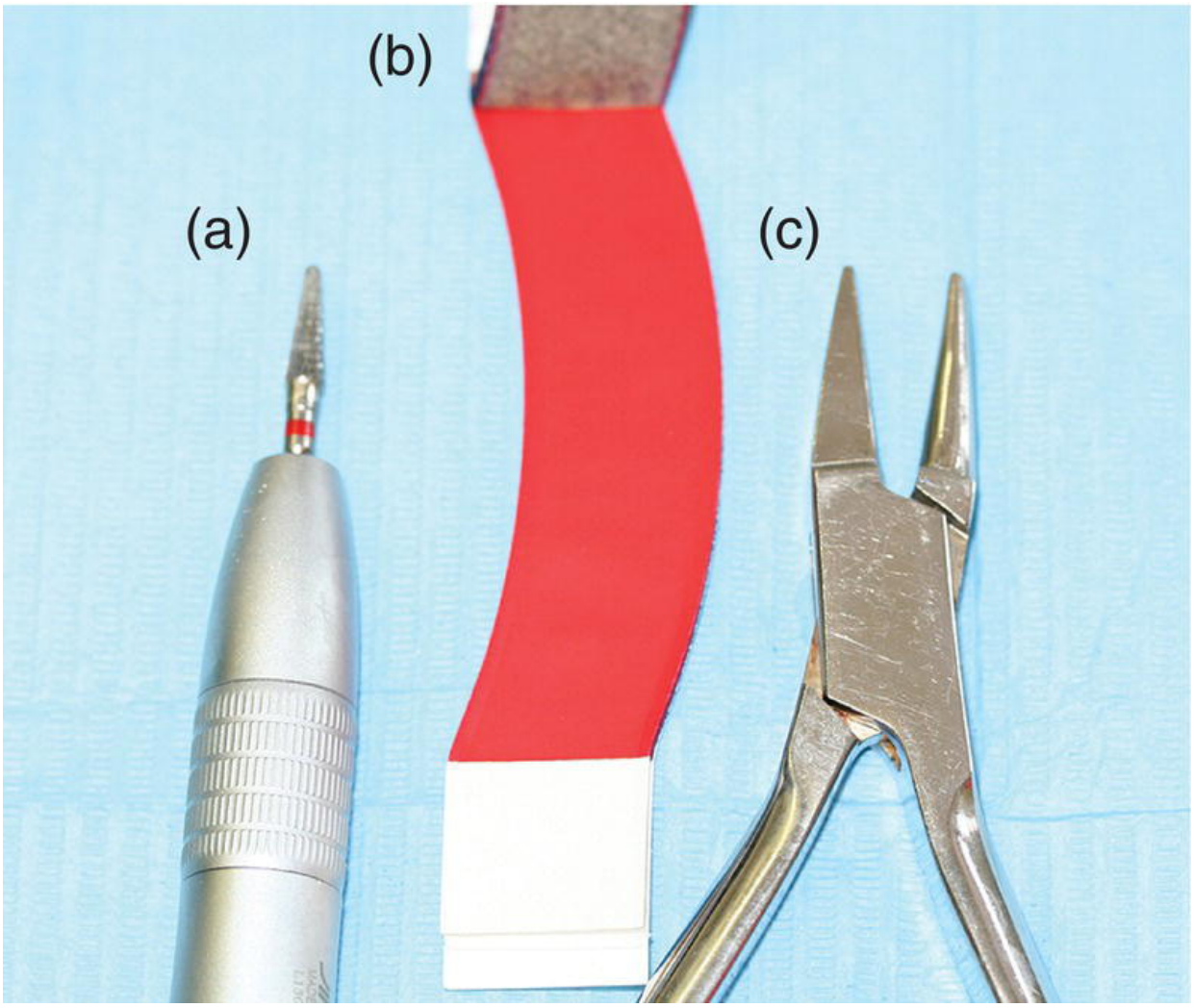


Figure 16.52 Equipment and materials for the fitting stage. (a) Straight handpiece and acrylic trimming bur. (b) Articulating paper. (c) Pliers to adjust clasps.

The work ticket information must be duplicated onto the patient record card or the computerised notes, so that if the ticket itself is ever lost or misplaced, the relevant details are still available.

The handling and aftercare of the impressions are as for fixed prostheses.

If changes are required to the prostheses they must be requested at this point, as once the flasking process has been carried out, no further changes can be made and the whole construction process would have to be started again.

Any concerns that the patient may have must be identified and discussed at this point and resolved to the satisfaction of both the patient and the dentist.

Instructions are given on the wear, care and cleaning of the new dentures, as follows:

- A demonstration of how to insert and remove the dentures is given, with the patient then practising the techniques in front of the mirror and under the dentist's supervision.
- Do not wear them overnight if possible, to avoid the development of oral fungal infections (thrush).
- Store them overnight in a denture pot containing water or ideally a soaking agent such as Steradent or Dentural.
- Clean after each meal if possible, using a denture brush and denture toothpaste; some ordinary toothpastes may be too abrasive for use on the acrylic teeth.
- Clean over a bowl of water, to avoid damage to the denture if it is dropped.
- Avoid soaking in bleach-based cleansers if any metal components are included in the design.
- Eat soft foods initially, while the oral soft tissues acclimatise to the prostheses.
- Take time to chew foods thoroughly, to avoid causing indigestion by swallowing large food particles.
- Harden oral soft tissues by carrying out hot salt water mouthwashes initially, otherwise the new dentures are likely to rub the soft tissues and make them sore.
- Return to the surgery if any ulceration occurs beneath the dentures, as further adjustments are likely to be required to remove high spots and deep flange edges.
- Dentate patients must continue to attend for oral health assessment at their regular recall interval, and edentulous patients are advised to attend at least once every 2 years, but ideally annually.

Patients are also told that new dentures do not last forever, and their fit and appearance will be checked at each recall. Alveolar bone gradually changes its shape following the loss of teeth and the denture will eventually become too loose as resorption spaces develop beneath the fitting surface. By that time, most patients will have learned how to control a loose denture using a combination of their soft tissues and denture adhesive products such as Polygrip and Fixodent (Figure 16.53), but the alveolar bone changes can adversely affect appearance as the loose denture may no longer provide adequate support for the lips and cheeks. It is consequently necessary to *reline* the fitting surface of a denture from time to time and perhaps make other adjustments (see later). Ultimately, the denture will need to be replaced.

Figure 16.53 Example of a denture adhesive.

If the denture cleaning advice is not followed, the soft tissues covered by a denture may become inflamed and develop into a condition called *denture stomatitis*. This is treated with antifungal drugs such as nystatin or fluconazole, and the reiteration of suitable oral hygiene instructions. Similarly, the dentures may become stained by products such as tea and coffee, and calculus may form on them in the same regions as for natural teeth; this can be professionally removed while

attending the dental workplace. Patients with these problems are advised to clean the dentures by soaking in hypochlorite (e.g. Milton solution) for 20 minutes, rinsing thoroughly and then immersing in water overnight. Dentures with metallic components should be soaked in non-hypochlorite disinfectants such as Dentural instead, otherwise the bleach-based products will cause metal corrosion.

Full and partial chrome-cobalt dentures

The metallic alloy chrome-cobalt can be used as the base of the denture, rather than acrylic, but the teeth still need to be attached to this metal base by acrylic on the ridges. Chrome-cobalt can form the base of both edentulous and partial dentures. Metal-based dentures are more difficult to construct than acrylic ones, as the metal is rigid and provides no room for adjustment once made, so the impression and working model must be perfectly accurate. They also cost more than acrylic dentures to construct, but still have several advantages.

- A much **thinner palatal covering** is possible with chrome-cobalt, which makes the whole denture more tolerable to patients, especially those with a strong gag reflex.
- Overcomes any tissue reaction to acrylic monomer, which some patients are sensitive to.
- Denture base is **far stronger** and less likely to break, even in thin section.
- Allows patients with deep overbites onto their palate to be able to wear a denture, as the bite point can be completely avoided or have just a very thin metal coverage.
- Can design partial dentures as '**skeletons**', giving minimal tissue coverage and making the denture more tolerable for the patient (Figure 16.54).
- As less tissue coverage is involved, especially around the teeth, chrome dentures tend to be more hygienic than acrylic ones.

Figure 16.54 'Skeleton design' upper chrome-cobalt denture.

If the whole palate is covered by a chrome base, then retention is provided by the saliva suction film, as for acrylic dentures. However, if a skeleton design is used then chrome-cobalt clasps must be incorporated into the design of the denture for retention, so an adequate number of healthy and well-positioned teeth are required for this purpose.

The clasps will be part of the chrome base, and tooth adjustments can be carried out to provide undercuts, as for stainless clasps on acrylic dentures.

Denture construction

The surgery stages are as for acrylic dentures, with the following exceptions:

- Final impressions are often taken with a special tray (see Figure 16.13) in a highly accurate **elastomer** material, rather than alginate, to ensure that a good working model is produced for the metal casting.
- The chrome-cobalt base is then made on the final model as a wax pattern by the technician, before being cast in a special furnace.
- The casting of the metal base is sometimes carried out at specialised laboratories, so extra time between appointments may be necessary.
- A try-in of the metal base only is often carried out, to ensure it is accurate before proceeding to add the teeth to the design.
- A second try-in is then performed, with the teeth added and held by wax to the metal base.
- No adjustment of the metal base can be made in the surgery once it has been constructed, except for minimal easing using a pink stone in the slow handpiece.

Additional instructions are given to the patient at the fitting stage to ensure that they never use bleach-based denture cleaning products, because they will corrode the metal. A suitable alternative is the cleaning solution Dentural. Otherwise, the same post-fitting instructions are given to the patient.

Some designs of partial chrome-cobalt dentures can be quite intricate, and adequate time must be spent ensuring that the patient is competent in both the fitting and removal of the denture before they leave the premises. Alternative materials to chrome-cobalt are also becoming available for partial denture construction, such as tooth-coloured speciality polymers which can be as intricately designed but are more aesthetic than the metal-based dentures.

Immediate replacement dentures

Dentures are usually made some months after the teeth have been extracted, as this allows time for completion of the initial alveolar bone resorption and gum healing to occur. Many patients, however, are not prepared to wait that long for the replacement of missing

front teeth, and understandably do not wish to have unsightly extraction gaps present, even for a few days. In such cases, the patient can be provided with an *immediate replacement denture*, which is made before the anterior teeth are extracted and fitted on the day of extraction, immediately after haemostasis has been achieved in the extraction sockets.

Obviously, there can be no try-in stage for this technique and the final aesthetic result is due to the skill of the technician alone, but otherwise the procedure for construction is the same as for conventional dentures, until the final stage when the technician removes the teeth to be extracted from the model and replaces them with the new denture teeth. The construction procedure is as follows:

- The dentist provides the technician with final impressions, the occlusal registration and the required shade for the new teeth, before any anterior extractions are carried out.
- In the laboratory, the anterior teeth to be extracted are cut off the working model by the technician, and the artificial ones fitted in their place as a wax-up on the model.
- This cannot be tried in the patient's mouth, as the teeth are still present, so the technician proceeds to tidy the wax-up and then processes it as a heat-cured acrylic.
- The final denture is trimmed and polished, then returned to the dentist.
- In the surgery, the anterior teeth are extracted and the denture is fitted at the same visit.
- Only minimal adjustments are made at this stage, as the oral soft tissues will be swollen from the local anaesthetic injections and the accuracy of the fit will not be obvious.
- The patient is given an appointment to attend the next day and is instructed not to remove the denture before then.

The patient must be made aware that following the fitting of the immediate denture, alveolar bone resorption will occur and this could result in the prosthesis becoming loose quite quickly. Patients tend to accept this phenomenon readily, as the alternative is to have

extraction spaces visible for months before a conventional denture is provided.

As chrome-cobalt cannot be adjusted once cast, immediate dentures are always constructed from acrylic only, although the replacement denture made after resorption has occurred can be a metal-based one.

If just one anterior tooth is to be replaced, the denture is usually designed in a 'spoon' shape, so that the gingival margins of other teeth are not covered by the denture, making it less likely to retain food debris around the teeth, and therefore more hygienic (Figure 16.55).

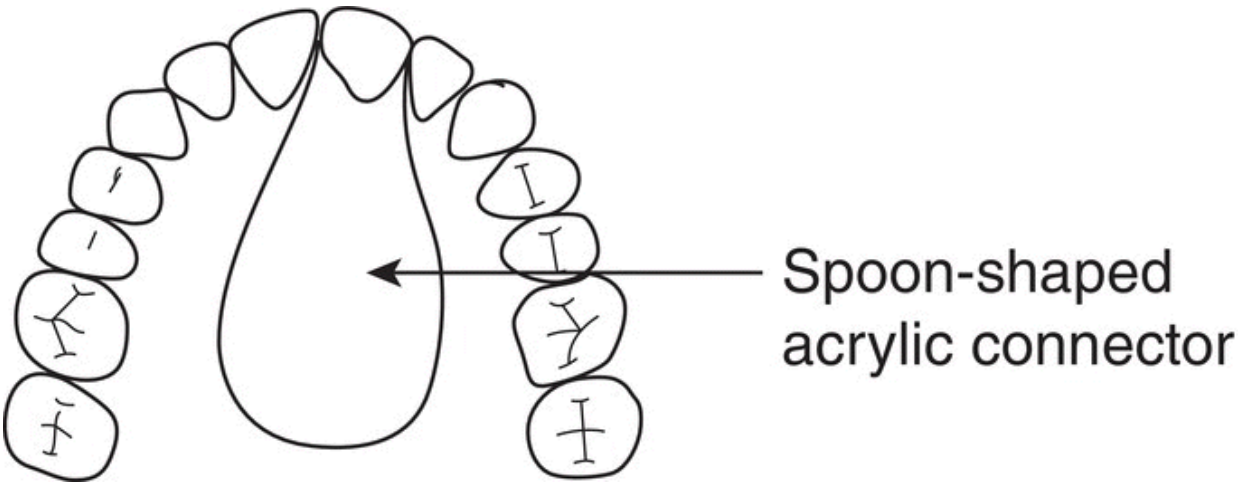


Figure 16.55 Spoon denture.

The aftercare instructions given to the patient on the day of extraction and fitting are as follows:

- Leave the denture in place overnight, to protect all the extraction sockets from food debris and the loss of any blood clots.
- Return to the surgery the following day, when the local anaesthetic has worn off and any high spots will be obvious. Any adjustments necessary can then be carried out.
- From then on, remove the denture after meals and carry out hot salt water mouthwashes to help heal the extraction sockets.
- Return to the surgery when bone resorption has caused significant loss of retention, so that adjustments can be made or a

permanent denture provided. This may take between 3 and 6 months to occur in some patients.

Other removable prosthetic procedures

From time to time, other procedures may be carried out to existing removable prostheses to improve their fit or extend their period of wear, without having to resort to the construction of a new denture.

- Relines or rebases.
- Additions of teeth or clasps.
- Replacement of worn teeth on an otherwise functional metal base.
- Use of tissue conditioners as:

  soft linings

  functional impression materials.

Relines and rebases

These may be required as alveolar bone resorption occurs beneath the denture with time, and the retentive fit is lost as a space develops beneath the fitting surface of the denture and it becomes loose. The bone lost during this natural process can be replaced with the addition of a new layer of acrylic within the fitting surface of the denture, as follows:

- The denture is thoroughly cleaned at the surgery, ensuring that no food debris is present.
- The patient is asked to carry out a vigorous mouthwash at the surgery, and toothbrushing if necessary, to also remove any food debris from their mouth.
- An accurate impression (**wash impression**) is taken within the denture itself, using an elastomer impression material.
- Alternatively, an alginate impression is taken of the mouth itself where a full denture is worn (without the denture in place).
- The impression and the denture are sent to the technician.

- The technician makes a cast within the denture, so that the alveolar bone is recorded where a wash impression has been taken, or casts a model of the arch from the alginate impression.
- Wash impression is removed from the denture and the space present between it and the model is filled with acrylic as a reline, or the full denture is placed over the new model and the space between the two is filled with acrylic.
- This creates a new base fitting surface to the denture, which will then sit accurately against the oral soft tissues again and improve the retention of the denture.

Additions

The addition of either a tooth or a clasp to an existing denture may be necessary from time to time, as the patient loses a natural tooth or the retention of the prosthesis deteriorates with time. The procedure is very straightforward and can often be completed by the technician within the day, as follows:

- An alginate impression is taken over the denture while in place in the mouth.
- The impression and denture are sent to the technician.
- The technician casts the model with the denture *in situ*.
- The position of the denture is then accurately recorded on the model.
- The denture can now be removed and repositioned exactly in place on the model, so that the new tooth or clasp can be fitted accurately to the existing denture and will then fit perfectly into place when returned to the patient.

Tissue conditioners

These are special materials used in two circumstances.

- As a **soft lining** when the soft tissues beneath the denture are continually sore, for whatever reason, so that the denture cannot be worn routinely without causing great discomfort to the patient.

- As a **functional impression** material which sets over several hours and therefore records the soft tissues and denture extremities more accurately than conventional impression techniques.

Persistent soreness beneath a denture is often a problem with elderly patients and can cause medical problems due to them being unable to eat sufficiently well. The soft lining construction procedure is similar to that used to place a hard reline into a denture, in that an impression is taken inside it using an elastomer material, so that the technician can cast up a working model. The base of the denture is then cut out by the technician and replaced by a soft tissue conditioner which acts as a cushion between the alveolar ridge and the denture. When the patient bites with the revamped denture, the cushioning 'bounces' and dissipates the occlusal force so that it is not transmitted onto the alveolar ridge as pain and discomfort. However, the conditioner requires regular replacement every 12–18 months, as it deteriorates in saliva over time, gradually becoming hardened and losing its 'bounce'.

Functional impressions are required in complicated cases of removable prosthesis construction, where conventional impression techniques fail to record the oral anatomy in sufficient detail to produce an adequately retentive denture.

Normal impressions record the hard alveolar ridge and any standing teeth, with the soft tissues pushed out of the way and held stationary while the impression is setting. The natural situation in the mouth is one of continual movement and change. Recording this real situation in an impression requires a material which takes hours to set while the denture is being worn and used.

The oldest functional impression material is black gutta percha but this has been superseded by modern materials which are a type of slow-curing acrylic resin, for example Visco-gel and Coe Comfort. They usually consist of a powder and liquid which are mixed together and applied to the fitting surface of the denture, reinserted into the patient's mouth, and worn for up to 6 hours. The patient must take no food or drink during this time. When found to provide a comfortable and satisfactory fit, the denture and its incorporated impression is sent to the laboratory for the casting of a working model. The

impression material is then removed and replaced with heat-cured acrylic, producing a well-fitting and functional prosthesis.

Obturators

These are specialist removable prostheses that will be provided to a patient via a hospital dental department, rather than from a general dental workplace.

They are appliances used to seal off an abnormal cavity in the maxilla, such as that due to a cleft palate or the space left after significant oral surgery for tumour or cyst removal. The abnormal cavity requires sealing off from the oral cavity to allow proper speech, as well as to prevent food and drink collecting in the maxilla. The denture area of the obturator is constructed in the usual way, but an elastomer material is also used to record the cavity accurately, before being incorporated into the denture design. As elastomers can record undercuts accurately, the impression material can be inserted into the cavity, allowed to set, then withdrawn without tearing and distorting.

Where large abnormal cavities require closing over, the extension area is made to be hollow so that the obturator is not too heavy to wear.

Overdentures

An overdenture is a full denture which is fitted on top of standing teeth or retained roots in the dental arch. The advantage of an overdenture is the presence of natural roots remaining in the alveolar bone. These have the effect of greatly reducing the absorption and shrinkage of alveolar ridges which normally occur after tooth extraction. When teeth are extracted, the alveolar bone becomes redundant, as it has lost its natural function of providing support for the teeth, and consequently diminishes in size as the bone resorbs. This loss of bone may be so great that it becomes very difficult to make a denture which is not perpetually loose, and lower dentures pose the most awkward problems in this respect.

As long as any roots remain, there is hardly any loss of alveolar bone and these problems of difficult lower dentures are far less common. However, dentures cannot be fitted directly on top of retained roots

or teeth. In most cases, a certain amount of preparation of these abutment teeth is required to remove undercuts and prevent caries.

Retained roots are root filled and ground to a dome shape level with the gum. If the root surface is irregular because of previous caries, the dome shape can be restored by fitting an appropriately shaped post crown. Teeth which still have intact crowns are usually treated by reducing the crown to a small tapered stump and fitting a full gold veneer thimble over the top. Having prepared the remaining teeth or roots, the overdenture is then made in the usual way of a full denture.

Overdentures are usually made as full dentures but they can be used as partial dentures in rare cases where some of the remaining teeth are unsuitable for the full denture design. They may also be used for patients with cleft palates and for those who have undergone surgical removal of part of their jaw, during treatment for oral cancer. In such cases the alveolar ridges may be so misshapen that properly fitting conventional dentures cannot be made.

More frequently now, or where there are no remaining roots anyway, *dental implants* can be used to support an overdenture. They are covered later in the chapter.

Orthodontic appliances

As mentioned previously, both fixed and removable orthodontic appliances share many common features with fixed and removable prosthodontics, especially in the materials used to construct and fit them. Consequently, they are included here for ease of reference.

Orthodontic appliances are used to align (straighten) crooked teeth, so that the patient is able to carry out effective oral hygiene techniques and prevent caries or periodontal disease from developing.

Two basic types of appliance are used.

- **Fixed appliance**: composed of individual metal or ceramic components bonded onto each tooth and connected together by an archwire. They cannot be removed from the mouth by the patient and are therefore similar to fixed prostheses.
- **Removable appliance**: composed of an acrylic base with stainless steel clasps and springs, and able to be removed from the mouth for cleaning, eating and adjustment; these appliances are therefore similar to removable prostheses.

Greater and more complicated forces can be applied to the teeth using fixed appliances, and the range possible for both types of appliance is as follows:

- Movement of teeth forwards or backwards in each arch: removable and fixed.
- Movement of jaws in relation to each other: functional and fixed.
- Alignment of slightly misplaced teeth in arch: removable and fixed.
- Alignment of severely misplaced teeth in arch: fixed.
- Derotation of teeth: fixed.
- Guided eruption of unerupted teeth: fixed.
- Guided reduction of deep overbite: removable and fixed.

Fixed orthodontic appliances

These consist of separate stainless steel or ceramic components called brackets that are individually bonded onto each tooth, using an orthodontic light-cured resin material. Molar teeth often have a circular metal device, called an orthodontic band, placed instead and these can be cemented with any type of luting cement, although coloured cements are particularly useful as they make cement removal at the end of treatment much easier to carry out.

The fitting procedure, called bonding, is carried out in the surgery with no laboratory input required except to cast up the preoperative and postoperative study models required. A bonded arch using metal brackets is shown in Figure 16.56. Bonding of the components causes no tooth damage, and they are 'snapped off' at the end of the treatment harmlessly, using special orthodontic instruments.

Figure 16.56 Bonded upper arch using metal brackets.

The equipment and instruments required for the monitoring and adjustment of the fixed appliance once it has been initially bonded are

shown in Table 16.10.

Table 16.10 Equipment and instruments required for the monitoring and adjustment of the fixed appliance once it has been initially bonded.

Item	Function
Archwire (Figure 16.57a)	Flexible nickel titanium or stainless steel wires, to fasten into the brackets or bands. Aesthetic alternatives are available with a tooth-coloured coating
End cutters	Right-angled cutters to trim the ends of the archwire after replacement
Alastiks	Rubber bands to hold the archwire into the slots of each bracket
Alastik holders	Ratcheted holders (similar to artery forceps) to apply the alastiks to the brackets
Brackets (Figure 16.57b)	Metal or ceramic components to attach to each tooth, if any have been lost since last appointment
Bands (Figure 16.57c)	Metal rings to attach to molars especially, although bands are available for all teeth and were the only attachments available before brackets were developed
Buccal tube (Figure 16.57d)	Used instead of a molar band where orthodontic forces are unlikely to dislodge the tube
Bracket holders	To hold and position each bracket to the centre of the tooth, if any replacements are required
Bracket and band removers (Figure 16.58)	To remove brackets, bands and any residual bond material before replacing, if necessary
Bonding materials	Acid etch and orthodontic resin bond material, to hold brackets onto the tooth
Band cement	Any luting cement material, to hold bands onto the molar teeth

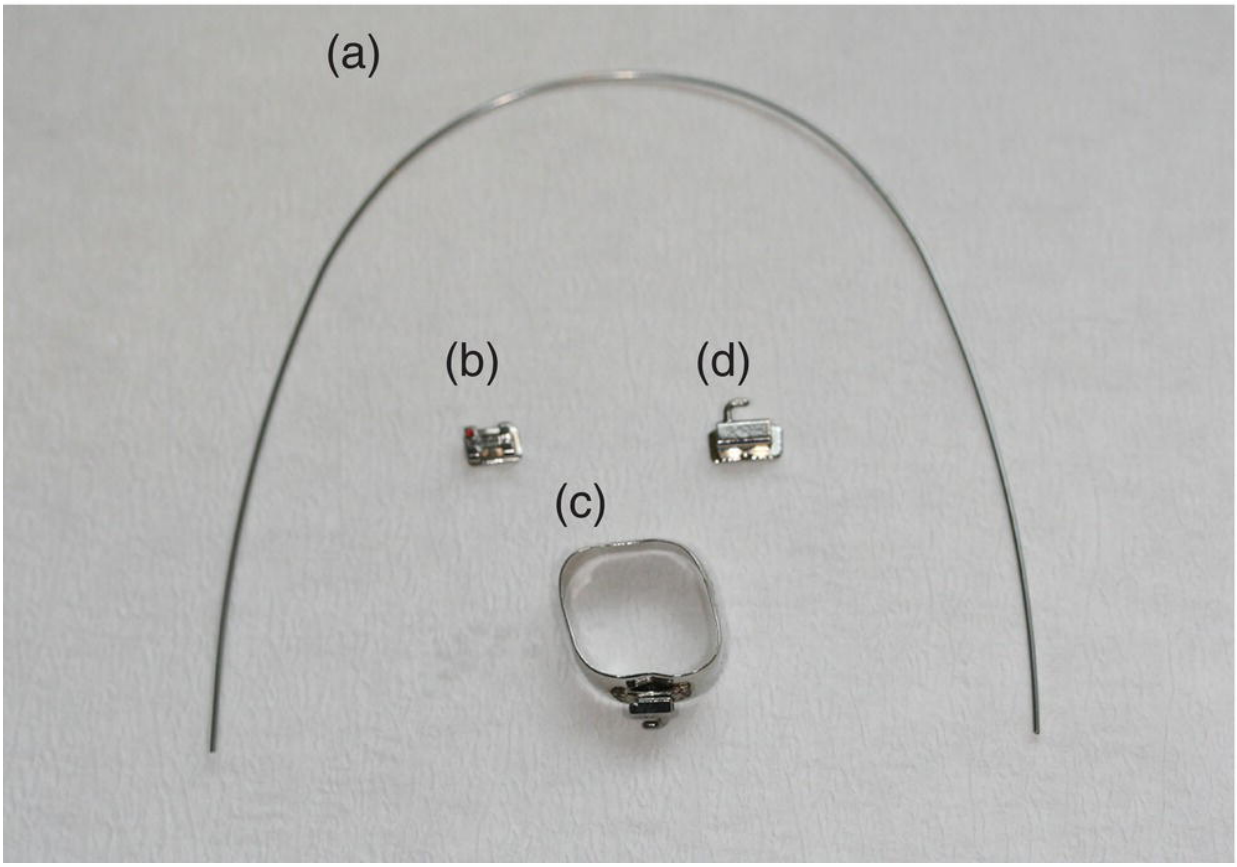


Figure 16.57 Archwire (a), bracket (b), molar band (c) and buccal tube (d).

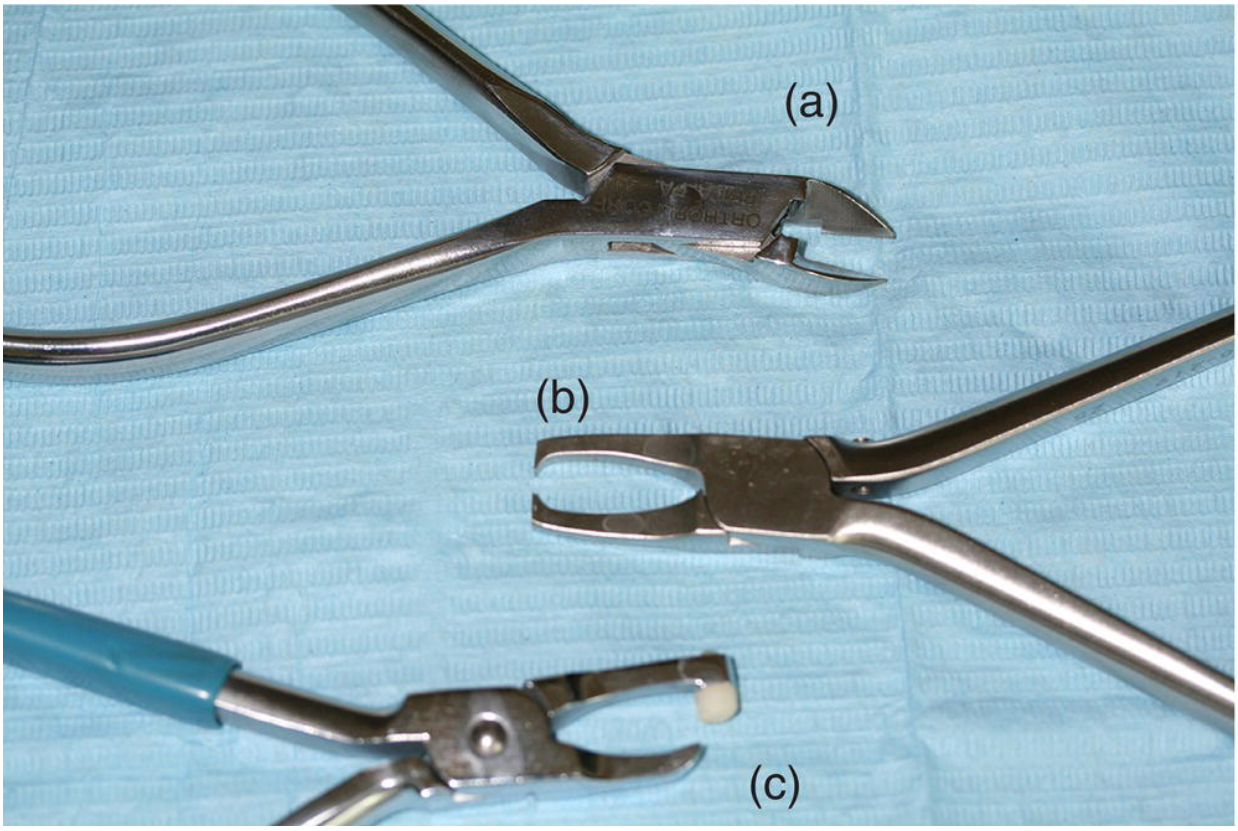


Figure 16.58 Fixed appliance instruments. (a) Wire cutters. (b) Bracket removers. (c) Band removers.

Patient advice for fixed appliances

All teeth from first molar to first molar are usually incorporated into a fixed appliance, so the number of stagnation areas and the potential for oral damage to occur are far greater than for individual fixed prostheses. Routine twice-daily toothbrushing alone is insufficient to maintain adequate standards of good oral hygiene, and special instructions and techniques are recommended for patients undergoing fixed orthodontic therapy.

- Careful manual toothbrushing should be carried out after each meal.
- Ideally, good-quality electric toothbrushes, such as Sonicare, Colgate Pro-clinical and Oral B, should be used whenever possible.
- Use of fluoridated toothpaste.

- Daily use of **interdental brushes** to clean around each bracket individually (Figure 16.59).
- Avoidance of cariogenic and acidic food and drinks, for the full period of treatment.
- Avoidance of sticky foods, for the full period of treatment.
- Use of **fluoride mouthwash** daily, to minimise the risk of decalcification.
- Regular use of **disclosing tablets**, to highlight problematic areas where plaque is being retained, to minimise the risk of decalcification.

Figure 16.59 Use of interdental brush to clean around brackets and beneath archwire.

Removable orthodontic appliances

These are similar to dentures in construction, in that alginate impressions of both arches and a wax bite registration are taken and

sent to the laboratory, along with a work ticket detailing the exact design of appliance required. Usually, the technician involved in the appliance construction specialises in orthodontic devices, as some of the components used are specific to this dental discipline and are not used with other prostheses.

A set of both study models and working models are cast from the impressions, and the latter set are used to construct the acrylic bases for each appliance, or for just one appliance if treatment is being carried out in one arch only. The additional components that can then be added to the acrylic base are as follows:

- **Adam's cribs** to retain the appliance in the mouth, usually to fit onto molar or premolar teeth and made of stainless steel (Figure 16.60).
- **Springs** in a variety of designs, to move the teeth along the arch as required (Figure 16.61).
- **Retractors** to push one or several teeth backwards (Figure 16.62).
- **Expansion screws** to move several teeth or each half of the upper arch outwards.

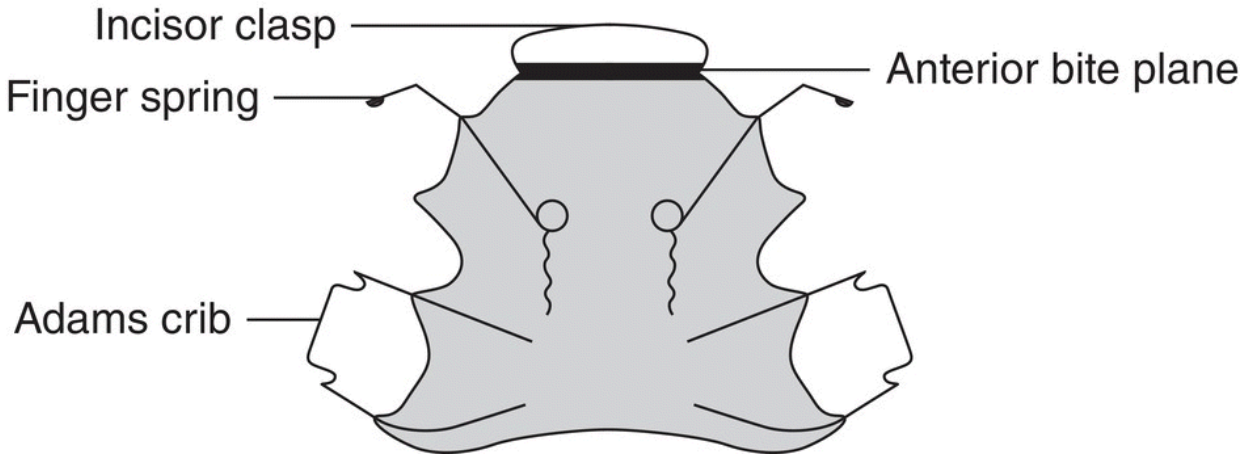


Figure 16.60 Removable upper orthodontic appliance.

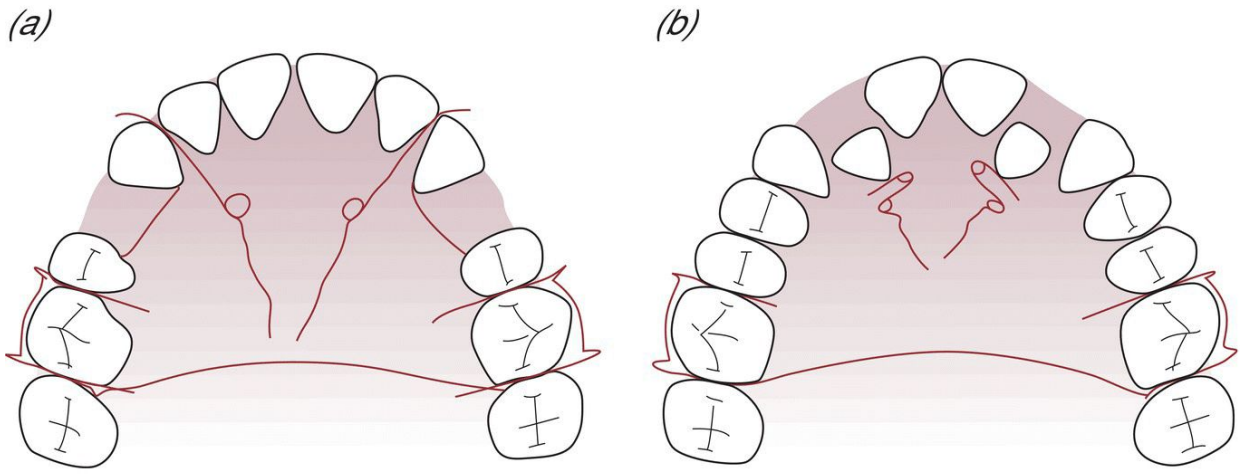


Figure 16.61 Types of spring. (a) Palatal finger spring. (b) 'Z' spring.

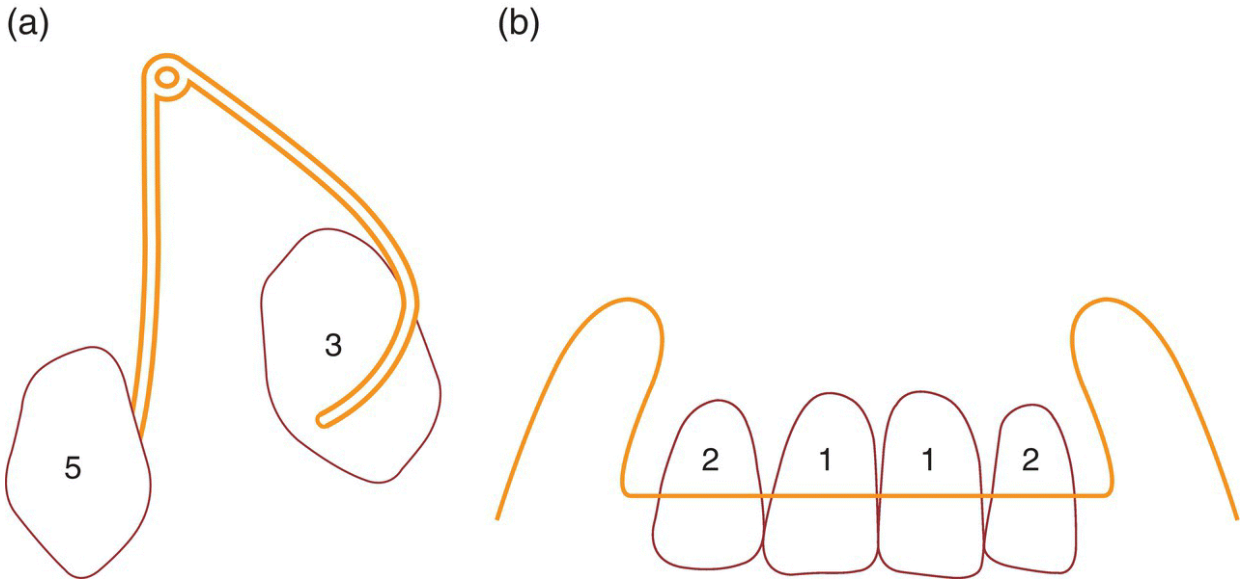


Figure 16.62 Types of retractor. (a) Buccal canine retractor. (b) Roberts retractor.

The equipment and instruments required for the monitoring and adjusting of the appliance are shown in Table 16.11.

Table 16.11 Equipment and instruments required to monitor and adjust the appliance.

Item	Function
Adam's crib pliers (Figure 16.63)	To adjust all metal springs and retractors, as necessary
Straight handpiece and acrylic trimming bur (Figure 16.64)	To adjust all acrylic areas of the appliance, as necessary
Measuring ruler	To record any measurable tooth movement, such as the overjet
Expansion screw key	To count the number of turns applied to the screw between visits, to ensure compliance by the patient

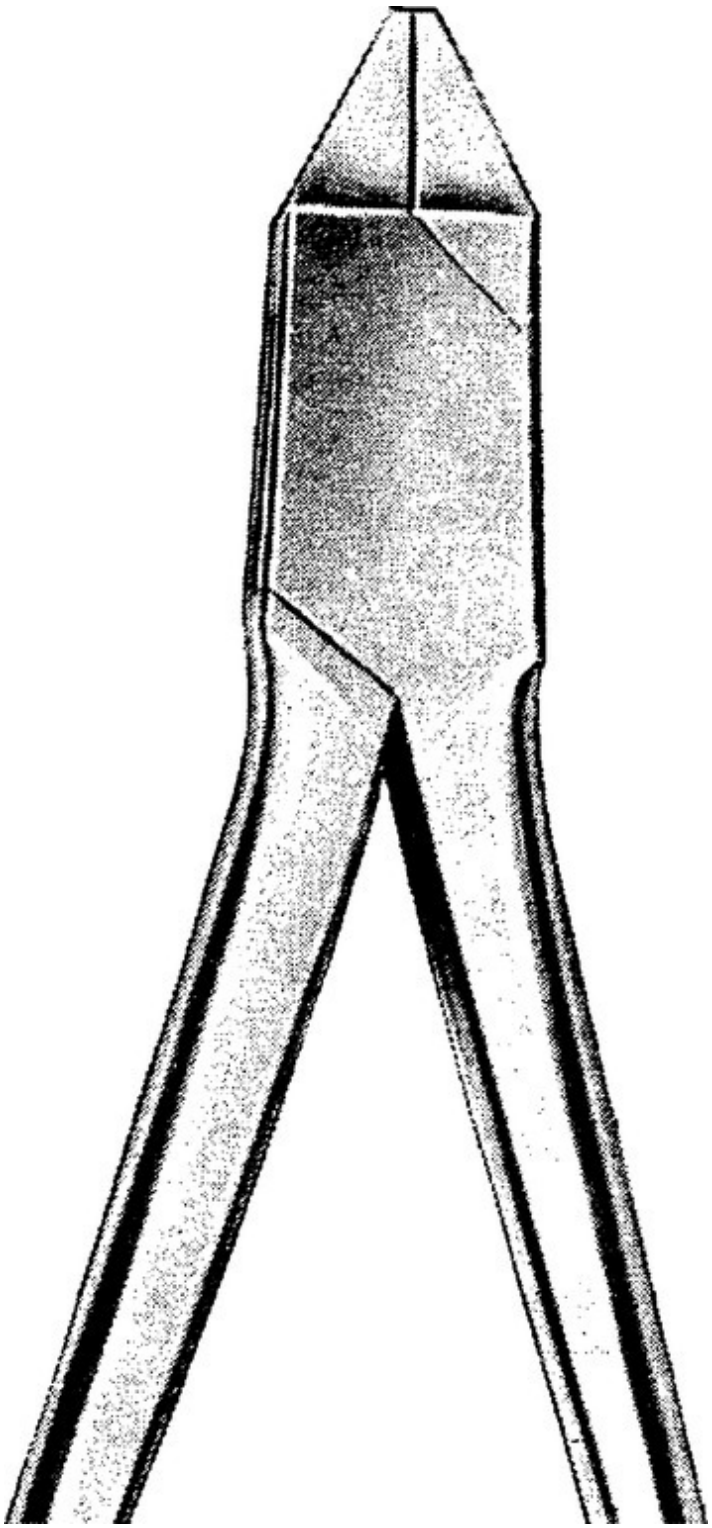


Figure 16.63 Adam's universal pliers.

Figure 16.64 Acrylic trimming bur in straight handpiece.

Patient advice for removable appliances

As with removable prostheses, orthodontic appliances are capable of acting as stagnation areas and holding food debris and plaque against the teeth and gingivae, unless a good standard of oral hygiene is maintained.

Although some dentists prefer patients to wear appliances during meals, it is possible that more acrylic breakages will occur if this is the case. The instructions for patients wearing removable appliances are as follows:

- Wear as directed by the dentist.
- Clean the appliance and teeth after each meal, using a toothbrush and toothpaste.
- Avoid cariogenic and acidic foods and drinks, as advised.
- Attend all dental appointments for the necessary adjustments.
- Contact the surgery immediately if any breakages or loss of the appliance occur.
- Expect the appliance to feel tight initially after each adjustment.
- Contact the surgery if any prolonged or excessive symptoms occur.
- If the appliance is to be removed for meals, ensure it is placed safely in a rigid container to avoid breakages during mealtimes.

Functional appliances

These are a specialised type of removable orthodontic appliance made of acrylic and stainless steel components, and worn in both arches at the same time, the most common one currently being a Twinblock (Figure 16.65).

Figure 16.65 'Twinblock' functional appliance in position and holding mandible forwards.

They are used to correct skeletal class II discrepancies, where the mandible is further back from the ideal position, and work by holding the mandible forwards in the ideal class I position and allowing mandibular growth to occur and correct the malocclusion naturally. As their success depends on the growth of the mandible, they can only be used while the patient is still growing but after the premolars have erupted (these teeth are required for retention of the appliance), so the ideal age is up to 14 years old.

The materials, instruments and patient advice are as for removable orthodontic appliances.

General patient co-operation and motivation with orthodontic appliances

The wearing of any type of orthodontic appliance demands a high level of motivation and co-operation from the patient. They must maintain a consistently high level of oral hygiene and their diet has to be restricted to minimise the risk of caries developing, and in the teenage years this is often unacceptable to the patient and their motivation will wane. This is more likely to happen with prolonged courses of treatment.

Co-operation and levels of motivation need to be assessed at each adjustment appointment and reinforced as necessary by both the dental nurse and the dentist.

Warning signs of reducing co-operation include the following:

- Failed appointments for appliance adjustment.
- Recurrent breakages of the appliance, either brackets dislodging or springs and acrylic being fractured.
- Continual reporting of problems wearing appliances that cannot be detected by the dentist, which have resulted in non-wear.
- Falling standards of oral hygiene or evidence of carious damage.
- Obvious lack of interest during adjustment appointments.
- Requests for early removal of fixed appliances, before treatment has been completed.
- Failure to wear removable or functional appliances during the daytime, so that when only worn at night little improvement is achieved.

Any combination of these signs should alert the oral health team that the treatment may fail, so co-operation must be reinforced and improvement seen to happen, otherwise the decision must be taken to abandon the treatment.

A system of discontinuation of treatment must be in place, so that patients are aware that failure to comply will result in early removal of the appliance and incomplete treatment. This may mean that

malocclusions remain as they were for life, with all the consequences that this will mean to the patient. If a patient persistently fails to wear the appliance or to attend appointments for adjustment and review, treatment is best discontinued at an early stage before too much surgery time has been wasted.

Patients who have discontinued treatment once and then re-present for continuation should be treated with great caution, as the likelihood of a second failed course is greater still.

Adult orthodontics

The popularity of having 'straight teeth' by undergoing orthodontic treatment as an adult has never been more popular, and there are various different treatment options now available.

- Conventional fixed orthodontics using aesthetic appliances: ceramic brackets and tooth-coloured archwires and treating the whole dentition.
- Short-term cosmetic fixed appliances treating anterior malocclusion only.
- Anterior tooth alignment using removable 'aligners' rather than fixed appliances.

For adult patients, the concept of having to wear conventional fixed appliances for up to 2 years to align their teeth is usually enough to dissuade them from undergoing this type of treatment unless aesthetic appliances are used. However, very often their only complaint is the appearance of their front teeth alone. Their posterior occlusion (the way their back teeth bite together) will have developed and become stable years earlier, so there is often no requirement to adjust the back sections of the dental arches, and consequently the short-term cosmetic fixed appliance treatment and the aligner treatment have been developed for these patients and have the following advantages over conventional treatment:

- As only the front teeth are to be repositioned, the treatment time is greatly reduced and the technique is actually referred to as short-term orthodontics.

- In carefully chosen cases, the treatment time is usually between 4 and 9 months, with an average of 6 months (hence the phrase ‘six month smiles’).
- The back teeth are not moved during the treatment so the occlusion remains stable, as it was before treatment began.
- In some cases, the space required to align the anterior teeth is naturally present.
- In other cases the space required is provided by careful trimming and adjustment of individual tooth widths as the treatment progresses (called interproximal reduction or IPR), and only in rare cases is tooth extraction required.
- The components of the fixed appliance used in short-term orthodontics are aesthetically acceptable to adult patients, as they are all tooth coloured (Figure 16.66).
- Aligners are also aesthetically acceptable to adult patients as they are practically invisble (hence the phrase ‘invisalign’).

Figure 16.66 Short-term cosmetic fixed appliance in place on model.

However, not all cases are suitable to be treated with these techniques and the dentist will choose those which are appropriate with great care. Children and teenagers should still be treated using conventional fixed appliance therapy so that the ideal posterior occlusion can be developed.

Short-term cosmetic fixed appliances

The dentist will have carried out an oral, photographic and radiographic assessment of the patient beforehand, and will have discussed the patient's main complaint with their teeth so that the treatment parameters have been determined. Impressions will have been taken in alginate to provide a set of pretreatment study models (see Figure 12.3), and now a second set of impressions will be taken using a more accurate elastomer material such as silicone. These are sent to a specialist laboratory where the working models will be cast up and used to construct the fixed appliance itself.

In the laboratory, the technician will carefully place each bracket onto each model tooth in the same way as the dentist does when bonding a conventional fixed appliance in the surgery. Once placed, the brackets are secured into their positions with two warmed sheets of rubbery material that are drawn down over the models under vacuum. When cooled, these sheets are trimmed and split in the midline to produce a quadrant of the appliance for each area of the mouth to be treated: left and right upper arch and/or lower arch (Figure 16.67). These are then returned to the dentist so that they can be bonded to the patient's teeth.

Figure 16.67 Prepared upper quadrants of short-term fixed appliance in place before removal of the alignment sheet.

The bonding technique is very similar to that used for conventional fixed appliances, as are the instruments and materials that may be required, as described below.

- The dentist, nurse and patient wear PPE at each appointment.

- The dental chair is placed supine for ease of access, and good moisture control is provided throughout the bonding appointment using low-speed suction, cotton wool rolls and a full-mouth soft tissue retractor (see Figure 16.67).
- The teeth in one quadrant are blown dry and a spot of acid etch is applied to the centre of the labial surface of each tooth.
- The etch is watched off and carefully collected using high-speed suction, then the teeth are dried again.
- A thin layer of adhesive is then painted onto each etched tooth.
- Meantime, the dental nurse will have applied the bonding cement to the ceramic brackets in the quadrant that is being bonded.
- The tray is then seated onto the quadrant of teeth and the cement is set using a curing light.
- Once all four quadrants have been bonded, the double trays are carefully peeled off the teeth, leaving the brackets in their correct positions on each tooth.
- Excess cement is carefully removed, and any necessary tooth trimming is carried out to begin creating the space necessary to resolve the tooth crowding.
- The tooth-coloured archwire is then tied into each bracket in a similar way to that of conventional fixed appliances.
- In cases where the lower arch brackets interfere with the patient's full bite, small bumps of composite filling material will be placed to prop the bite open slightly while the teeth move into better positions. These bumps are then removed once the bite has adjusted and the brackets are safe from being knocked by the upper teeth.
- Detailed oral hygiene instructions will be given for the thorough cleaning of the appliance, without dislodging it.
- At each appointment thereafter, progress is checked against the original study models. Any necessary tooth trimming is carried out to allow the crowded teeth to align, and new archwires are placed.

- Once the tooth movement required has been achieved, both a fixed retainer and a removable soft gum shield (Essix) retainer are provided for each arch, and will be worn for life to prevent relapse of the tooth positions.
- Both arches are then de-bonded, final models and photographs are taken, and the fixed retainers are cemented into place.
- If necessary, the teeth are scaled and polished to remove any residual stain, plaque or tartar.

Aligners

For those adult patients who do not wish to wear any form of orthodontic appliance fixed to their teeth, even cosmetic ones, a technique of achieving tooth movement using a series of preformed retainer-like appliances has been developed. These are called 'aligners'. In skilled hands, a wide range of tooth movement can be carried out with this technique without the patient having to have anything bonded to their teeth, but movements such as derotation of twisted teeth are particularly difficult to achieve. Nevertheless, aligners are a useful alternative to fixed appliances for suitable adult patients.

The dentist will have carried out an oral, photographic and radiographic assessment of the patient beforehand, and will have discussed the patient's treatment aims to determine their suitability for this type of orthodontic treatment. Impressions will have been taken in alginate to provide a set of pretreatment study models, and now a second set of impressions will be taken using a more accurate elastomer material such as silicone. These second impressions are sent to a specialist laboratory where the working models will be cast up and used to produce the series of aligners required to straighten the teeth in each arch.

The working models are scanned in three dimensions into a specialised computer program, which then automatically produces an image of the perfectly aligned arches. The computer then determines the tooth movements and IPR measurements required at each stage to go from the initial arches to the aligned arches, and produces a set of gum shield-like aligners (Figure 16.68) which must be worn in sequence over a set period of time to produce the aligned arch results.

These are then sent back to the dentist, who ensures that the patient can insert and remove the first aligner correctly, and so the treatment begins.

Figure 16.68 Series of aligners.

Some patients are sufficiently capable to have the full set of aligners handed over at this appointment, knowing the sequence to follow and how long each one must be worn for before moving onto the next one, but the majority will reattend to have the aligners fitted sequentially by the dentist.

No special oral hygiene techniques are required as the aligners are removed for cleaning and toothbrushing, but the patient must ensure that they clean their teeth after each meal before reinserting the current aligner so that food debris is not inadvertently trapped beneath it and cause tooth cavities to develop. At the end of treatment, the final aligner will act as the retainer, although fixed lingual or palatal retainers (Figure 16.69) are usually also provided. As with all orthodontic treatment, retention is for life if there is to be a permanent result.

Figure 16.69 Fixed palatal retainer in place.

For those dental nurses with an interest in orthodontics, an extended duty can be gained in 'further assisting in the treatment of orthodontic patients' and further information is given in Chapter 18.

Dental implants

The use of dental implants over the last 30 years or so has provided a technique for improving the life and masticatory efficiency of many patients.

Previously, when a tooth had to be extracted it could only be replaced by a denture or a bridge. Both of these techniques have their own advantages and disadvantages as discussed earlier in the chapter, and a reminder of these in comparison to dental implants is shown in Table 16.12.

Table 16.12 Comparison of denture, conventional and adhesive bridge, and implant to replace teeth.

Denture	Conventional bridge	Adhesive bridge	Implant
Removable acrylic or metal frame which can replace one or all of the teeth	Fixed artificial tooth replacement in ceramic or bonded porcelain replacing one or more teeth	Fixed artificial tooth replacement in ceramic replacing usually one tooth	Fixed artificial tooth replacement which can replace one or all of the teeth
Held in place by suction film with metal clasps where possible	Held in place by cutting down adjacent teeth and bonding the bridge to them using luting cement	Held in place by bonding metal wings to the back of adjacent teeth without cutting them	Held in place by being screwed into the jaw bone and becoming incorporated into bone structure
Usually takes four to five visits to fit, over 4 or 5 weeks	Usually takes two visits to fit, over 2 weeks	Usually takes two visits to fit, over 2 weeks	Usually takes four visits to fit, over a 6-month period
Main advantages: no tooth cutting involved, cheapest option, removable to clean, good longevity	Main advantages: fixed option, good aesthetics, good longevity	Main advantages: no or minimal adjacent tooth cutting involved, fixed option, good aesthetics	Main advantages: fixed option, no adjacent tooth cutting involved, good aesthetics, good longevity

Denture	Conventional bridge	Adhesive bridge	Implant
Main disadvantages: become loose with time, can fracture components, aesthetics not as good as other options	Main disadvantages: tooth cutting of adjacent teeth required which may cause loss of vitality, failure of retention can cause damage to abutment teeth	Main disadvantages: can be dislodged more easily, require special cleaning before being rebonded	Main disadvantages: most expensive option, unavailable on NHS, involves surgical procedure, only available from specialist, poor care can result in significant bone loss
Unsuitable for patients with a strong gag reflex, epileptics, those with poor oral hygiene	Unsuitable for patients with sound adjacent teeth, those with poor oral hygiene	Unsuitable for patients requiring multiple tooth replacements, those with heavy bite or parafunctional habits, those with poor oral hygiene	Unsuitable for patients with severe bone loss, those with poor wound healing (diabetics and smokers) or those taking anticoagulants, those with poor oral hygiene

An implant is effectively a titanium double-screw cylinder that is inserted into a hole drilled into the alveolar bone of either jaw, to replace one or several teeth. Unlike when posts are cemented into tooth roots when placing post crowns, the implant is not ‘glued’ into place. Instead, the alveolar bone gradually grows around it and into its hollow screw structure so that it is eventually locked into the bone itself. This is called *osseointegration* and takes several months to occur.

Once the implant is firm within the bone structure, the top section can have the tooth replacement screwed onto it, and this can be any of the following devices:

- Single crown tooth.
- Multiple crowns to form a bridge (Figure 16.70).
- Metal bar to act as a locking device beneath a denture.
- Metal ball to act as a locking device beneath a denture.

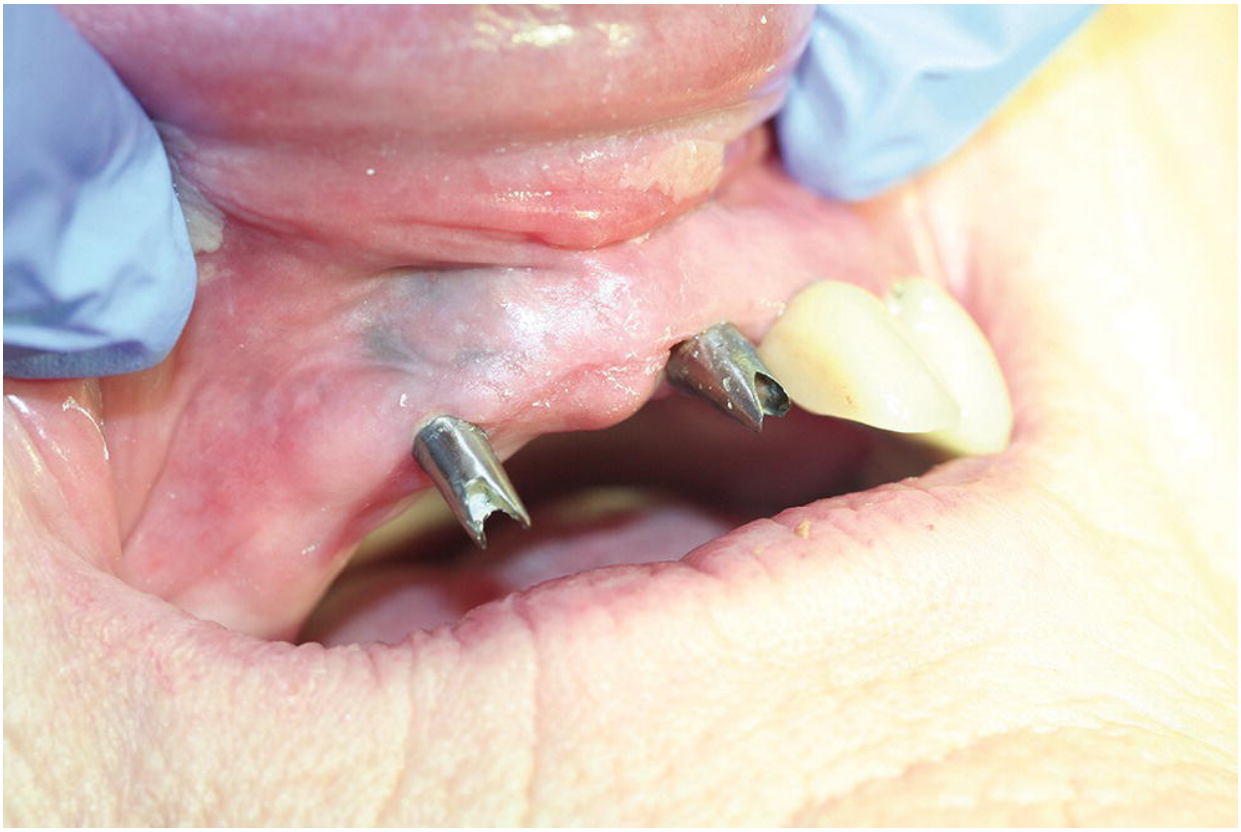


Figure 16.70 Implant heads in place for bridge superstructure placement.

The successful use of implants depends on many factors.

- **Bone**: there must be a deep enough section of alveolar bone to screw the implant into, without it damaging other structures such as dental nerves or the maxillary antrum (although materials have been developed to replace bone using synthetic alternatives, and an operation can be performed to 'raise' the floor of the antrum to provide more space, called a 'sinus lift' procedure).

- **Patient selection**: not all patients will be suitable for such an extensive surgical procedure, and some medical conditions may also contraindicate the use of implants (such as osteoporosis, haemophilia, diabetes due to poor wound healing).
- **Oral health**: patients with poor oral health are unsuitable for implants, as success depends very much on being kept clean of dental plaque. The presence of plaque allows periodontal disease to develop around the implant, and the resultant pocketing will allow the titanium cylinder to become loose and the implant will fail. This condition is called *peri-implantitis*.
- **Lifestyle factors**: factors such as smoking and poor dental attendance may lead to failure of an implant in the same way that they are associated with higher levels of dental disease (especially periodontal disease) in dentate patients without implants.

Implant and prosthesis placement procedures

- A team consisting of an implantologist, a specialist technician and a hygienist examine and assess the patient, helped by study models, photographs, radiographs, and three-dimensional computer scans (Figure 16.71).
- They can then plan the preparation, construction and maintenance of an implant procedure for the patient, using surgical stents and diagnostic wax-ups with the study models.
- Depending where the placement procedure is carried out, local anaesthetic (with or without conscious sedation) or general anaesthetic is given to the patient.
- The oral surgery procedure of inserting the titanium implants into the alveolar bone is carried out under the usual surgical conditions of other minor oral surgery procedures, with all personnel wearing appropriate PPE for a surgical procedure (Figure 16.72).
- However, as the bone drilling handpiece requires copious water cooling during the process, a special isolated sterile water supply and delivery system is required to ensure there is no

contamination of the surgical site (Figure 16.73), as may happen if usual water sources are used.

- A mucoperiosteal flap is raised to expose the bone and special low-speed implant drills (mills) are used to prepare accurate holes for the implants, at the correct width, depth and angulation as determined by the preplanning stage and using the tools from the relevant implant kit (Figure 16.74), including a calibrated depth gauge.
- Alternatively, the extraction socket of the tooth itself is used and prepared in a similar fashion.
- The chosen implants are driven into the prepared holes using torqued insert instruments and a surgical hammer, and the tissue flap is then sutured back into place to completely bury the implant (Figure 16.75) with just the head projecting through into the oral cavity.
- If any of the missing teeth require replacement during the healing process, the implant head is covered with a plastic cap and either a temporary denture or etch-retained bridge is placed.
- After a suitable time period, which can be up to several months, the implants become firmly embedded in the bone by osseointegration, and the permanent prosthesis can be placed in a two-stage implant placement procedure.
- In suitable single tooth cases a one-stage implant placement procedure may be carried out instead, with immediate loading of the implant for normal use.
- In the two-stage procedure, under local anaesthetic a small incision is made in the overlying gingiva to expose the top of each implant, and the artificial abutments are then screwed into the inner surface of the implants. Abutments may be in the form of stumps for fitting single crowns or bridge abutments (Figure 16.76) or a ball or bar for clipping on a removable overdenture.

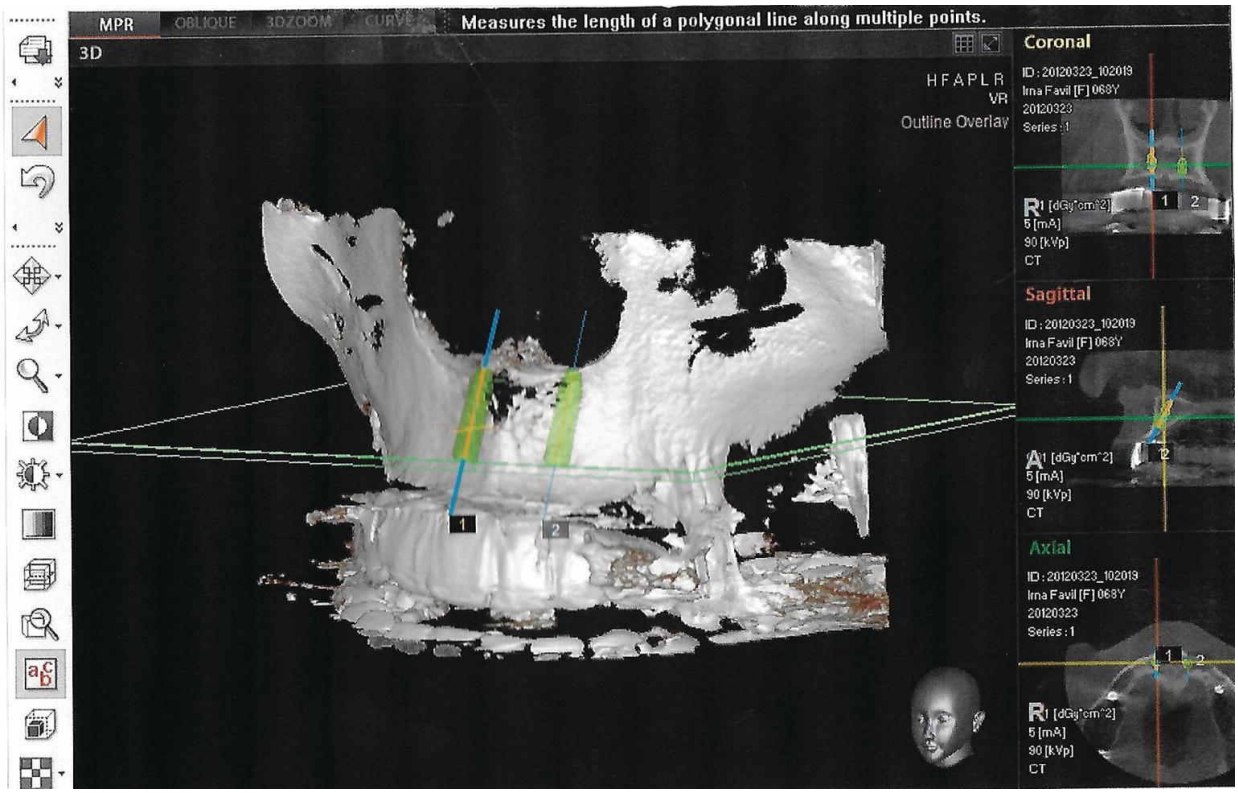


Figure 16.71 Example of a computerised three-dimensional scan for implant planning.

Figure 16.72 Personal protective equipment suitable for implant procedure.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REDC RPM M-CM FLOW
IMTEC

Figure 16.73 Example of implant handpiece and sterile irrigation system.

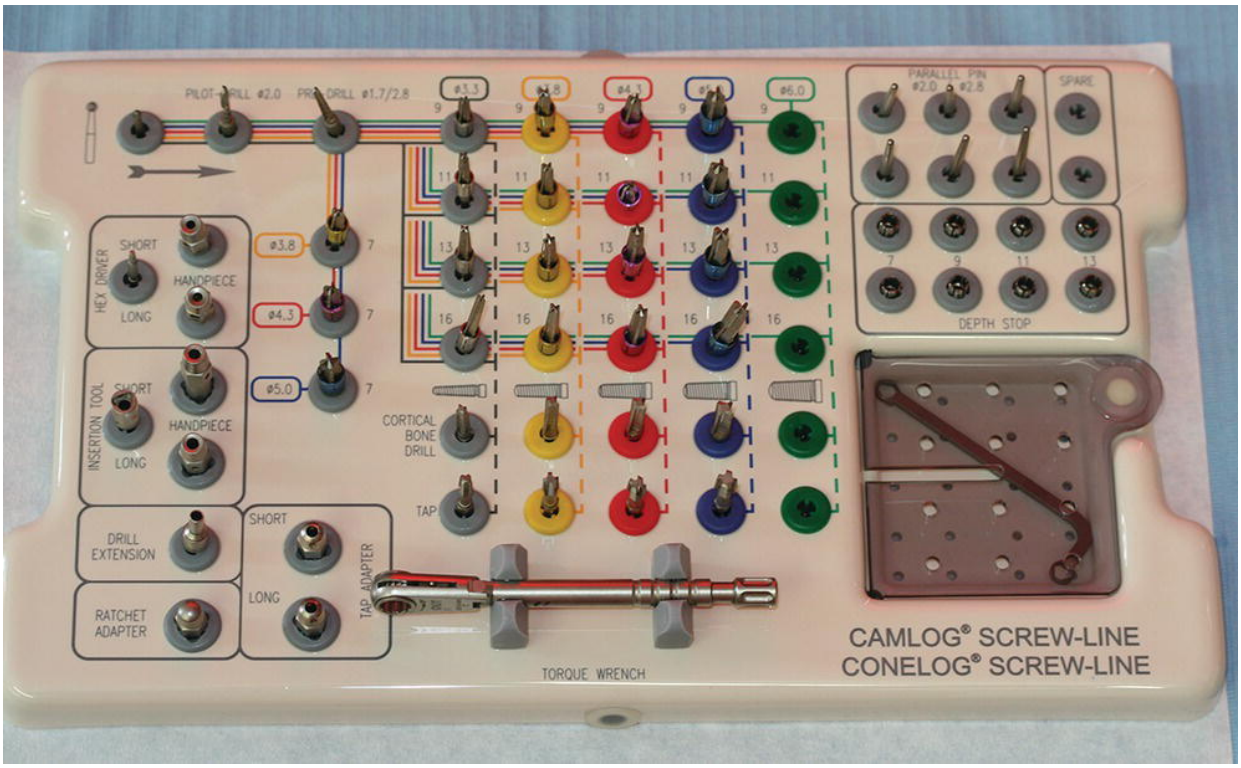


Figure 16.74 Example of implant kit.

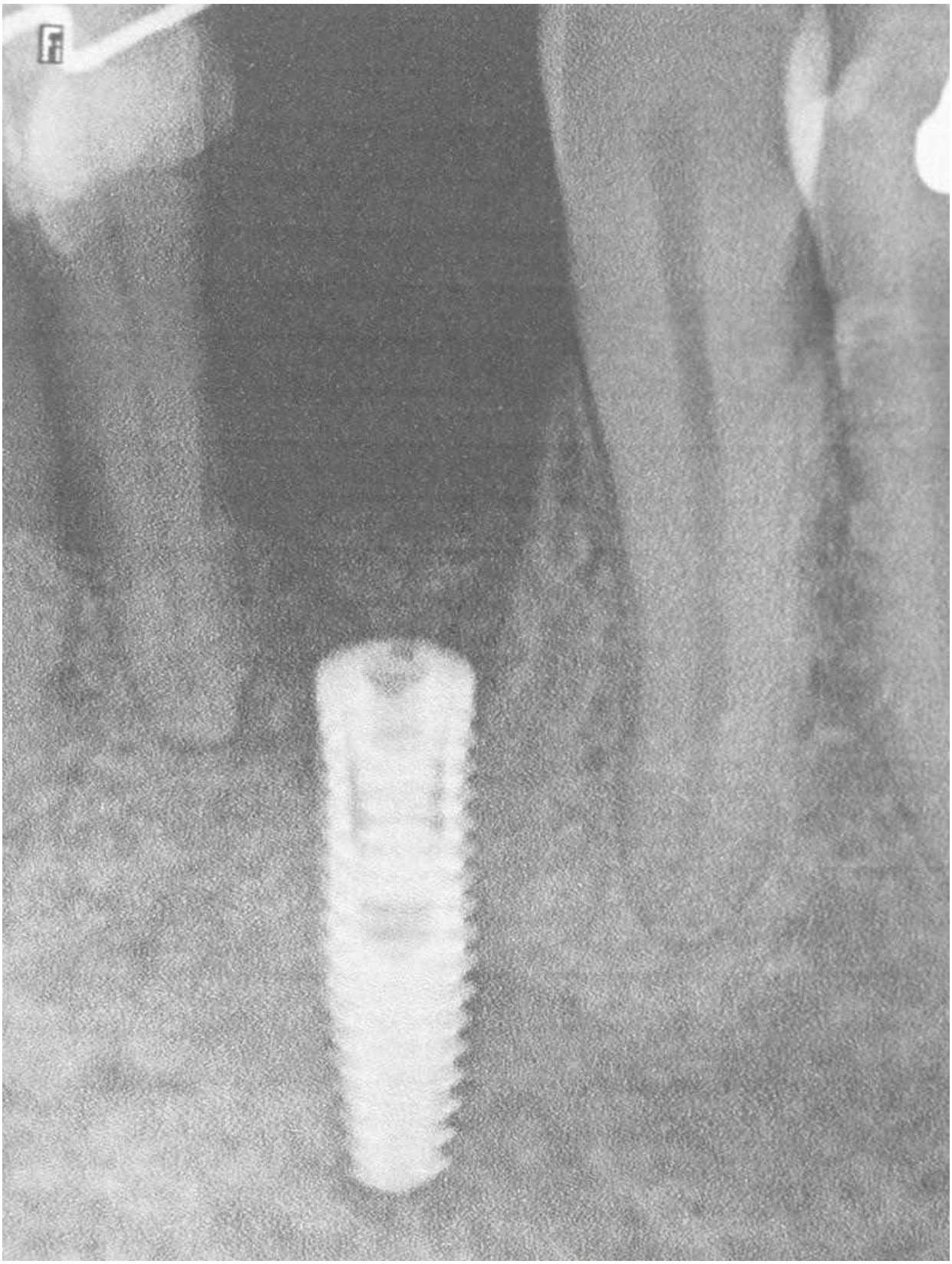


Figure 16.75 Radiograph showing implant placement.

Figure 16.76 Implant-retained bridge in place.

Role of the dental nurse in implant dentistry

Although many of the chairside skills required are generic to many other dental procedures, for dental implants the role of the dental nurse will include an enhanced knowledge of dental anatomy and physiology, to enable them to understand the various stages of the implant procedure and be able to communicate them effectively to the patients. Further information on anatomy and physiology is available in the textbook *Basic Guide to Anatomy and Physiology for Dental Care Professionals* (C. Hollins, 2012, Wiley-Blackwell).

The skills required for the dental nurse to assist at the chairside during implant procedures are as follows:

- Have knowledge of the specific instruments and materials required for each stage of the procedure, and be able to set them out accordingly (these vary depending on the stage involved and the implant system in use).

- Provide chairside support during implant procedures using four- or six-handed techniques for maximum efficiency.
- Use surgical suction and irrigation techniques effectively, to provide a clear operating field for the surgeon.
- Use instruments effectively to retract soft tissues as required during implant procedures.
- Have good chairside skills to assist during the restorative phase of the procedure, including knowledge and manipulation of the various materials used.
- Have good communication skills to assist other team members, and to liaise and reassure the patient where appropriate.
- Be able to provide patient care, support and monitoring throughout the procedures.
- Be able to provide preoperative and postoperative instructions to implant patients.

The oral hygiene information required by a patient once implants have been provided is similar to that for other fixed prosthodontics, although a specific condition may occur in the absence of good levels of oral health – **peri-implantitis**. As the name suggests, this is a specific inflammation that occurs in the gingival soft tissues surrounding an implant due to the build-up of a plaque biofilm in the area. Many patients believe that the replacement of teeth with implants means they no longer have to use oral health products, such as toothpaste, toothbrush, mouthwash and interdental cleaning aids, but nothing could be further from the truth. Plaque biofilm forms even in an edentulous mouth and implants provide stagnation areas just as teeth do, so all debris must be cleaned away daily using the techniques described in Chapter 13. This information and the skills required to avoid peri-implantitis are often provided and monitored by the dental hygienist, but the dental nurse has a role in reinforcing this information at every opportunity. Indeed, where a hygienist is not present in the dental workplace the dental nurse may acquire the necessary skills and knowledge to take over this role following suitable extended duties training.

When peri-implantitis develops and remains unchecked, the implant is likely to fail and the patient will ultimately lose further bone structure and eventually the implant itself, so as with all other restorations, a consistently good level of oral hygiene is required for dental treatment to be successful.

Obviously, the successful placement of implants in dentistry depends on the surgical skill of the dentist or oral surgeon involved, as well as the competence and support of the dental team including the dental nurse. Training courses available for dentists are numerous but all must meet the criteria for accreditation set out by the GDC, which is assisted by input from the FGDP in determining these. The more complicated cases should only ever be handled by those with adequate training in the more complicated techniques, and specialist implantologists. The laboratory stages of the top section of the appliance have to be carried out by specialist technicians, although the chairside preparation stage is no different from that for a conventional crown or bridge preparation. The use of denture locking devices requires special impression techniques to be used. However, implants provide successful dental treatment options to patients who were previously untreatable, as well as offering less invasive techniques in simpler cases, such as single tooth replacements.

As implant dentistry therefore becomes ever more popular, with specialist practices setting up around the UK, there is an increasing need for a highly trained and qualified support team to assist in the speciality. Dental nurses with an interest in this field can now undertake a Dental Implant Nursing training course with the NEBDN and gain a certificate in the qualification, which should enable them to become highly sought-after members of the dental team. Further information is available at www.nebdn.org.

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

17
Extractions and Minor Oral Surgery

Key learning points

A **factual knowledge** of

- simple extraction techniques
- surgical extraction techniques

A **working knowledge** of

- the instruments and equipment used in simple tooth extractions
- the instruments and equipment used in surgical extractions and minor oral surgery procedures

A **factual awareness** of

- the complications of extraction and their avoidance
- other minor oral surgery procedures, including implant placement surgery

Many procedures carried out daily in the vast majority of dental workplaces can be collectively termed ‘minor oral surgery’ (MOS), as opposed to major oral surgery procedures such as treatment and reconstructive surgery for oral cancer, orthognathic surgery to correct skeletal problems, and head and neck trauma surgery. Major oral surgery procedures are carried out in hospital dental theatres. Those minor surgical procedures to be discussed here are the following:

- **Simple extractions**: of roots or whole teeth, where no soft tissue or bone removal is required.
- **Surgical extractions**: of roots or whole teeth, where soft tissue alone or with bone, has to be removed to gain access to the root or tooth.

- **Operculectomy**: the surgical removal of the gingival flap overlying a partially erupted tooth, especially a lower third molar.
- **Alveolectomy**: the surgical adjustment and removal of bone spicules from the alveolar ridge after tooth extraction, to produce a smooth base for denture seating.
- **Basic implant placement**: the surgical replacement of a missing tooth by an osseointegrated implant.
- **Gingivectomy and gingivoplasty**: periodontal soft tissue surgery to adjust the shape of the gingivae to aid oral hygiene measures.
- **Periodontal flap surgery**: the surgical raising and replacing of surgical flaps, to enable subgingival debridement to be carried out.
- **Soft tissue biopsies**: the partial or complete removal of soft tissue oral lesions, for pathological investigation and diagnosis.

Arguably, these surgical procedures constitute those most worrying to the patient, as bleeding and possible postoperative pain are quite likely to occur. The dental nurse has a very important role in the reassurance and monitoring of the patient during these procedures, so that the patient remains less anxious and more co-operative throughout.

As always, health and safety and infection control procedures must be strictly adhered to before, during and after the surgical procedure.

Extractions

These procedures involve the removal of teeth, or their roots if the crown of the tooth has disintegrated, to leave a section of the alveolar ridge bare and ready for tooth replacement by:

- the pontic of a bridge
- a denture
- an implant.

Reasons for tooth extraction

Both deciduous and permanent teeth may require extraction at some point. This is usually due to infection and pain being present following caries, periodontal disease or trauma, but may also be due to the following reasons:

- The tooth is unrestorable, whether pain and infection are present or not.
- The position of the tooth prevents the placement of a fixed or removable prosthesis.
- The tooth is too poorly positioned to be aligned orthodontically.
- The tooth may be selectively extracted to provide space in a crowded dental arch.
- Attempts to save the tooth by root filling have failed.
- The tooth may be partially erupted and impacted and suffer from recurrent painful infections (pericoronitis) due to food trapping.
- Deciduous teeth can be selectively extracted to encourage the timely eruption of their permanent successors into more favourable positions.
- The patient's choice, where attempting to save the tooth by root filling is not the preferred option.

To ensure that any tooth is extracted painlessly and successfully, the dentist has an in-depth knowledge of the anatomy and physiology of the head and neck region, as well as the oral cavity and its nerve

supply. An efficient and supportive dental nurse must also have a background knowledge of these subjects, to be able to provide the level of preparation, chairside support and help required during any likely complication that may arise. Head and neck anatomy and oral anatomy and physiology are covered in detail in Chapters 9 and 10 respectively.

When the dentist has no choice and decides that a tooth has to be extracted, it will be for one or more of the following reasons.

- Unless successful treatment to save it can be carried out, a carious or periodontally involved tooth is a continual source of infection in the patient's oral cavity.
- Any infection may be intermittent, but often there are acute and very painful episodes that may require analgesic and antibiotic treatment.
- Infection can spread into the bloodstream (**bacteraemia**) and the patient can become generally unwell. This can be a serious event in elderly and medically compromised patients.
- Repeat prescriptions of antibiotics to treat infection without tooth removal are considered poor practice, as this allows bacteria to develop resistance to antibiotics over time.
- No replacement of the tooth can be carried out to restore oral health until the tooth has been extracted.

Once it has been determined that a tooth or root requires extraction, the complexity of the procedure depends mainly on which tooth is involved (and therefore how many roots), how much tooth or root is present to hold on to, whether any roots are curved, and their position in the jaw bone. The options available for the extraction procedure will then fall into one of the following categories:

- Simple extraction where the tooth is just loosened in its socket and removed whole.
- Surgical extraction involving soft tissue removal to expose an unerupted tooth or buried root.

- Surgical extraction involving dissection of the tooth in its socket and removal in sections.
- Surgical extraction involving the raising of a mucoperiosteal flap and bone removal to gain full access to a tooth or root.

If the tooth involved is a deciduous one, the following points need to be considered:

- **Resorption**: has root resorption occurred so that effectively just the crown of the tooth remains, attached merely to the gingivae?
- **Permanent successor**: is the underlying permanent tooth present, and likely to be damaged during the extraction procedure?
- **Infection**: is any dental infection present that may make the procedure unnecessarily painful?
- **Age and co-operation**: younger patients are usually less willing to undergo extraction procedures than older patients and, along with some of those with special needs, are less able to understand the need for the procedure nor the consequences if it is not carried out.
- **Medical history of the patient**: some medical conditions contraindicate extraction.
- **Tooth status**: a grossly carious deciduous tooth may be difficult to extract simply and quickly, but a surgical procedure is not usually feasible in conscious younger patients, so some form of anxiety control will have to be considered.

If the tooth involved is a permanent one, the following points need to be considered:

- **Infection**: is any dental infection present that may make the procedure unnecessarily painful?
- **Medical history of the patient**: some medical conditions contraindicate extraction.
- **Medications**: some adult medications (such as anticoagulants other than warfarin, and bisphosphonates) will require the

patient to be treated in hospital for extractions or MOS, because of possible serious side-effects.

- **Co-operation**: some adults and some patients with special needs will require some form of anxiety control to undergo these types of procedure.
- **Age**: older patients have more friable soft tissues which are more easily traumatised during surgical procedures, and their jaw bones will be more brittle and more easily fractured.
- **Tooth status**: a grossly carious tooth is more likely to require a full surgical procedure to complete its removal.
- **Post extraction**: will the missing tooth require replacement, and if so what are the options and cost implications?

Simple extractions

Simple extractions are so called because the tooth or root is removed whole from the dental arch without involving tooth sectioning, flap raising or bone removal. Any or all of these additional techniques may be required during a surgical extraction. Whether the tooth is still vital or has died from any associated infection, local anaesthesia will always be required to numb the surrounding gingivae at least, even for a simple extraction.

The specific instruments, equipment and medicaments that may be required for a simple extraction are shown in Table 17.1.

Table 17.1 Specific instruments, equipment and medicaments that may be required for a simple extraction.

Item	Function
Forceps	Range of sterile hand instruments used to grip a tooth or root at its neck before applying appropriate wrist actions to loosen the tooth/root in its socket during the extraction procedure. Various designs are available for use on upper or lower teeth, and for each individual tooth
Luxators	Sterile hand instruments used to widen the socket and sever the periodontal ligament attachment
Elevators	Sterile hand instruments used to prise the tooth/root out of the socket. Various patterns are available: Cryer's, Warwick James', Winter's
Fine-bore aspirator (Figure 17.1a)	Disposable narrow suction tip used to suck away all blood and maintain good moisture control during the procedure; also useful for sucking and holding tooth debris so that it can be removed from the mouth safely
Haemostats (Figure 17.1b)	Gelatine sponges or oxidised cellulose packs, which are inserted into the socket after extraction to aid blood clotting and achieve haemostasis; can be used with or without a suture

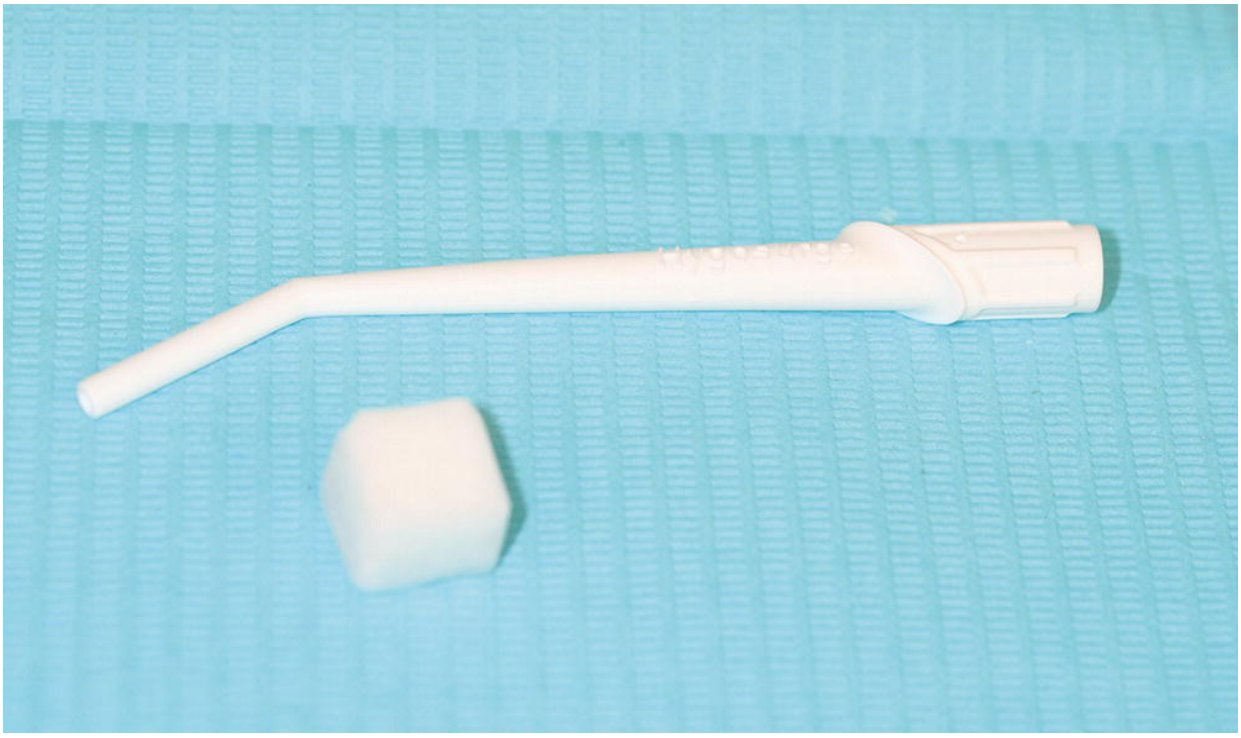


Figure 17.1 Fine-bore surgical suction tip (top) and haemostat sponge (bottom).

Forceps are the instruments most frequently used to extract a tooth and are handled by being pushed from the gingival margin into the periodontal space and along the sides of the root, to sever the periodontal membrane as it goes. Once a reasonable position has been achieved, the root is gripped and gentle twisting wrist movements are employed to gradually loosen the tooth in the socket. The forceps are gradually worked further towards the apex of the tooth until it is loose enough in the socket to be removed. In effect, then, a tooth is actually extracted by being *pushed out* of the socket by the root, rather than being pulled out of it by the crown, as most people would assume.

Unnecessary force during extractions often results in tooth or root fracture, although this can also occur anyway with brittle root-filled teeth or grossly carious teeth.

Forceps are designed in various patterns, to be used individually for each type of tooth. Upper tooth forceps tend to have their handles and blades roughly in line with each other, whereas lower tooth forceps tend to be at right angles to each other for ease of access to the lower

arch (Figure 17.2). Multirooted molar tooth forceps have blades which are shaped like beaks so that they can grip the *furcation* area between the roots, but single-rooted tooth forceps have smooth blades (Figure 17.3).

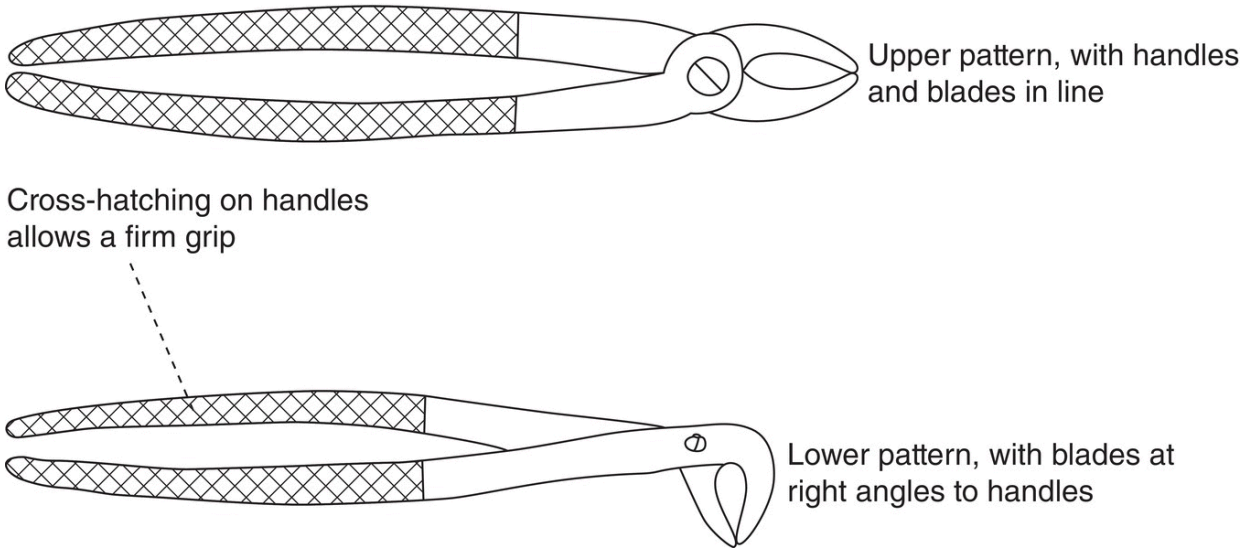


Figure 17.2 Upper and lower pattern of forceps.

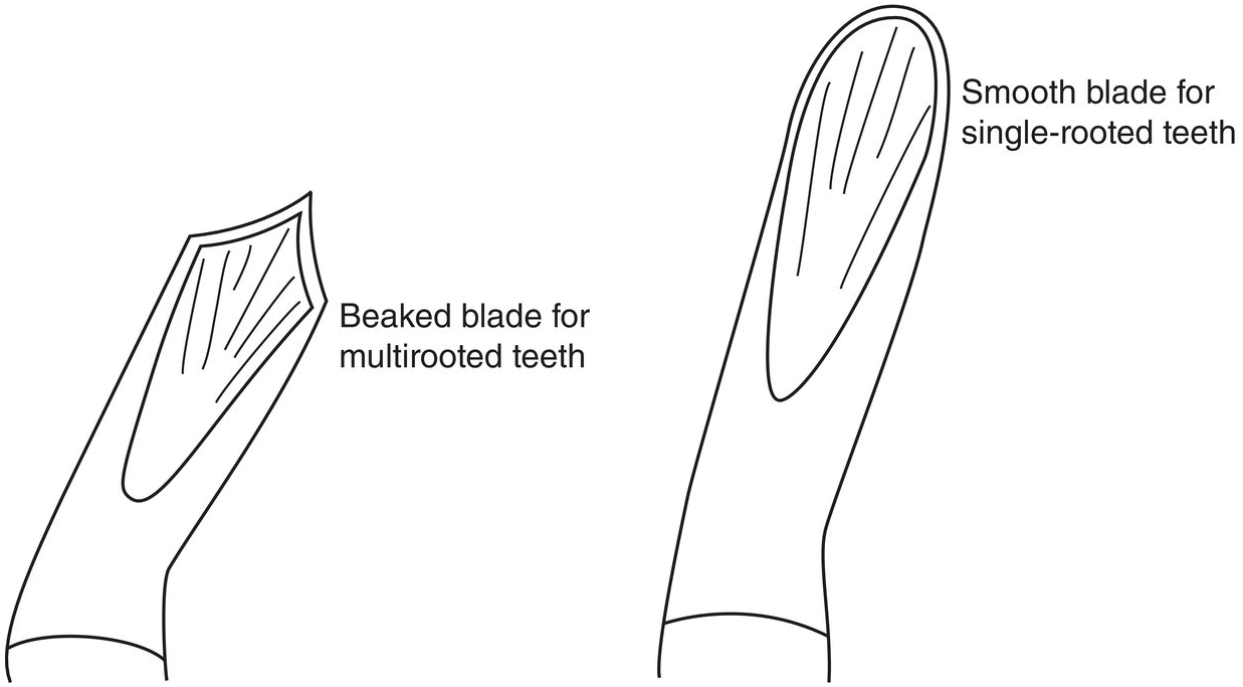


Figure 17.3 Blade detail of forceps.

The most common patterns of forceps are shown in Figure 17.4.

- **Upper incisor and canine forceps** are straight with single rounded blades and have both wide and narrow patterns.
- **Upper root forceps** are similar in appearance, with narrow straight blades.
- **Upper premolar forceps** have slightly curved handles and single rounded blades.
- **Upper left molar forceps** have curved handles and a beaked blade to the right of the instrument, and a rounded blade to the left to grip the buccal roots and the palatal root respectively (many dental nurses identify upper molar forceps by the mantra 'beak to cheek').
- **Upper right molar forceps** have curved handles and the beaked blade is to the left of the instrument.
- **Upper bayonet forceps** have extended handles and angled blades to gain access to third molars, or have angled pointed blades to gain access to fractured roots.
- **Lower anterior forceps** have single rounded blades at right angles to the handle that are particularly useful for extracting lower premolars.
- **Lower root forceps** are similar, with narrow and straight blades that are also particularly useful for extracting small or crowded incisors.
- **Lower molar forceps** have beaked blades at right angles to the handles, to grip the furcation of the two roots.
- **Lower 'cowhorn' forceps** have curved and pointed blades at right angles to the handles, to grip the furcation of lower molar teeth.
- **Smaller versions** of most patterns exist, for deciduous tooth extractions.

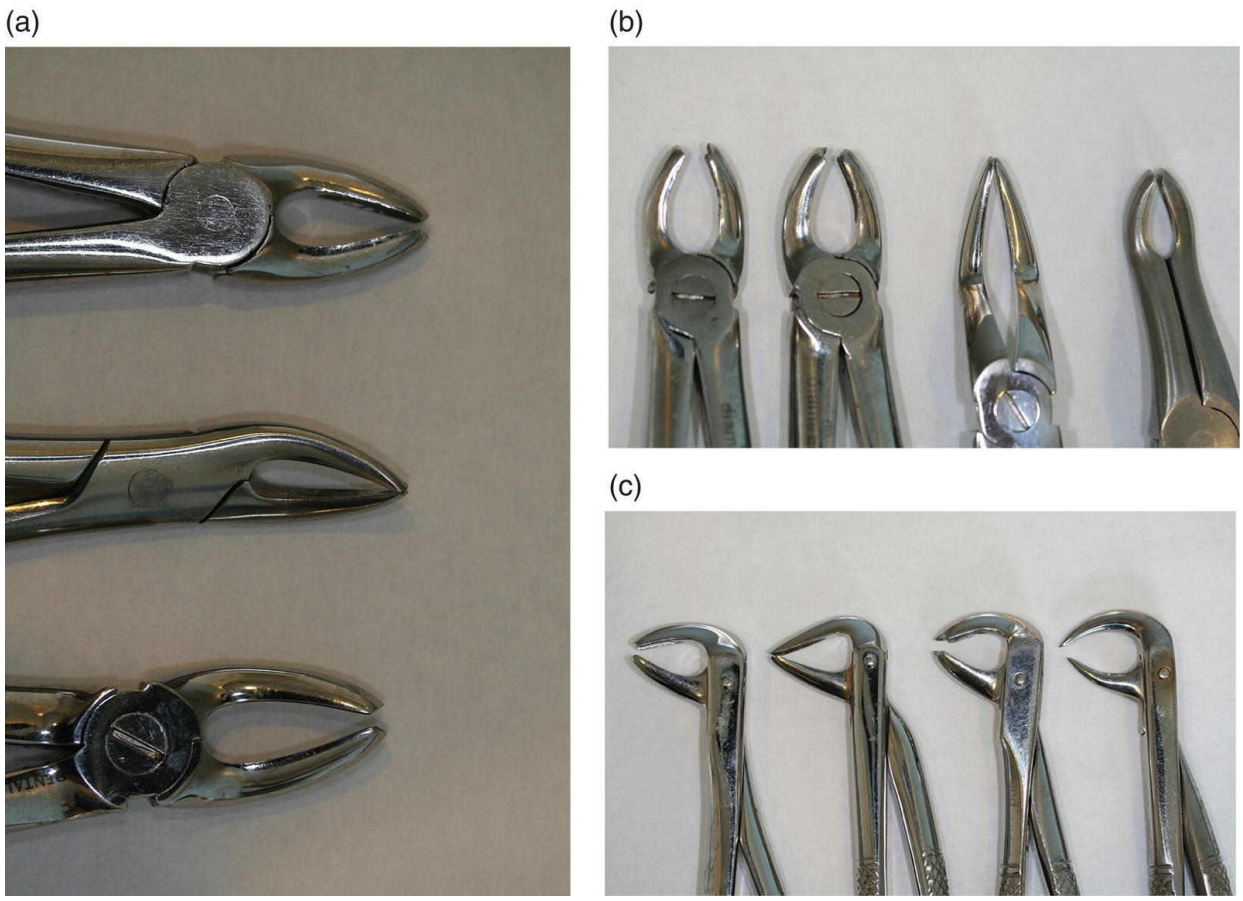


Figure 17.4 Extraction forceps. (a) Upper straight, root, premolar. (b) Upper left and right molar, bayonets. (c) Lower anterior, root, molar, cowhorns.

Similarly, elevators are available in a variety of patterns and are used to gradually sever the periodontal membrane and loosen the tooth in the socket (Figure 17.5). They are specifically used to elevate retained roots and impacted teeth, where adequate access to the root or tooth is not possible with conventional forceps, or where the angle of elevation required to loosen the root or tooth is not possible with forceps.

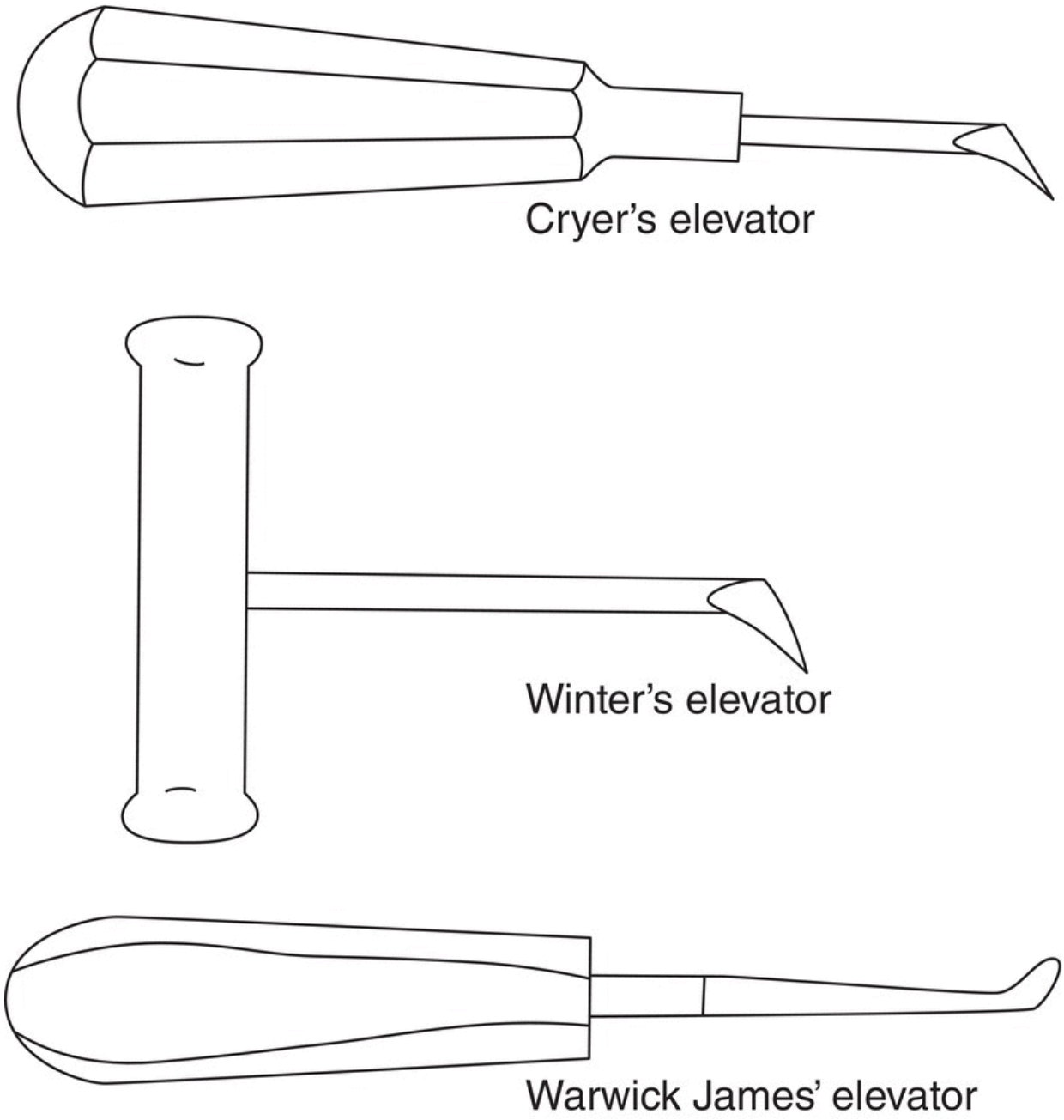


Figure 17.5 Types of elevators.

The more common types are as follows:

- **Cryer's elevators** are available as left and right patterns but can be used on either side of the mouth, depending whether they are engaged mesially or distally; the tips are triangular shaped and pointed.

- **Winter's elevators** have a similar blade design as Cryer's but have a corkscrew-style handle to give more leverage.
- **Warwick James' elevators** are available as left, right and straight patterns; the tips are a similar shape to the round blade of forceps.

Alternatively, the dentist may choose to use one of a variety of *luxators* (Figure 17.6) that are available and are used in a similar fashion to an elevator but with greater effect, as the tips are sharper and finer and therefore more easily pushed into the periodontal space between the root and the bony socket. It is possible to extract practically any tooth using a luxator alone, and many dentists are able to do so.

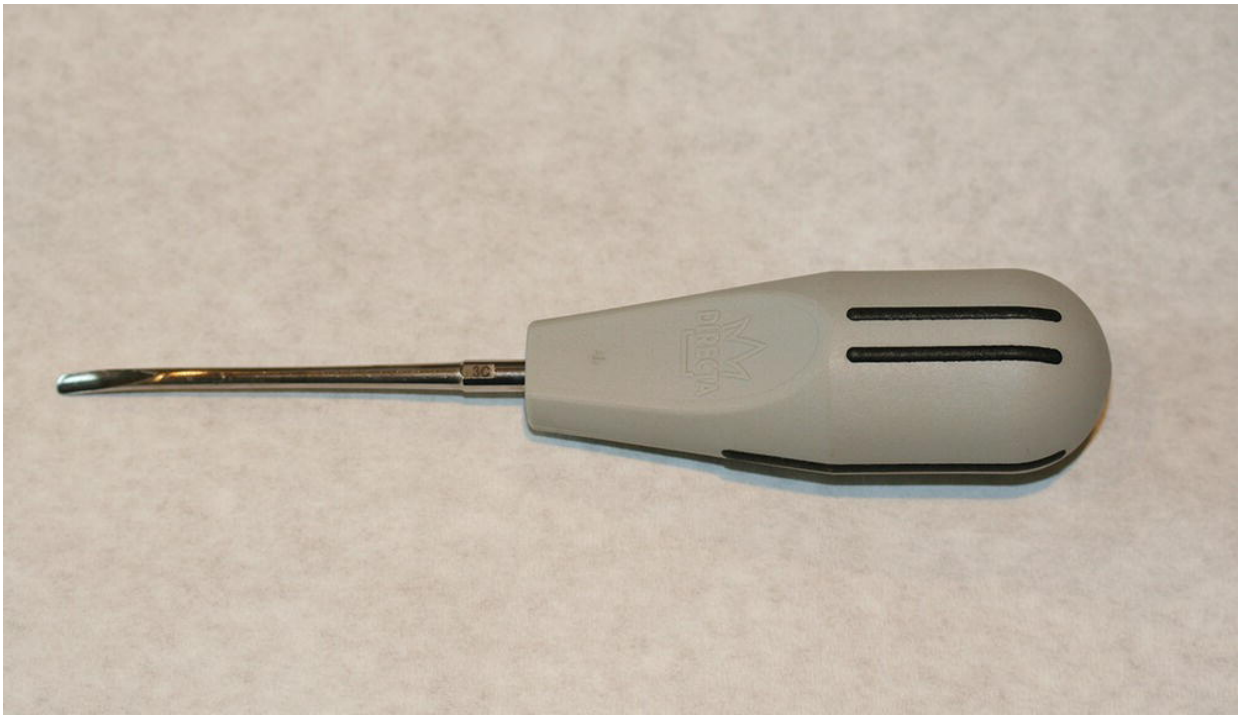


Figure 17.6 Luxator.

A single-bladed chisel is also available for splitting multirooted teeth, called a *Coupland's chisel* and available in sizes 1, 2 and 3 (Figure 17.7).

Figure 17.7 Coupland's chisels: sizes 1, 2 and 3.

Difficult extractions can be quite exhausting for the dentist and the patient, and it often helps both for the dental nurse to actually support the patient's head or mandible during the extraction. In this way, the dentist is not wasting energy by rocking the patient's head rather than loosening the tooth, and it also allows the patient to relax more, rather than trying to hold their head still for the dentist.

Upon removal of the tooth, the dentist squeezes the socket walls together, places a bite pack over the socket, and instructs the patient to bite on it for up to 30 minutes to help to achieve haemostasis (stop the bleeding). After treatment, the patient is not dismissed until the bleeding has ceased and postoperative advice has been given. A suitable bite pack can be made from a cotton wool roll and gauze sheets, as shown in Figure 17.8. The cotton wool is placed at one corner of the gauze sheet, which is then folded over it. The adjacent sides of the sheet are folded into the centre and the cotton wool is rolled across the sheet to the opposite corner, to create the bite pack. The cotton wool gives the patient something firm to bite onto, while

the gauze overlay prevents the wool fibres becoming stuck in the blood clot as it forms. It is usual to wet the bite pack with cold water before insertion, as this assists with clotting as well as further preventing the pack from sticking to the blood clot.

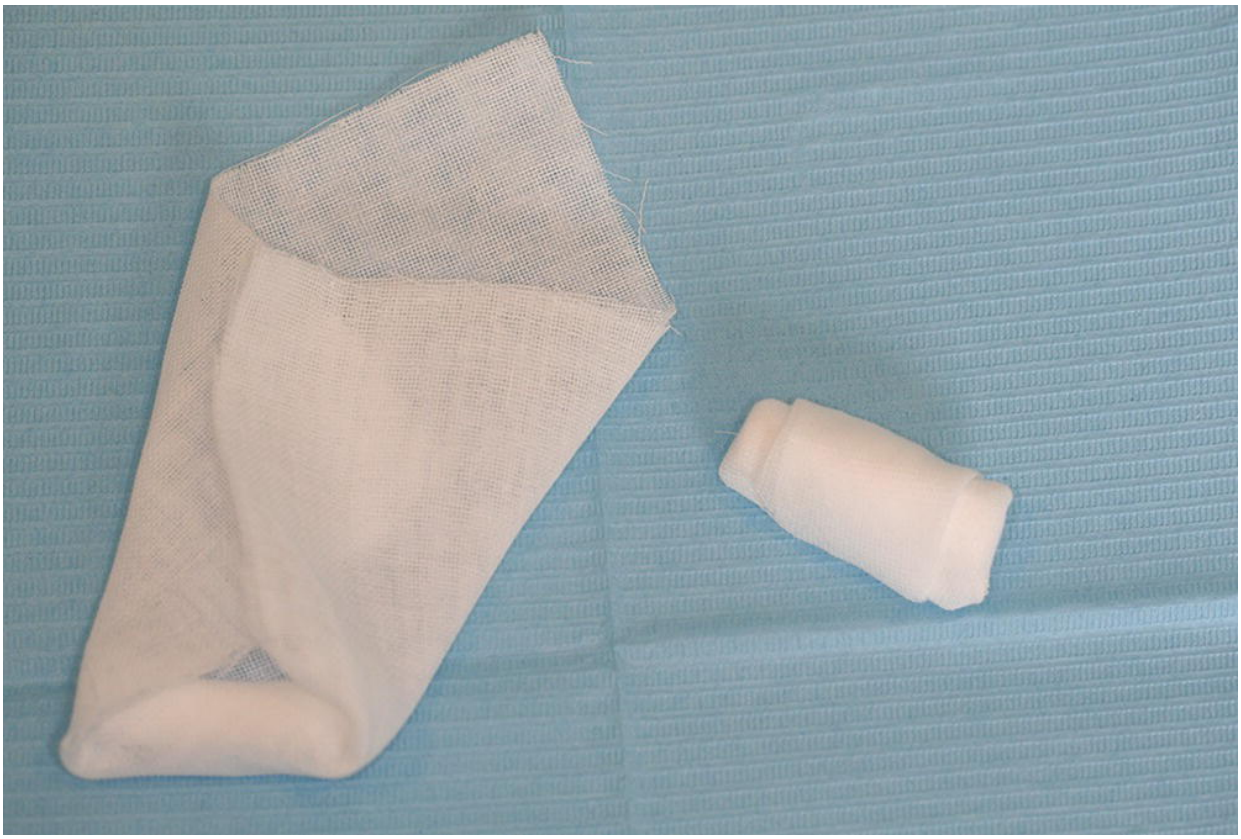


Figure 17.8 Bite pack construction.

Role of the dental nurse during the procedure

The dental nurse should have a full working knowledge of each instrument likely to be used, including the full range of forceps available, to ensure the ability to provide close support and assistance to the dental team during the procedure.

Each instrument will be sterile and bagged and should be carefully opened without touching it and then handed to the dentist handles first, while holding the tips still within the sterile pouch. This is the 'no-touch' technique (Figure 17.9) that maintains infection control.

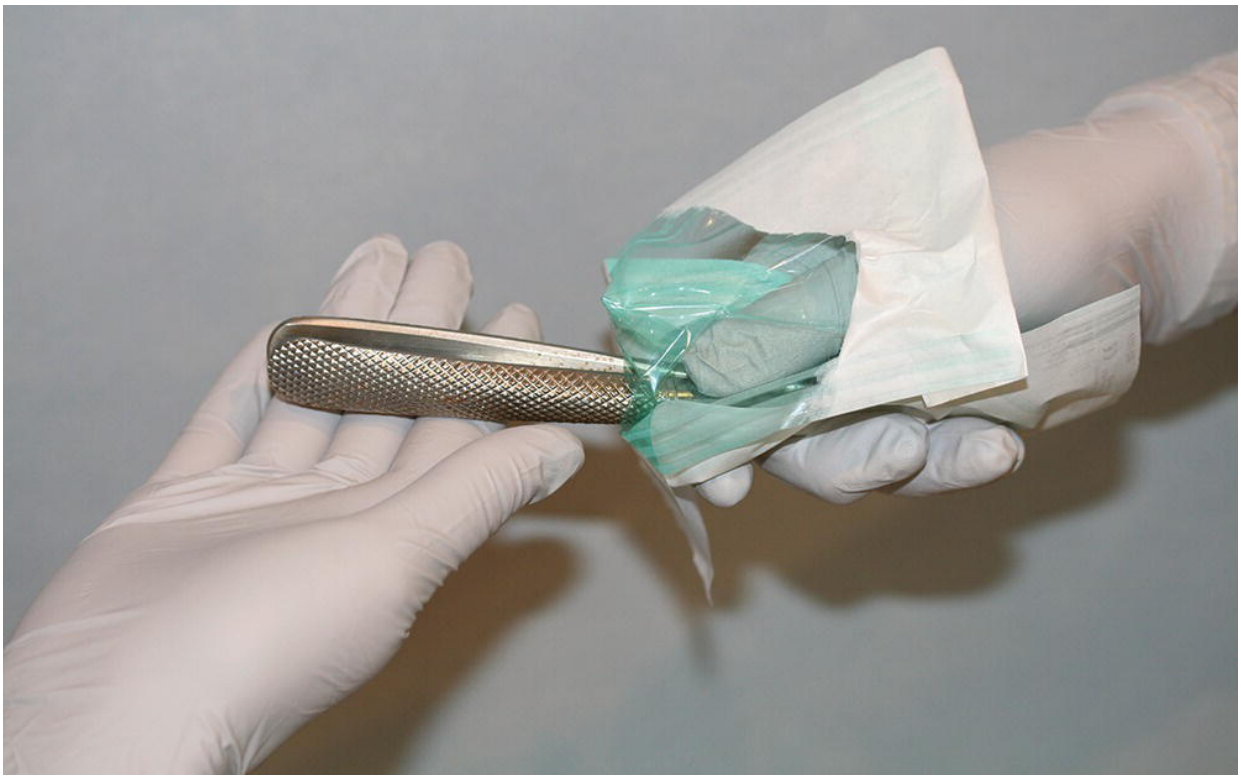


Figure 17.9 'No-touch' technique of passing forceps.

As with any dental procedure, all the required instruments and equipment will have been made ready before the procedure begins and laid out in their bags, close to the dental chair for easy access but not in full view of the patient, since this is likely to increase their anxiety.

The dental nurse will anticipate the dentist with regard to the instruments required and their order of need, and safely pass them as required using the 'no-touch' technique described above.

Throughout the procedure, the dental nurse will monitor the patient for any signs of distress (such as feeling pain) and notify the dentist accordingly. A calm, reassuring manner is required to put the patient at their ease and this must be adapted for the various types of patient that may be treated, whether a child, an adult or elderly person, or a patient with special needs. When treating patients from different ethnic backgrounds, it is very useful to have a friend or family member present to interpret as necessary.

As the forceps, luxators and elevators used have to be pushed into the tooth socket, the dental nurse may also be required to stabilise the

patient's head or mandible so that the dentist's efforts are not wasted. The purpose of the support should be briefly explained to the patient beforehand.

Surgical field considerations

Whichever technique is used to extract a tooth or root, the procedure is considered a surgical one, as bleeding will definitely occur and the tissues of the patient's oral cavity will be breached by the instruments used. If the working area is not treated as a sterile field during the procedure, there is a potential risk of cross-infection occurring and this is more likely with oral surgery procedures than with any other procedure in dentistry.

Consequently, the following special precautions are taken:

- **Sterile bagged instruments**: all instruments to be used must have been sterilised and individually bagged before the procedure, unlike restorative instruments that are bagged together.
- **PPE for the dental team**: over and above the usual PPE requirements for dental procedures, surgical gowns or single-use plastic aprons should be used to prevent blood contamination of the uniform.
- **PPE for the patient:** safety glasses must always be worn by the patient during the procedure, to prevent possible eye injury from sharp debris; they should also have a disposable waterproof bib placed to prevent blood contamination on their clothing.
- **Disposable items**: wherever possible, disposable items should be used to prevent cross-infection, including aspirators, scalpel blades, needles, suture needles, etc.
- **Contamination policy**: any single-use items and materials that are opened but not used during the procedure should be disposed of anyway, to avoid their possible contamination and then spread of infection by resealing and using at a later date.
- **Suction equipment**: must be run through immediately after the procedure with the required disinfectant solution to remove

all traces of blood from its inner workings, rather than at the end of the session as usual.

- **Operative field**: should be assumed to be blood contaminated and wiped down thoroughly with sodium hypochlorite (bleach) or another accepted decontaminant.
- **Equipment coverage**: items such as the dental chair will obviously be reused and are not sterilisable, so they must be covered before the procedure with a single-use impervious membrane, to prevent blood contamination.
- **Sterile field**: the oral cavity and its immediate vicinity will be regarded as a sterile field during the procedure, and any team member who is not wearing suitable PPE should not enter it nor pass instruments into it without using a 'no-touch' technique.

The aspects of infection control and health and safety that are relevant to these procedures, especially cleaning methods, infection control and sterilisation, are fully discussed in Chapters 4 and 8. They are summarised below.

- All sharps are carefully disposed of in the sharps box, including local anaesthetic needles, cartridges, scalpel blades, suture needles, teeth without amalgam fillings.
- Teeth with amalgam fillings present should be placed in the amalgam waste receptacle.
- All autoclavable items are placed in a washer-disinfector unit or an ultrasonic bath and decontaminated thoroughly before being placed in the autoclave for sterilisation.
- All contaminated waste is placed in orange hazardous waste sacks; this includes all the impervious covers used as barriers on equipment items.
- All surfaces are disinfected using the correct solution.

Preoperative and postoperative instructions

Often, the patient will request information regarding the procedure itself in advance, and the dental nurse is ideally suited to allay their fears by giving advice beforehand as follows:

- Local anaesthesia will always be necessary for an extraction.
- The procedure will not be painful, as adequate local anaesthesia will be given.
- If a surgical procedure is being undertaken, sutures will be necessary.
- Patient must take all medication as normal before the procedure unless the dentist informs them otherwise, except for aspirin which prevents blood clotting and could cause postoperative bleeding.
- Patient must have a light snack 2 hours before the procedure, to avoid fainting.
- Full postoperative instructions will be given verbally and in writing, so the patient does not have to remember them.
- If the patient is a nervous adult or child, they should be escorted by a reassuring and competent adult.

After the procedure a full list of postoperative instructions should be given verbally (to give the patient the opportunity to ask questions and clarify points) and in writing (Figure 17.10), so the patient does not have to remember everything they have been instructed to do. It is important that the patient understands that most postoperative complications occur because of disturbance to the blood clot which forms in the area, and that they should avoid this happening wherever possible. Postoperative instructions should include the following points:

- Pain, swelling or bruising may occur after the procedure.
- Analgesics (**except aspirin**) may be taken as required.
- Alcohol, hot drinks and exercise should be avoided for 24 hours after the procedure.
- No mouth rinsing should be carried out on the day of the procedure.
- Hot salt water mouthwashes should be carried out after each meal, from the day after the procedure for up to 1 week.

- If bleeding does occur, bite onto a cotton pack for up to 30 minutes.
- Give an emergency telephone number for care and advice if problems occur.
- Give details of further appointments if necessary, including suture removal.

What to do after a tooth extraction

Most patients heal quickly and uneventfully after having a tooth extraction. Problems will occur if the blood clot which forms in the tooth socket is dislodged, or if the socket is not kept clean during the healing period.

To avoid dislodging the blood clot you must not do any of the following for the rest of the day:

- Take any exercise or carry out any manual work
- Drink any alcohol or hot drinks
- Smoke
- Rinse your mouth out

Do not eat or drink anything until the anaesthetic has worn off, as you may bite, burn, or scald yourself. Once the anaesthetic has worn off, you may eat cold or warm foods (not hot) but keep the food away from the tooth socket so that the blood clot is not disturbed. Cold or lukewarm drinks may also be taken, but do not rinse them around your mouth before swallowing.

To keep the socket clean you must do the following:

- Use hot salt water mouthwashes after each meal, from the day after the extraction
- Use a teaspoon of salt per glass of water, and use the glassful each time
- Do these for a minimum of three days after the extraction, or as instructed by the dentist
- Do not use other mouthwashes for at least three days
- Avoid touching the socket with your fingers or other objects, as infection may be introduced
- All other teeth must be brushed as usual, but take care around the extraction site

Pain relief

Normal pain killers (such as those used for a headache) can be taken if necessary after the extraction, but do not exceed the stated dose, and do not use aspirin-based pain killers. Aspirin thins the blood by reducing clotting, and its use will allow bleeding to occur. If pain begins several days after the extraction, contact the surgery for advice.

If bleeding occurs after several hours you must do the following:

- Stop whatever caused the bleeding to resume (exercise, rinsing, and so on)
- Place a dampened cotton cloth over the socket and bite firmly on it for at least thirty minutes, and repeat this action up to three times
- Contact the surgery for advice if the bleeding continues after this time

Figure 17.10 Postoperative instruction sheet.

Surgical extractions

Under certain circumstances, a simple extraction cannot be carried out to remove a tooth, and either soft tissue alone or soft tissue and alveolar bone have to be removed so that the dentist can gain access to a tooth or root. Alternatively, with multirooted teeth any root curvatures may make it impossible to remove the tooth whole and the tooth must be dissected into sections with a single root attached, then extracted separately. These procedures are referred to as surgical extractions and may be necessary for any of the following reasons:

- When previous attempts at tooth extraction have left a significant section of retained root in the alveolar bone. Very small apical sections are often left *in situ*, as they cause no problems and sometimes rise to the surface of the alveolar bone some time later, when they can be simply extracted without having to carry out any bone removal to do so, as would have been necessary at the time of the original extraction.
- When a tooth is so grossly carious that attempts at simple extraction are impossible, as the tooth is too rotten to be held by forceps (Figure 17.11).
- When the morphology of the roots makes it unlikely that the whole tooth can be removed simply, especially when the roots are curved so that the tooth cannot be pushed out of the socket in one direction alone (Figure 17.12).
- When the tooth is only partially erupted and impacted, so that full eruption cannot occur and the tooth becomes a stagnation area.
- When the tooth is unerupted and has associated pathology, such as a cyst.
- When the tooth is unerupted and likely to cause future problems with either prostheses or orthodontic treatment.
- When a deciduous tooth has failed to exfoliate because the root has become cemented to the alveolar bone and natural exfoliation cannot occur – the tooth is said to be **ankylosed**.

Figure 17.11 Radiograph of grossly carious upper left second premolar, which will require surgical extraction.

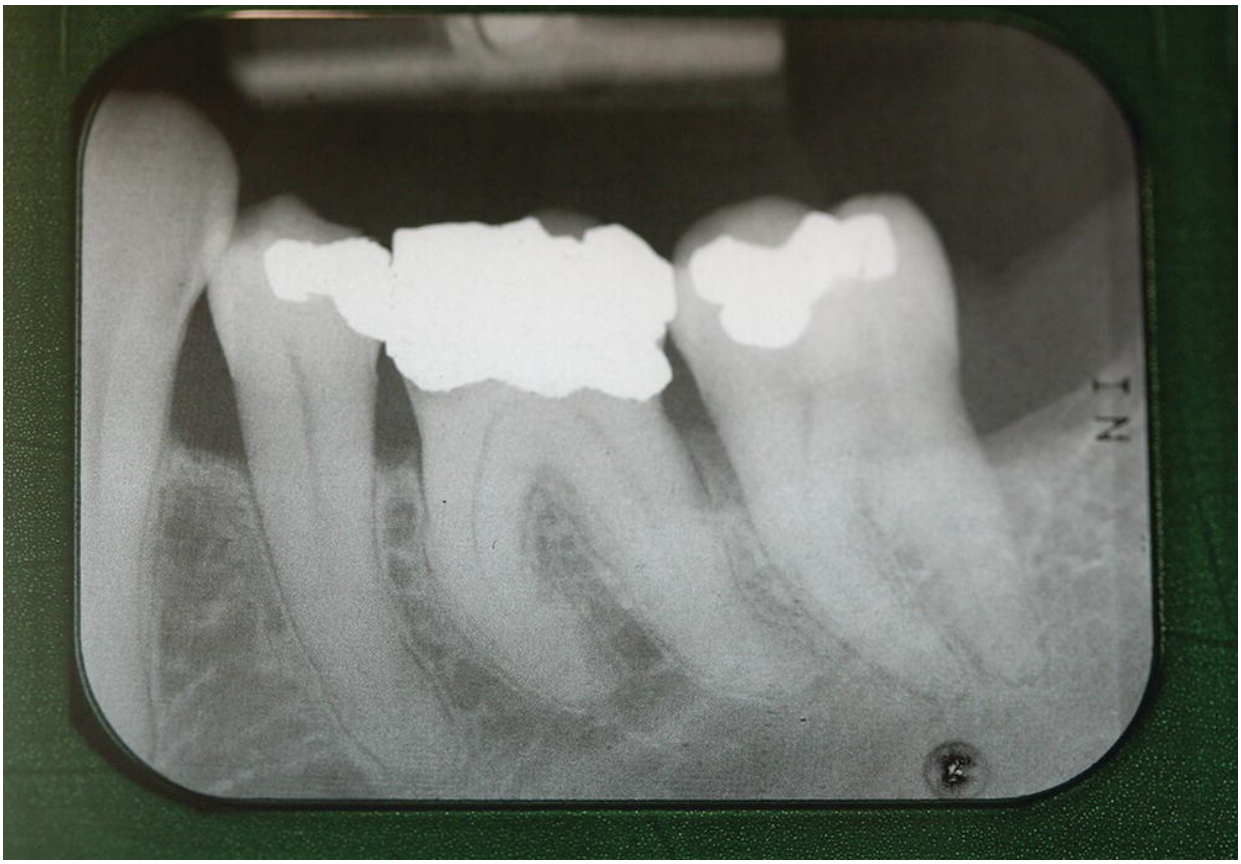


Figure 17.12 Radiograph of posterior teeth with root curvatures, which will require sectioning.

Consequently, surgical extractions will fall into one of the following categories:

- Extraction involving soft tissue exposure.
- Extraction involving tooth sectioning.
- Extraction involving the raising of a mucoperiosteal flap.

The preoperative and postoperative instructions given to the patient have been detailed previously, as is the dental nurse's role during these procedures. What differs from simple extractions is the list of instruments that may be necessary to allow the dentist to gain access to the tooth or root.

Extraction involving soft tissue exposure

Very often when a section of root remains after a previous extraction attempt, the surrounding gingivae will grow over the stump and it will not be visible during routine examination. Bone will not regrow over the stump, although it may be surrounded on all other sides by the original alveolar bone (Figure 17.13). However, when the tooth is replaced with a denture the area may be tender during chewing and the patient may be unable to wear the appliance. Alternatively, the stump may be discovered on radiographing the area before a bridge or implant is provided, and it is decided that surgical removal is required.

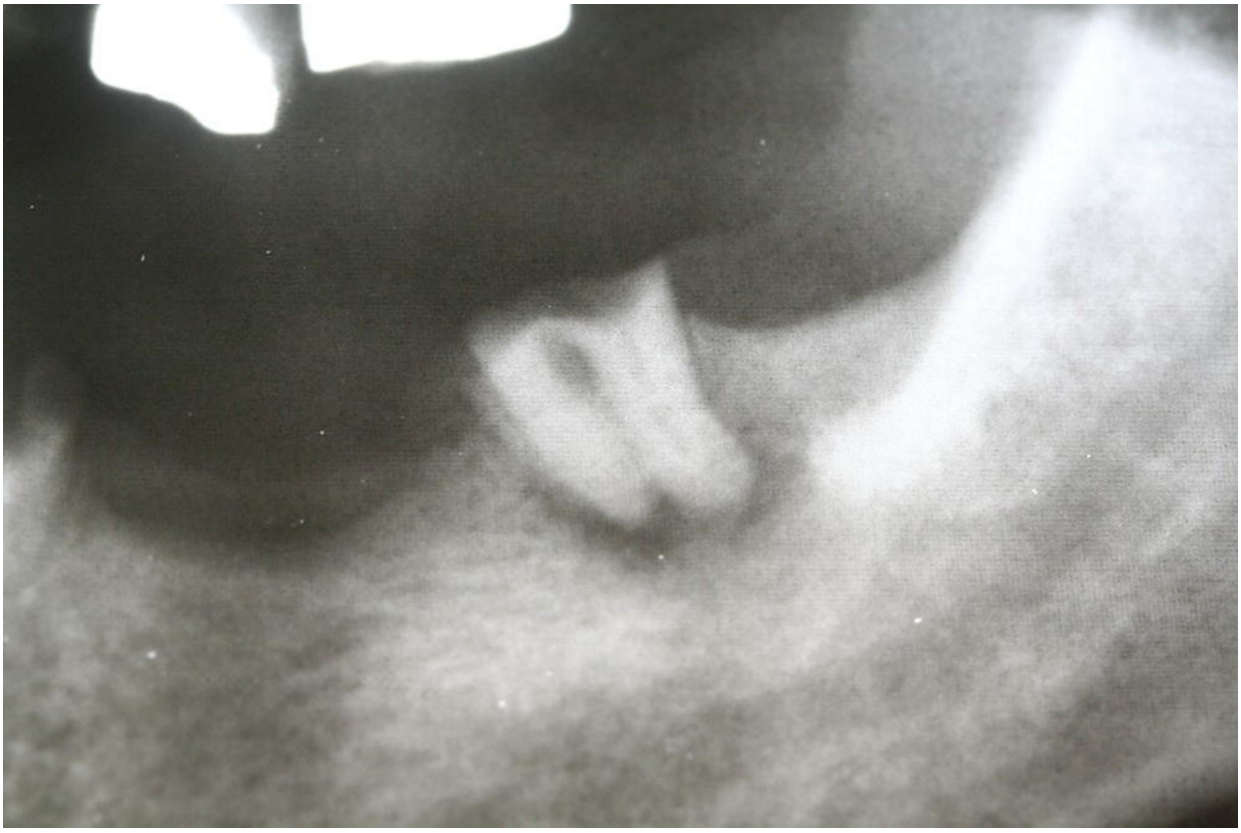


Figure 17.13 Radiograph of retained roots with soft tissue coverage.

Following suitable radiography to determine the position of the retained root, its soft tissue exposure and surgical extraction should be fairly simple, although it may be necessary to use a location device to determine the exact position of the root when lying in an edentulous area. This can be as simple as using a lead foil from an X-ray packet moulded around an available tooth and into the soft tissue

area before X-ray, and then measuring the distance of the root from the foil.

Once located, the soft tissue exposure procedure is as follows:

- A two-sided incision is made over the top of the retained root to expose it.
- This can be peeled back to give greater exposure.
- Once visible, the root stump is loosened from the surrounding bone with the use of a luxator to sever the periodontal ligament attachment and gradually push the root out of the socket.
- Forceps are not used as they often just 'nibble' the top of the stump without providing an adequate hold on it.
- Once the root has been pushed out of the socket and removed, the two-sided flap is simply and fully closed using one or more sutures (see later).

Extraction involving tooth sectioning

Tooth sectioning is effectively a variation on the simple extraction technique for multirooted teeth that cannot be extracted whole. This is often due to unfavourable root curvature or gross root caries that prevents a simple forceps removal of the roots (see Figure 17.12). The dentist can cut the tooth into a number of sections equal to the number of roots present, and then effectively extract each one as a separate root in the usual way, using forceps, elevators or luxators.

Sometimes, it may be necessary to remove some of the septal bone that lies between the roots and forms the individual socket walls. The only differences in the tooth sectioning technique from that of simple extractions are as follows:

- Use of high-speed turbine and a suitable diamond bur (usually a crown preparation bur, for its greater length) to cut the tooth into sections down towards the furcation area.
- Use of a Coupland's chisel to achieve the final separation of the roots, by inserting the chisel into the drilled slot between the tooth sections and twisting to snap them apart.

- Use of a surgical handpiece and bone burs to remove any septal bone.
- Use of high-speed suction to remove the water coolant of the handpieces.
- Careful retraction and protection of the patient's soft tissues during the cutting and sectioning procedures.

Extractions involving mucoperiosteal flaps

There are certain cases when successful extraction cannot be carried out without gaining full access to a tooth or root by raising a mucoperiosteal flap, as listed below.

- Unerupted or impacted tooth.
- Buried retained root if a simple soft tissue exposure cannot be performed.
- Root curvature is excessive and requires extensive bone removal.
- Gross root caries prevents adequate instrumentation to extract the tooth in any other way.

Teeth lie in sockets of alveolar bone, with a covering of mucoperiosteum over the bone which runs into the gingivae around each tooth (see Chapter 10). The mucoperiosteum is tightly held onto the bone and has to be cut and separated to its full thickness before bone removal can be carried out – this is the *mucoperiosteal flap* (Figure 17.14).

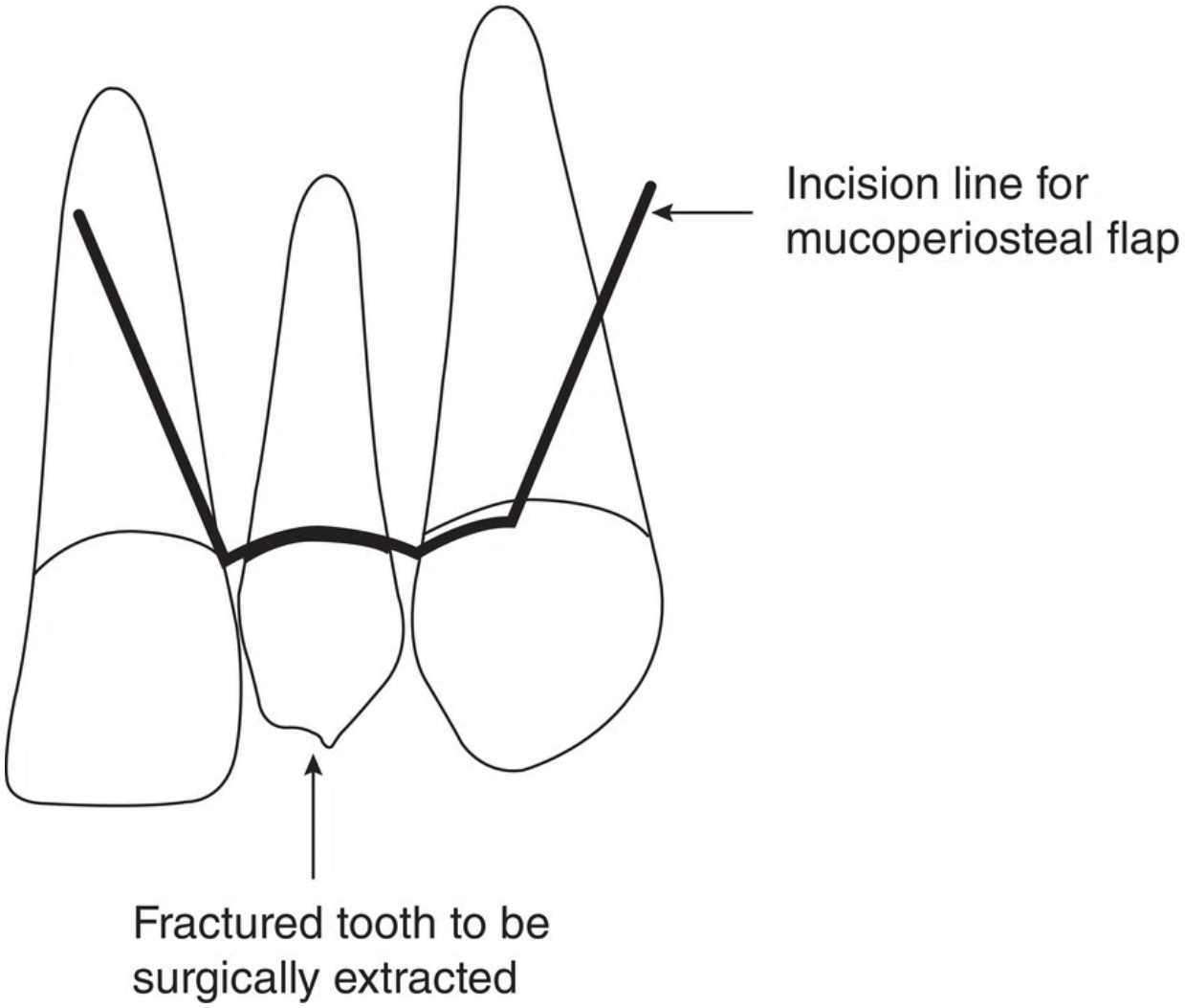


Figure 17.14 Three-sided surgical flap design.

The flap thus raised has to have a wide base to ensure a good blood supply, so that full healing occurs once the procedure has been completed. It then has to be sutured accurately back into place for long enough so that reattachment can occur (usually around 7 days).

This is a full surgical technique so all the surgery and instrument preparation as described for simple extractions apply but more specific surgical instruments are required. These are detailed in Table 17.2.

Table 17.2 Surgical instruments for flap procedures.

Item	Function
Scalpel blade and handle (Figure 17.15)	To make the initial incision through the full-thickness mucoperiosteum and around the necks of the teeth to create the flap
Osteotrimmer (Figure 17.16)	To raise the corners of the flap off the underlying alveolar bone
Periosteal elevator (Figure 17.17)	To complete the elevation of the flap off the bone, by pushing the instrument over the bone surface beneath the flap and effectively peeling it off the bone
Handpiece and surgical burs	To remove any alveolar bone necessary to gain access to the tooth or root
Irrigation syringe	To irrigate the surgical field with sterile saline or sterile water, although the handpiece often has its own irrigation supply from the bracket table bottle
Austin and Kilner retractors	To protect and retract cheeks, lips and tongue from the surgical field, providing clear access for the dentist
Rake retractor	To retract the mucoperiosteal flap itself
Bone rongeurs	To nibble away bony spicules and produce a smooth bone surface for healing
Dissecting forceps (Figure 17.18)	To hold the loose flap edges taut during suturing
Needle holders (Figure 17.19)	To hold the prethreaded needle firmly while suturing
Suture pack (Figure 17.20)	Half-moon needle, prethreaded with either black braided silk or a resorbable suture material such as vicryl, to suture the flap back into position over the alveolar bone

Item	Function
Suture scissors (Figure 17.21)	To cut the suture ends after each stitch

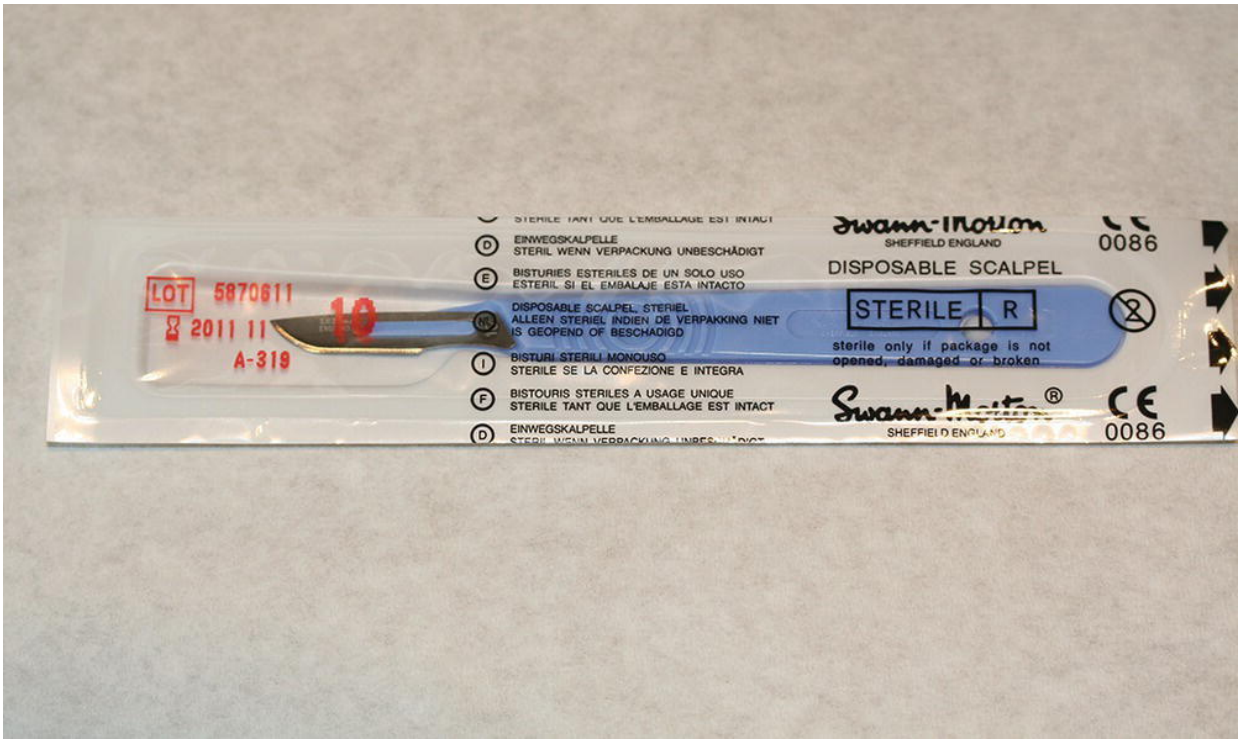


Figure 17.15 Sterile scalpel blade and handle.

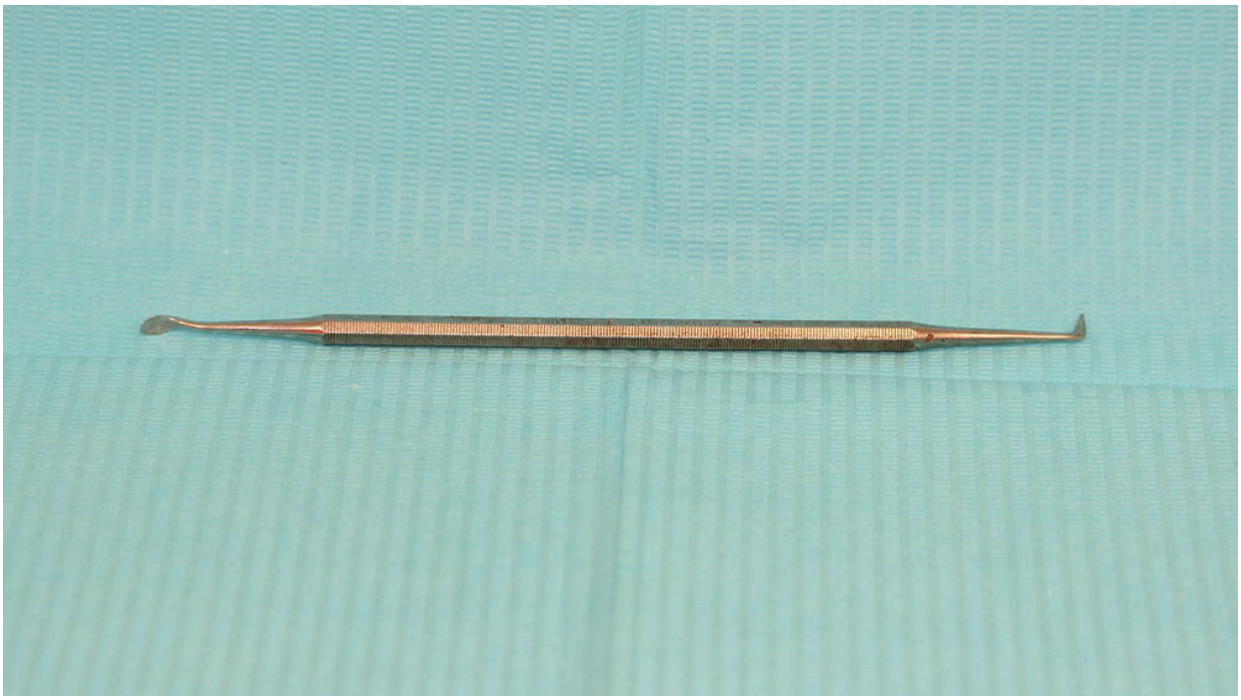


Figure 17.16 Mitchell's trimmer.

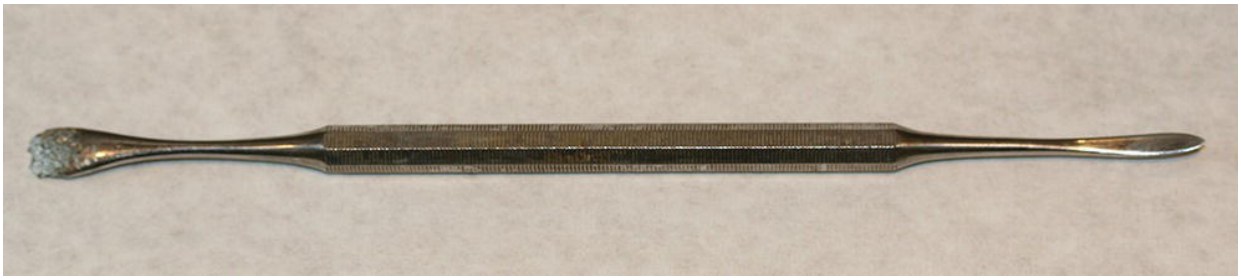


Figure 17.17 Periosteal elevator.

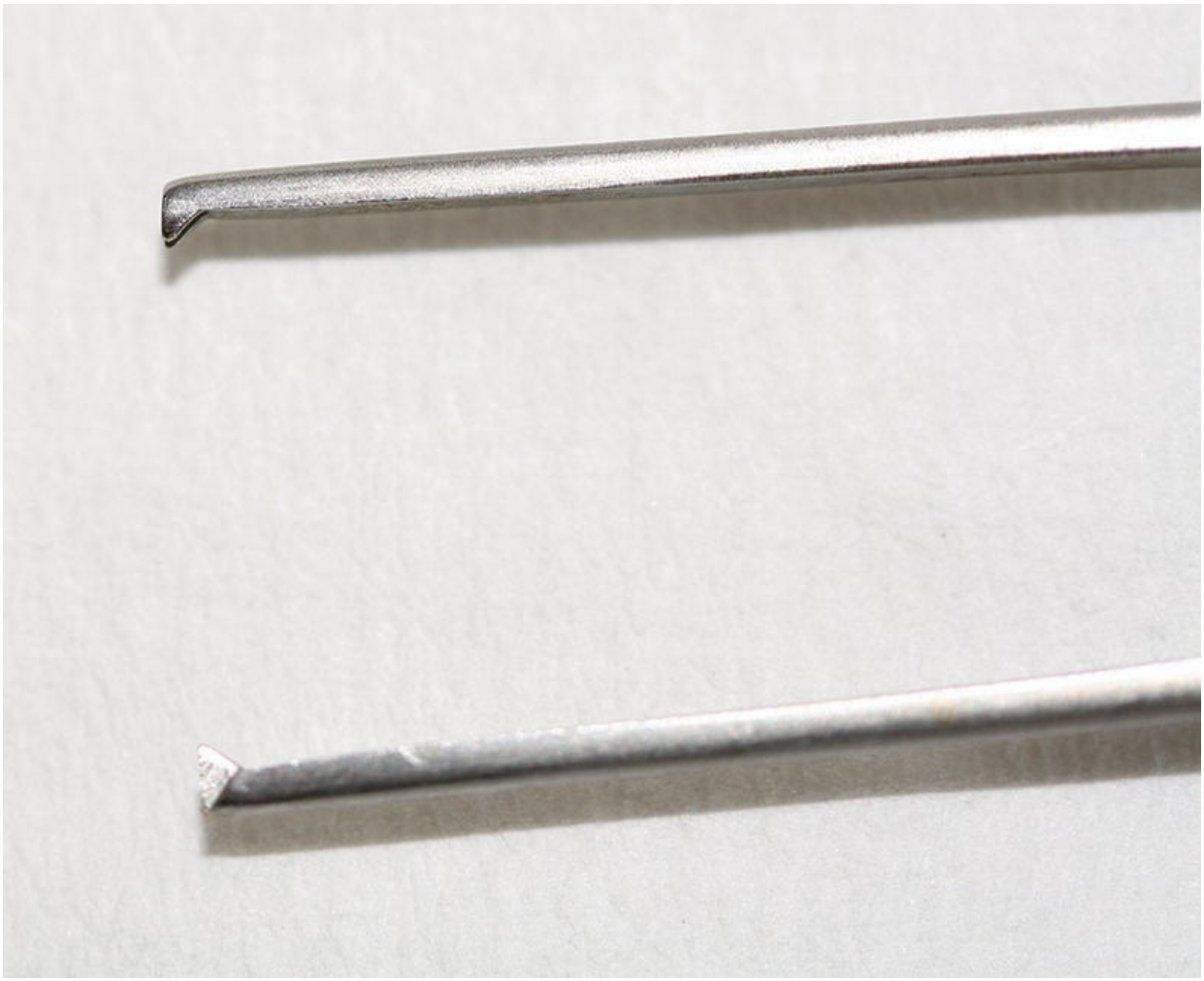


Figure 17.18 Tissue dissecting forceps: end detail.

Figure 17.19 Example of needle holders.

Figure 17.20 Suture pack.

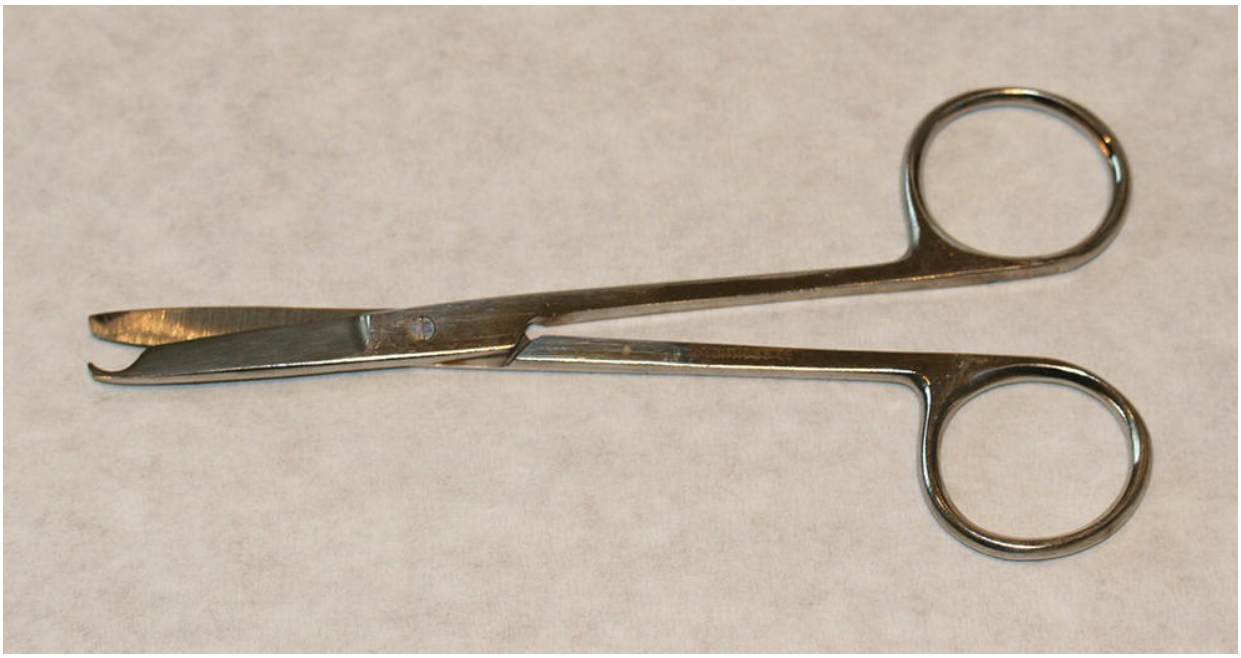


Figure 17.21 Suture scissors.

The principle of the sterile field and the maintenance of thorough infection control are of great importance in preventing any contamination complications during the procedure. Patients with a compromised medical history may require the surgical procedure to be carried out in a hospital or dental clinic environment.

The dental nurse has specific roles to perform during the flap procedures, over and above all those previously identified.

- Correct and accurate use of suction equipment to remove water coolants and irrigation solutions.
- Correct and accurate use of fine-bore surgical aspirator to remove blood and debris from the immediate surgical site.
- Careful retraction of soft tissues for their protection and to provide a clear operative field, but without being so forceful that tissue damage occurs.
- Assisting during the placement of sutures, which may include holding the flap taut and cutting the suture ends.
- Preparation of bite packs to aid haemostasis.

- Assisting in the placement of haemostats, such as oxidised cellulose or gelatine sponge.

Again, full verbal and written postoperative instructions are given before the patient is discharged, and then the surgery is decontaminated as previously described.

While the records are being written, the number of sutures used is specifically recorded so that all can be accounted for, if they are of the non-resorbable type, at the suture removal appointment.

Tooth impaction

This situation arises when an unerupted tooth is prevented from fully erupting into the oral cavity by having its path blocked by either bone or another tooth, so that it remains stuck in position within the jaw bone, or stuck partially into the oral cavity.

The most usual teeth to become impacted are the lower third molars, or 'wisdom' teeth. These are the last permanent teeth to erupt and are often short of space to do so. The type of impaction that occurs will affect the difficulty of the removal of the tooth.

- **Vertical impaction**: the tooth is upright but impacted into the ramus of the mandible.
- **Horizontal impaction**: the tooth is lying on its side, facing forwards, backwards or across the dental ridge.
- **Mesio-angular impaction**: the tooth is tilted forwards into the second molar tooth (Figure 17.22).
- **Distoangular impaction**: the tooth is tilted backwards into the ramus of the mandible.

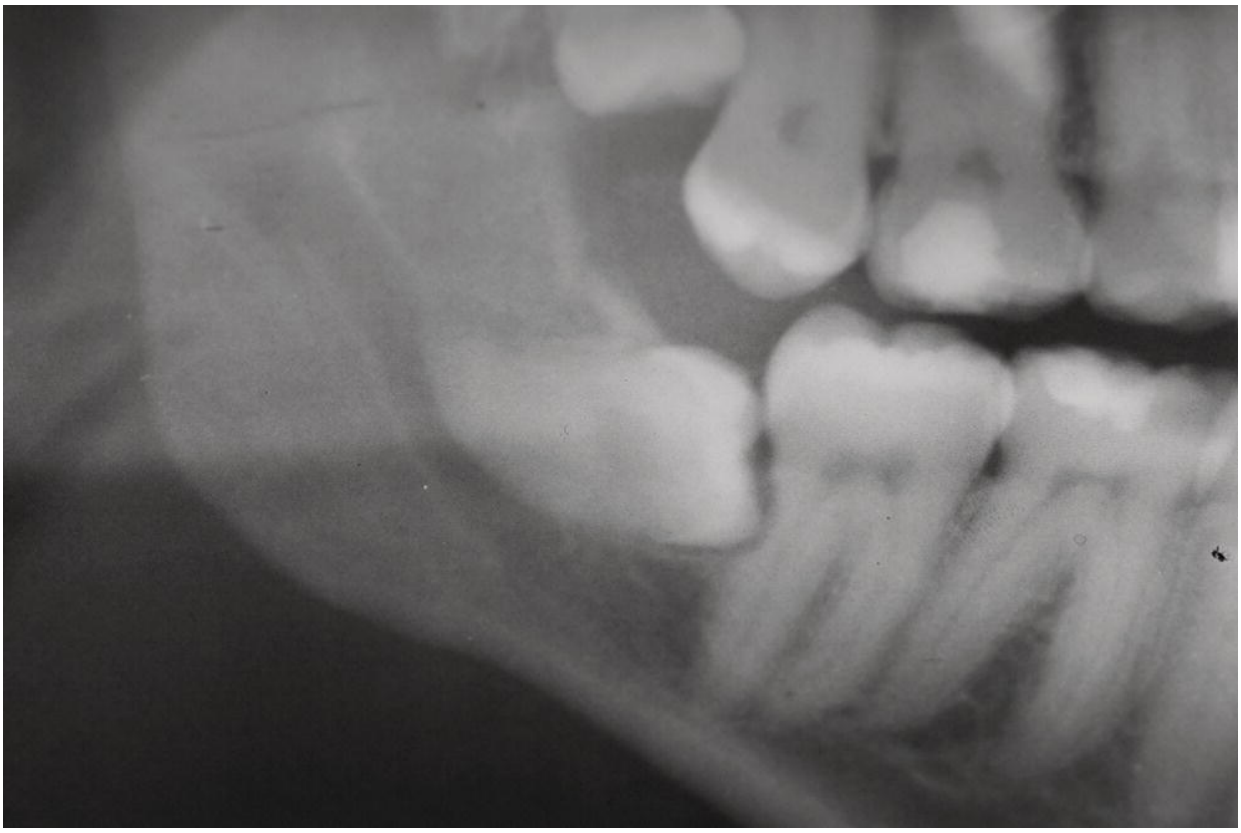


Figure 17.22 Mesio-angular impacted lower third molar.

Some dentists will refer patients with the more difficult types of impaction to a specialist oral surgeon for extraction, if the teeth are persistently infected or are causing food trapping and caries in adjacent teeth. However, if the impacted tooth is causing no problems (that is, it is *asymptomatic*) then it is usual for it to be left *in situ*, as there are risks involved in having the tooth surgically extracted.

- Extensive bone removal can weaken the mandible.
- Postoperative pain and swelling are very likely to occur after a full surgical procedure.
- The inferior dental nerve and lingual nerve lie close to the operation site and can be temporarily or even permanently damaged if they become traumatised or severed during the surgical procedure.
- Limited mouth opening (**trismus**) can occur temporarily after surgery, and this will make eating and talking difficult.

Patients must be warned of all these possible complications before undergoing the surgical extraction procedure.

Complications of extractions

Complications that may occur during extraction include damage to adjacent nerves, fracture of the tooth, perforation of the maxillary sinus and loss of a tooth. Complications that may occur after extraction are bleeding and infection of the bony socket.

Some complications can be highlighted as potential risks that may occur during the extraction procedure, the most common being the possibility of damage to one of the trigeminal nerve branches. This risk can be identified by good preoperative dental radiography and accurate planning of the procedure beforehand. Where there is potential for nerve damage to occur, such as when the roots of lower molars lie very close to the inferior dental nerve, the patient should be referred to a specialist for the procedure and warned of the possibility of nerve damage beforehand, so that informed consent may be given.

Similarly, those medically compromised patients with conditions or medications that may cause problems during extractions (such as haemophiliacs or those taking one of the modern anticoagulants) should also be referred to specialist clinics or hospitals for treatment. Reasons for the occurrence of the other possible complications listed above are as follows:

- **Unexpected tooth fracture**: especially if the tooth is heavily filled or root filled, and this may result in a simple extraction becoming a more complicated one.
- **Bone fracture:** shards of bone from around the socket wall or the bony septum of multirooted teeth often fracture during the extraction procedure, and if not removed can act as 'foreign bodies' and cause localised infection.
- **Oroantral fistulas**: due to a perforation of the maxillary sinus, this can occur while extracting the upper premolar or molar teeth, as the maxillary sinus lies over their roots and is often only separated by a membrane, so perforation of the sinus is sometimes inevitable.
- **Loss of the tooth**: either into the respiratory or digestive tracts or out of the mouth, as a result of it slipping out of the dentist's

grip while pushing the tooth out of the socket or lifting it out of the mouth.

Complications that can occur after the patient has left the surgery are as follows:

- **Bleeding**: either within hours of the extraction (**reactionary haemorrhage**) due to the blood clot being disturbed and reopening torn blood vessels, or after 24 hours (**secondary haemorrhage**) due to an infection developing at the surgical site. **Primary haemorrhage** is bleeding that occurs at the time of the extraction and is a normal occurrence which ceases once the patient's blood has formed a clot in the extraction socket.
- **Infection**: between 2 and 4 days after the procedure and following loss of the blood clot from the socket, the bony socket walls become infected – the condition is called **localised osteitis** (dry socket).

Tooth fracture

A grossly carious or heavily filled tooth is likely to fracture during extraction attempts, and the dentist should be aware of the possibility and warn the patient regarding progression to a surgical procedure if necessary. This progression is likely to occur when the tooth fracture extends subgingivally, as adequate access to the roots may then be difficult without bone removal. Alternatively, root fracture may occur during extraction, especially where the roots are fine or curved, and then require a surgical procedure to remove them.

However, if small apical pieces of root fracture during extraction, they can be left *in situ* to either rise to the alveolar ridge surface by themselves over time, and be more easily removed, or to remain buried and cause no further problems. Whichever occurs, the patient must always be informed of the situation and a full explanation and reassurance given.

Bone fracture

The twisting and rotary movements required to loosen the tooth in the socket during extraction with forceps can sometimes fracture thin

pieces of alveolar bone from around the socket wall, or from the bony septum within the socket which lies between the roots of multirooted teeth. Their fracture can sometimes be felt by the dentist as a sudden 'give' in their extraction efforts, or even heard as a 'crack'. Once the tooth has been extracted, the socket should be visually checked and explored using an instrument such as a luxator tip, and any fractured pieces of bone located. These should be removed from the socket as otherwise they will prevent healing and result in a localised infection of the socket. If a significant portion of bone is fractured and removed, the socket will heal more quickly if the soft tissue edges are closed using sutures. As always, the patient should be fully informed of the event and reassured accordingly.

Oroantral fistula

This is a complication of the extraction of upper premolar and molar teeth only, as the maxillary sinus lies over and between their roots. An inappropriate extraction technique can sometimes push the root into the sinus, where it will act as a foreign body and cause infection. The patient is best referred to a specialist oral surgeon for its removal.

Long-rooted upper molar and premolar teeth sometimes impinge into the sinus naturally, and when they are extracted an opening will be created between the antrum and the oral cavity. This is called an oroantral fistula and, if small, will close naturally within a week, although the patient should be instructed not to blow their nose during this healing period. Indeed, the presence of a fistula can be confirmed by the appearance of air bubbles in the socket when the patient pinches their nose closed and blows.

Large openings require surgical repair either by direct suturing or by raising a gingival flap off the palate and swinging it across to seal the fistula.

Loss of the tooth

The tooth can be dropped during its removal from the mouth, or the force exerted during extraction can cause it to dislodge rapidly from the socket, before a firm grip has been achieved with the forceps.

If the tooth is swallowed, it poses no problem and should be allowed to pass naturally. However, if the tooth is likely to have been inhaled (especially likely if the patient has a coughing fit as the tooth disappears), the patient should be sent to hospital immediately for chest and abdominal radiographs, to locate the tooth, as it could cause a serious respiratory infection. It may be removed using a bronchoscope if lodged in the main bronchi but if it has descended further into the respiratory tract, thoracic surgery may be necessary to remove it.

Bleeding

Haemorrhage during extraction is a natural occurrence, as blood vessels in the periodontium are torn during the procedure. This usually stops within 5 minutes of completion of the extraction with the use of a bite pack and is called **primary haemorrhage**.

When there is no history of previous haemorrhage, haemostatic sponges and/or sutures may still be required if excessive bleeding occurs. This may even be carried out routinely in elderly patients and those with hypertension, as a precautionary measure. In all cases, however, the patient must not be dismissed from the premises until bleeding has ceased.

The blood clots in the following way:

- Torn blood vessels constrict to slow the blood flow.
- **Platelets** circulating in the blood are exposed to air at the wound site. This causes them to become sticky, and clump together.
- Two complicated **clotting mechanisms** ensue, resulting in the protein fibrinogen being converted to fibrin.
- **Fibrin** chemically seals the cut vessels, and the haemorrhage ends.

Bleeding which occurs several hours after the extraction is called **reactionary haemorrhage** and is usually caused by the patient not following the postoperative instructions accurately and disturbing the blood clot, either by using a mouthwash or taking alcohol or exercise.

In healthy patients, it is easily controlled by reapplication of pressure to the socket, reiteration of the postoperative instructions or by suturing of the socket to compress the wound edges and promote clotting again, possibly with the insertion of a haemostatic sponge too.

An additional cause of primary haemorrhage is failure of the blood-clotting process so that uncontrolled bleeding occurs. This is an uncommon but very serious matter, occurring in patients taking anticoagulant drugs, those with liver disease, and with some rare blood diseases such as haemophilia. Patients with such conditions should have been identified by the completion of a thorough medical history beforehand, or they may carry a warning card for presentation to any practitioner they attend. In particular, patients with certain heart conditions may be prescribed the anticoagulant drug *warfarin*. The effectiveness of their blood clotting will be regularly monitored by undergoing a blood test to determine their INR score and this will indicate whether extractions can be safely carried out in a dental practice or whether the patient requires a hospital referral. Current practice is for patients with an INR score of more than 4 to be treated in hospital for surgical procedures, including extractions. If excessive bleeding then occurs, the patient can be given vitamin K to safely reverse the effects of the warfarin.

Patients taking aspirin to prevent a stroke should be treated carefully when undergoing surgical procedures in the practice, and the use of a haemostatic sponge and suture may be required as a matter of routine to avoid complications. Similarly, patients taking one of the modern anticoagulants (such as clopidogrel) should be treated with extreme caution in the practice setting, as unlike warfarin there is no antidote available to reverse the anticoagulant effect of these medications.

The third type of bleeding complication is **secondary haemorrhage**, where the blood clot is lost early (before the socket has undergone adequate healing) and the socket subsequently becomes infected, with breakdown of the healing mechanism. This occurs after 24 hours from the extraction being carried out. Cleansing of the socket, then pressure and the insertion of a haemostatic sponge should solve the problem.

Infection

The condition of infection of the extraction socket is called localised osteitis (dry socket) and is a very painful condition which develops 2–3 days after extraction. It is an acute inflammation of the bone (*osteitis*) lining the socket and is caused by microbial invasion. The natural protective barrier against such invasion is the blood clot which fills the socket immediately after an extraction, so anything which prevents formation of an adequate blood clot can give rise to a dry socket, such as:

- infection of the blood clot
- failure of formation of a blood clot
- disturbance of the blood clot.

Infection of the blood clot may occur in neglected mouths where gingival or periodontal infection is already present, and also is particularly likely to occur in patients who smoke. Hordes of micro-organisms invade the socket, overwhelm the defending white cells, disintegrate the blood clot and set up an acute inflammation of the unprotected bare bone of the socket. Pre-extraction scaling of the teeth reduces gingival infection and may prevent a dry socket. Alternatively, application of chlorhexidine to the gingival crevice just before extraction helps to reduce the risk of infection.

Failure of formation of a blood clot may occur in difficult extractions, as pressure on the bone during such an extraction crushes the blood vessels and results in insufficient bleeding to produce a protective blood clot. It is more common in the mandible than maxilla as the former has a thicker layer of compact bone.

Disturbance of the blood clot is caused by too much mouth washing soon after extraction or by the patient poking at the extraction socket, especially with dirty fingers. This breaks away the blood clot and leaves the socket bare, allowing the introduction of micro-organisms to the immediate vicinity.

To treat the condition, any food debris or necrotic clot tissue is removed with gentle irrigation and the use of tweezers, and then a sedative dressing (such as Alvogyl) is carefully placed in the socket. Irrigants such as sterile saline solution, local anaesthetic solution or purified water are ideal for this purpose, but the use of chlorhexidine

as a socket irrigant is no longer recommended following the death of several patients after its use in this situation. It is believed the unfortunate patients had allergy-type reactions to the solution as it contacted the bony socket. The pain experienced by the patient suffering with a dry socket can be relieved with the usual anti-inflammatory analgesics, and it is best if the postoperative instructions are reiterated, in particular the use of hot salt water mouthwashes and the avoidance of smoking.

The dental nurse's duty

Sometimes the dentist is away from the workplace when a patient returns with post-extraction haemorrhage. In such a case it is the dental nurse's duty to reassure the patient that the condition is not likely to be serious and should be easily remedied. After obtaining full details about the patient and the extraction, the dental nurse must contact the dentist for instructions.

Meanwhile, the patient is made more comfortable by the provision of a mouthwash to be carefully and gently rinsed around the mouth to remove the unpleasant taste and cleanse the area, without vigorously swishing the solution into the socket. Then, unless instructed to the contrary, the dental nurse may give the patient a pressure pad (bite pack) to bite on until the dentist arrives. While awaiting the arrival of the dentist, the dental nurse should switch on the autoclave and prepare the surgery for a possible suture procedure. Mouth mirror, tweezers, cotton wool, swabs, suction, haemostatic drugs, local anaesthetic and suture equipment may be required.

If the dental nurse is unable to contact the dentist, and a pressure pad is ineffective, help may be sought from an emergency dental service, the patient's doctor or a local hospital.

Accidental extraction

This is the term used to describe the unplanned situation where a tooth is lost from its socket unexpectedly and can occur for several reasons. One example is the removal of an unerupted premolar while extracting its deciduous predecessor. As a premolar crown is

surrounded by the deciduous molar roots (Figure 17.23), it can be dislodged or completely extracted together with the deciduous tooth.

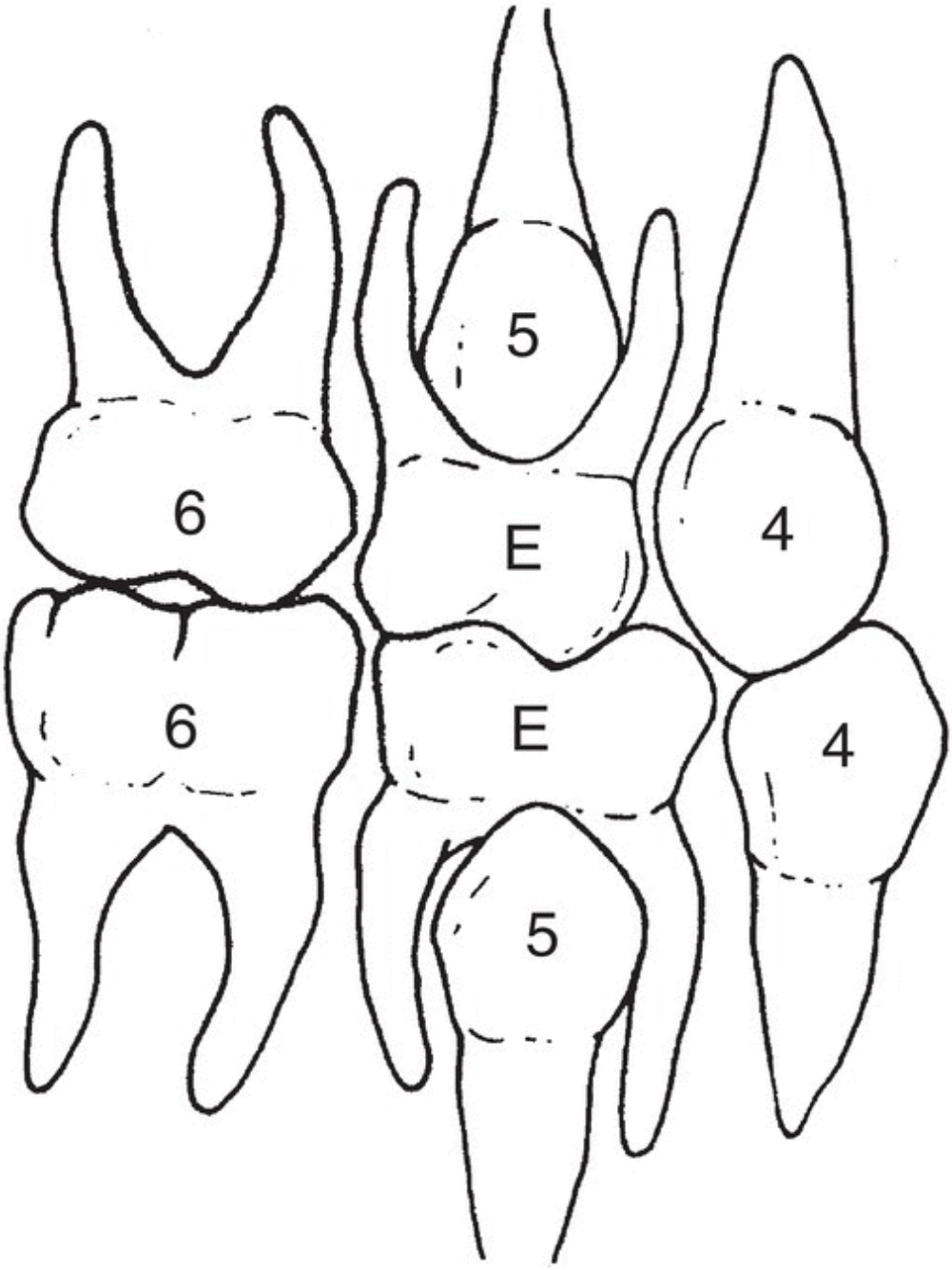


Figure 17.23 Deciduous second molars and premolar successors.

Source: Foster, T.D. (1990) *A Textbook of Orthodontics*, 3rd edn, Blackwell Scientific Publications, Oxford. Reproduced with permission of John Wiley and Sons.

Fortunately, the accidentally extracted premolar can be saved by immediately replanting it in its socket. The periodontal membrane and pulp should retain their vitality and the tooth subsequently erupts normally. Success is accomplished by immediate replacement, which gives no time for the periodontal membrane to become infected or dried out.

The same procedure can be adopted if a child's tooth, usually an incisor, is knocked out by a fall or a blow. Such a tooth is said to be *avulsed*. As long as the periodontal membrane remains vital, the tooth can be pushed back into its socket, with complete success in many cases. This type of accident constitutes a dental emergency and it is essential that correct first-aid treatment is applied before the child reaches the dental workplace. The following advice should be given to the person reporting the accident:

- Reassure the child (and the parent) that successful treatment is possible.
- Retrieve the tooth and, holding it by its crown only, rinse it gently in warm water.
- The root of the tooth should not be handled in any way.
- Instruct them not to use any type of disinfectant or mouthwash solution to rinse the tooth.
- Put the tooth back into its socket, it they feel able to do so.
- If that is not possible, let the tooth lie loose in the child's own mouth to keep it moist in saliva, although care should be taken with younger patients to avoid choking.
- If that is impracticable, immerse the tooth in a container of milk.
- The tooth must not be wrapped in anything but should be left bathing in the milk.
- Come to the surgery immediately.

Once the tooth has been replanted in its socket and an X-ray taken, no further treatment may be necessary, but a splint is sometimes required to immobilise it for a week or so, followed by root filling if the tooth becomes non-vital.

Use of antibiotics with minor oral surgery

As previously stated, many extractions are carried out because the patient presents with the pain of an acute infection. Previously, antibiotics were often prescribed for these patients as the first line of treatment (especially if the patient attended without an appointment), and the dental problem would be dealt with at a later date. Current thinking is that antibiotics:

- are an adjunct to treatment only so are to be used as a back-up to treatment, not as a replacement for it
- should only be given if there is evidence that the infection is spreading locally
- should only be given if there is evidence of systemic involvement (raised body temperature is a good indicator) or if the patient has a predisposing medical condition which necessitates antibiotics during treatment.

The routine use of antibiotics is contraindicated for the following reasons:

- The source of the infection is better removed by extracting the tooth or by lancing any abscess present and draining as much pus as possible from the area.
- Resistant strains of bacteria are more likely to develop if antibiotics are overprescribed.
- A single course of antibiotics can have long-term consequences for the normal bacterial flora in the body, possibly lasting for months.
- The dangerous potentiating action that antibiotics have on several drugs, especially oral anticoagulants: they increase the blood-thinning effect of the anticoagulants so that haemostasis cannot be achieved.
- The possibility of other drug interactions, especially with oral contraceptives and alcohol.

- The development of hypersensitivity to the antibiotics by the patient, preventing their use in future.
- All drugs should be avoided wherever possible during pregnancy.

If antibiotics do need to be prescribed, the following regimens are currently recommended:

- First choice: amoxicillin 500 mg, three times daily for 5 days.
- Second choice: metronidazole 200–400 mg three times daily for 3 days.
- Third choice: erythromycin 250 mg four times daily for 5 days, for patients who are allergic to penicillin and its derivatives.

In severe infections and where more than one type of micro-organism may be involved, the first and second choices can be given together.

Other minor oral surgery procedures

Operculectomy

This procedure is the surgical removal of the gingival flap (operculum) overlying a partially erupted tooth, especially a lower third molar, which lies at the point closest to the hinge of the jaw and therefore has the least room for clearance when the mouth is closed. Consequently, the operculum overlying a third molar is most likely to be bitten by the opposing tooth during normal chewing movements.

As teeth begin to erupt, the overlying gingiva is pushed up into the mouth and bulges over the tooth until its incisal or occlusal surface breaks through into the oral cavity. However, in some patients, this gingival bulging over the lower third molars means that the area is constantly bitten and traumatised by the upper teeth when the mouth is closed, causing pain and inflammation in some cases.

As the area becomes more painful, the patient often reduces their oral hygiene efforts, which then compounds the issue by allowing plaque and food debris to collect further, and eventually an infection will develop – this is called *pericoronitis*. In severe cases, the patient develops *trismus* and is unable to fully open their mouth.

Treatment is as follows, in order of lesser to greater severity of the symptoms:

- Oral hygiene instruction, to ensure the regular removal of food debris and plaque.
- Irrigation of the underside of the flap to remove debris, using chlorhexidine or an oxygen-releasing solution, such as Peroxyl mouthwash (see Figure 13.13), which is particularly useful at fighting the anaerobic bacteria involved in the infection.
- The use of anti-inflammatory analgesics, such as *ibuprofen*, to reduce the inflammation and ease the symptoms.
- The surgical removal of the operculum if the problem recurs, ideally using an electrosurgical cautery unit (Figure 17.24) rather than conventional techniques using a scalpel blade, as the control of haemorrhage with the unit is far superior.

- The unit uses an electric current running through a wire-tipped probe to act as an ‘electrical knife’ which cuts the soft tissues it contacts, at the same time burning (cauterising) the ends of any severed blood capillaries so that no bleeding occurs.
- A 3-day course of metronidazole antibiotics, to destroy the anaerobic bacteria involved.

Figure 17.24 Electrosurgical cautery unit.

Alveolectomy and alveoplasty

These are procedures carried out to remove pieces of the alveolar ridge or smooth and alter its shape, respectively.

When teeth have been extracted, the edges of the sockets can sometimes remain as sharp spicules of bone which make the wearing of dentures impossible without discomfort to the patient. The quality of the alveolar ridge can easily be seen on a radiograph and, where appropriate, the spicules and sharp edges can be removed so that dentures can be worn. A mucoperiosteal flap must be raised to gain access to the ridge, and then bone rongeurs (Figure 17.25) or surgical burs are used to remove all the bony projections. The procedure may

also be carried out to provide a smooth surface before the placement of implants.

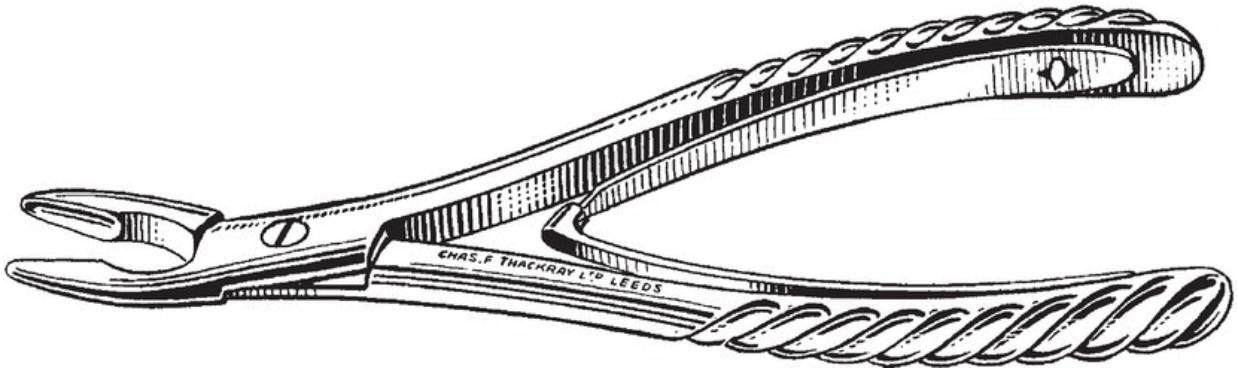


Figure 17.25 Bone rongeurs.

Alveoplasty is carried out to alter the shape of the ridge so that deep undercuts are removed and dentures can seat correctly and comfortably.

Gingivectomy and gingivoplasty

These are periodontal surgery techniques that are carried out to adjust the shape of the gingivae and aid oral hygiene measures so that more effective plaque removal is possible, or to lengthen the crowns of the teeth before restoration.

Sometimes, successful treatment of periodontal disease is hindered by failing to eliminate established false pockets, and they can be surgically removed by the technique of gingivectomy. This is the removal of a strip of gingival margin level with the the point of the epithelial attachment (Figure 17.26). It is mainly confined to cases with excessive overgrowth of gum (*gingival hyperplasia*) caused by certain drugs used for medical conditions: phenytoin (for epilepsy), nifedipine (for hypertension) and ciclosporin (following organ transplant).

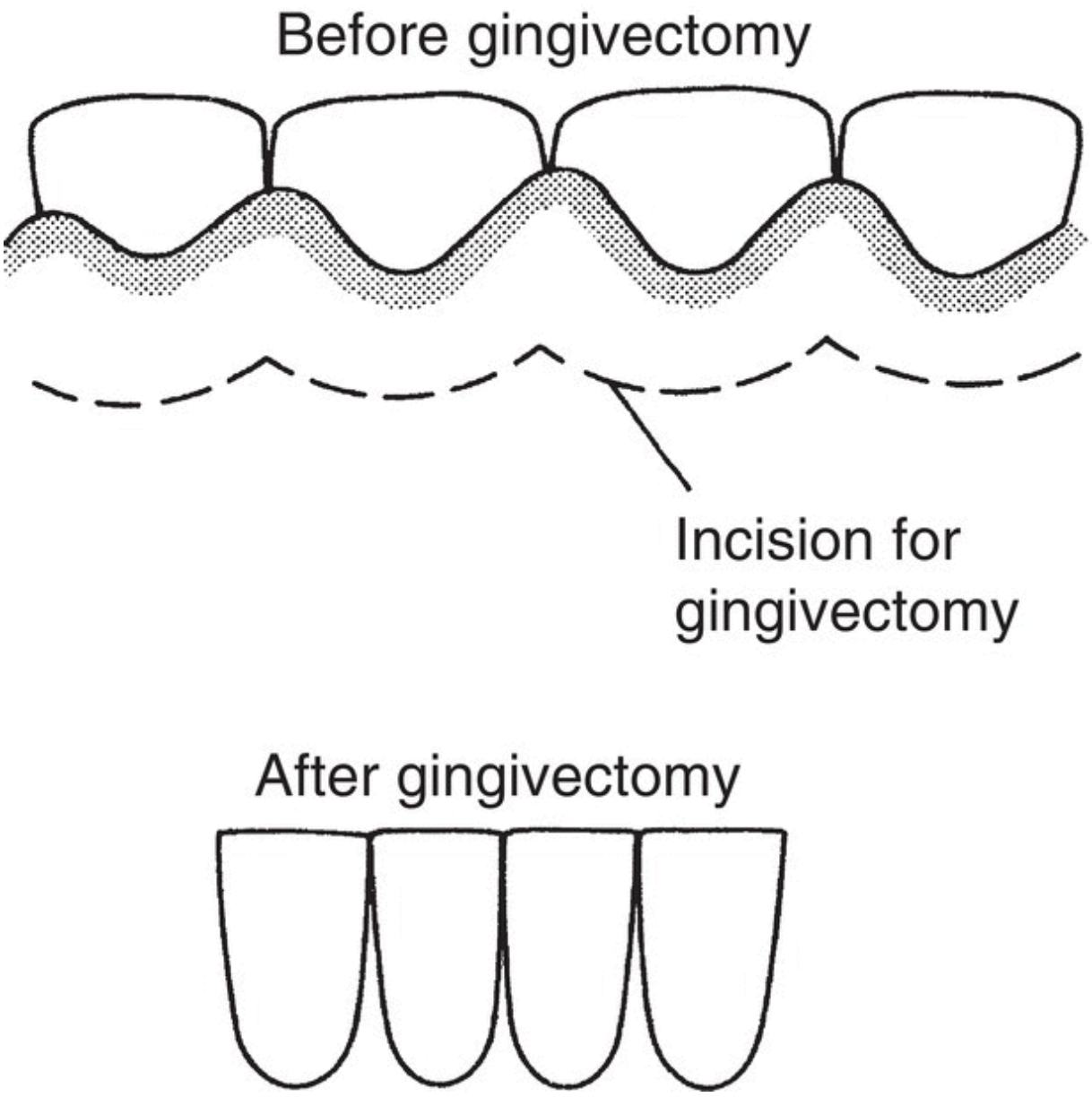


Figure 17.26 Gingivectomy procedure showing the incision line following the contours of the inflamed gingivae, and afterwards with the inflamed section of gingivae removed so that the teeth are visible again.

The excess gum is removed with a *gingivectomy knife* or one used for periodontal flap surgery (see later). There are many different types of gingivectomy knife available with various angled handles and blades for ease of access, the most common being Blake's gingivectomy knife (Figure 17.27). The strip of incised gum is removed with tweezers and the raw area covered with a zinc oxide/eugenol *periodontal pack*,

such as Coe-Pak, to protect the gum and promote rapid painless healing. The pack is removed about a week later and thorough scaling is then performed.

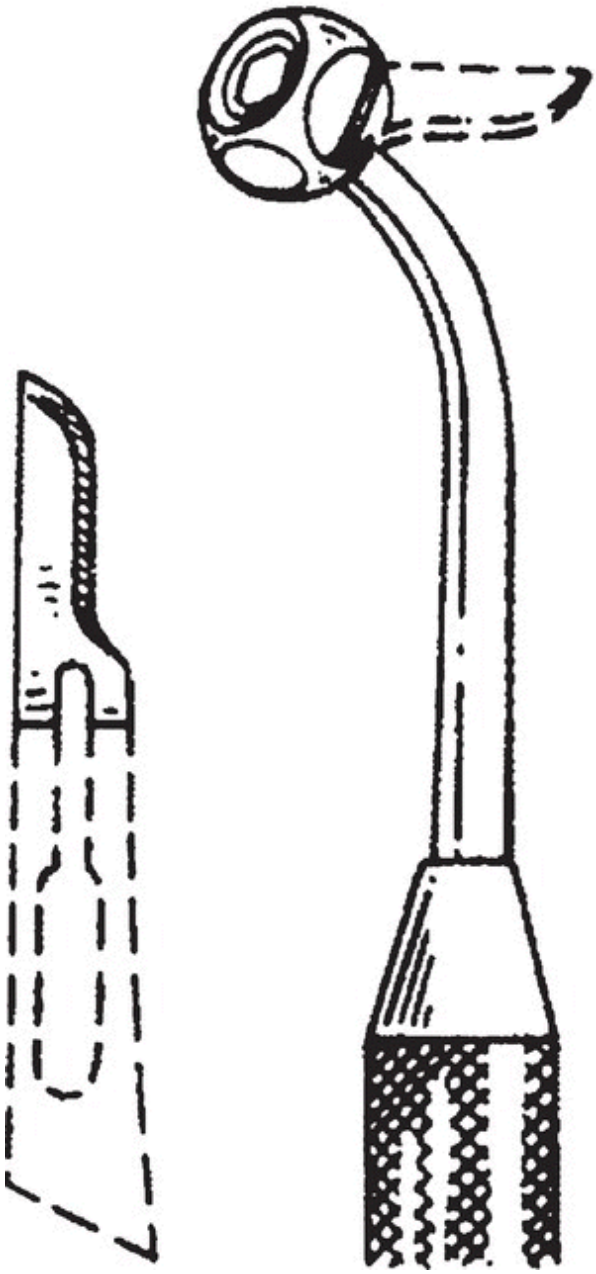


Figure 17.27 Blake's gingivectomy knife.

A technique similar to gingivectomy may also be necessary for exposing more root surface prior to crown preparation, in cases where there would otherwise be insufficient retention for a crown. This procedure is called *crown lengthening*.

Surgical recontouring of the gingiva can also be carried out once periodontal health has been established, to help the patient in their efforts to thoroughly cleanse the area by providing better access for oral hygiene devices, such as interdental brushes. This technique is called *gingivoplasty* and is often carried out using an electrosurgical cautery unit which cuts and coagulates bleeding tissues at the same time (see Figure 17.24).

Following gingival surgery, patients are given or prescribed analgesic drugs to relieve afterpain, given an appointment for removal of sutures or pack a week later, and instructed to avoid smoking, eating hard food and using a toothbrush on the operative area meanwhile. A soft diet and chlorhexidine mouthwashes are advised instead.

Periodontal flap surgery

Periodontal conditions which do not respond to plaque control procedures, such as meticulous oral hygiene by the patient and subgingival scaling by a dental operator, may require treatment by minor oral surgery procedures. They are performed under local anaesthesia and may be undertaken by the patient's own dentist or by referral to a periodontal specialist.

Periodontal flap procedures use techniques and instruments similar to some of those described previously for the surgical extraction of an unerupted tooth, but they do not involve the raising of a full mucoperiosteal flap. They cover a variety of procedures to remove inaccessible subgingival plaque and facilitate subsequent plaque control. Teeth with irregular gingival pocketing, a complex and uneven pattern of bone loss or involvement of the *furcation* (the branching of roots of multirooted teeth) are those most likely to need such operations (Figure 17.28).

- The incision is made through the gingival papilla of the tooth, down to the tooth surface, so that the layer of gingiva in contact with the tooth and forming the inner wall of the periodontal pocket is separated from the remainder of the gingival tissues.
- This severed piece of tissue is removed from the area.
- The remaining gingival flap is then reflected to expose the underlying bone, root surface and all the hidden subgingival

calculus.

- Alveolar bone surfaces may then be trimmed and contoured to eliminate bony pockets.
- All subgingival plaque and calculus are removed, using curettes or an ultrasonic scaler.
- In addition, all contaminated cementum and any toxin-impregnated granulation tissue are removed.
- Local delivery antibiotic/medicament systems such as Gengigel, Dentomycin or PerioChip may then be placed in these inaccessible areas, to help the healing process (see Figures 13.25 and 13.26).
- The flap is then sutured back into place.
- There is no removal of full-thickness gingival tissue but the gingival margin may be repositioned more apically (towards the root tip), and thus permanently expose more of the root to make cleaning easier in future.
- While this technique gives a 'long in the tooth' appearance, it should avoid the need for tooth extraction otherwise.

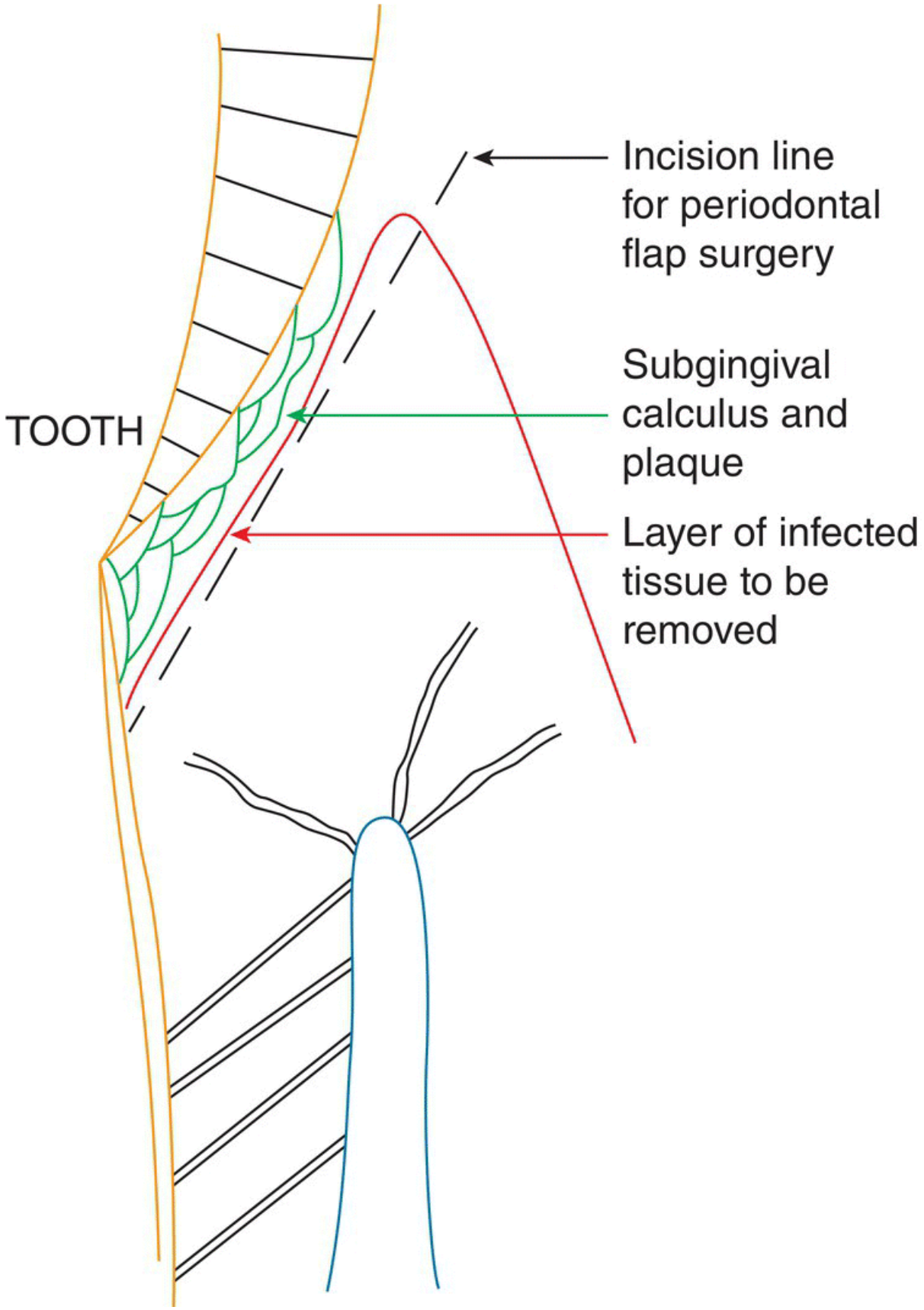

Incision line
for periodontal
flap surgery
Subgingival
calculus and
plaque
TOOTH
Layer of infected
tissue to be
removed

Figure 17.28 Periodontal flap incision.

Soft tissue biopsies

These are procedures carried out to remove a soft tissue lesion from the mouth, to be sent away for pathological examination and diagnosis. Large lesions may have just a section of tissue removed and these are referred to as *incisional biopsies*. Ideally, and certainly with smaller lesions, the whole of the tissue lesion is removed, and these are referred to as *excisional biopsies*.

It is usual for the patient to be referred to a hospital dental department for these types of procedure to be carried out by an oral surgery specialist, as incomplete removal of a sinister lesion (such as oral cancer) may make its treatment ultimately more difficult or even risk spreading cancerous cells more widely.

Cyst removal

A cyst is a fluid-filled sac confined within a soft tissue lining. There are many different types found in various parts of the body. In dental practice, they are most commonly seen as an abnormal cavity in the bone, at the apex of a dead tooth (*dental* or *apical cyst*) or surrounding and preventing eruption of an unerupted tooth (*dentigerous* or *follicular cyst*). If left untreated, a cyst gradually enlarges, causing swelling of the jaw and displacement of other teeth. Whenever possible, they are removed, complete with their lining, and invariably by a specialist oral surgeon within the hospital.

Frenectomy

This means the removal of a frenum, which is a band of fibrous tissue, covered with mucous membrane, which attaches the tongue and lips to the underlying bone. If the lingual frenum restricts the movement of the tongue so that speech is affected, a lingual frenectomy is performed. If the upper labial frenum is too large it may allow a wide gap to persist between the upper central incisors – this gap is called a *median diastema*. It can also affect the fit of an upper denture. In such cases an upper labial frenectomy is often undertaken.

Implant placement surgery

There are many different implant systems available, each with their own specific instruments and items to be used and surgical techniques to be followed. Only a basic overview of implant placement surgery is given here, and for those dental nurses with an interest in this area a post-registration Certificate in Dental Implant Nursing qualification is available with the NEBDN. Further information is available at www.nebdn.org.

When a patient is being assessed for their suitability to receive implants, various factors must be considered to ensure that the patient's acceptance of their responsibilities, their level of oral and general health, and their standard of oral hygiene are sufficient to make implant treatment successful in the long term. The patient must be willing to undertake the following:

- Follow all the postoperative advice given at the time of surgery.
- Attend regularly for examinations, even when the implants are replacing all their teeth.
- Maintain a consistently good level of oral hygiene throughout the mouth, including around the implants.
- Seek dental help as soon as any problems become apparent with the implants.

Before accepting the patient for implant treatment, the dentist will assess them to determine the following individual factors and decide on their suitability for treatment, as well as the implant system to be used.

- Quality of bone in the implant area: usually, the more compact bone present the better
- Sufficient depth of bone to place adequate length implant: usually the longer the better.
    - Maxillary antrum (sinus) may be too close to the alveolar ridge following extraction and bone resorption, and require a **sinus lift** procedure to be carried out.

    - Mandibular ridge in edentulous patients may be severely resorbed and require **bone regeneration** (using artificial bone) or even **bone grafts**.
- Sufficient thickness of bone to place adequate-diameter implant and leave an intact rim of bone around it once placed, usually a 1-mm rim buccolingually/palatally and a 1.5-mm rim from each adjacent tooth (Figure 17.29). Ideally, the implant is the same diameter as the root of the tooth it is to replace.
- Implant placement technique
    - One-stage technique: implant is placed into the bone with its top end protruding through the sutured soft tissue, so that the superstructure restoration (crown, bridge, denture) can be attached immediately.
    - One-stage technique as above, with delayed superstructure attachment and the protrusion covered with a cap while healing and osseointegration occurs.
    - Two-stage technique: implant is placed into the bone with its top end beneath the sutured soft tissues and protected from overlying tissue growth by a cover-screw for several months (Figure 17.30). At the second stage, the implant site is reopened, the cover-screw removed and replaced with a healing abutment which projects into the oral cavity for several weeks, and then is eventually replaced with the final restoration (Figures 17.31 and 17.32).
- Type of implant: usually a two-piece design with the implant body in the bone and a screw-attached abutment at the neck. The final superstructure restoration is attached either with the abutment screw in one piece, or with a luting cement onto the abutment itself (Figure 17.33) in a similar fashion to conventional crowns and bridges.
- Although hollow implants are available, the majority placed in the UK are solid as they have been shown to be stronger over time and therefore less susceptible to fracture.
- When an implant-supported denture is to be placed, the abutments are present as locator housings in the alveolar ridge

which lock into accurately positioned retentive inserts on the fitting surface of the denture.

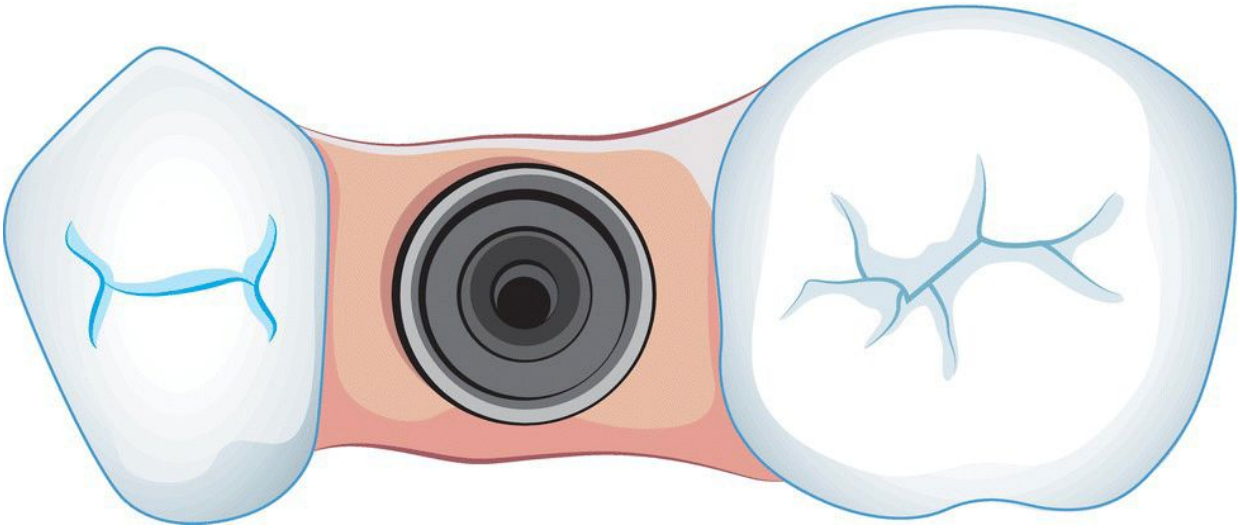


Figure 17.29 Illustration of the correct diameter choice and positioning of the implant.

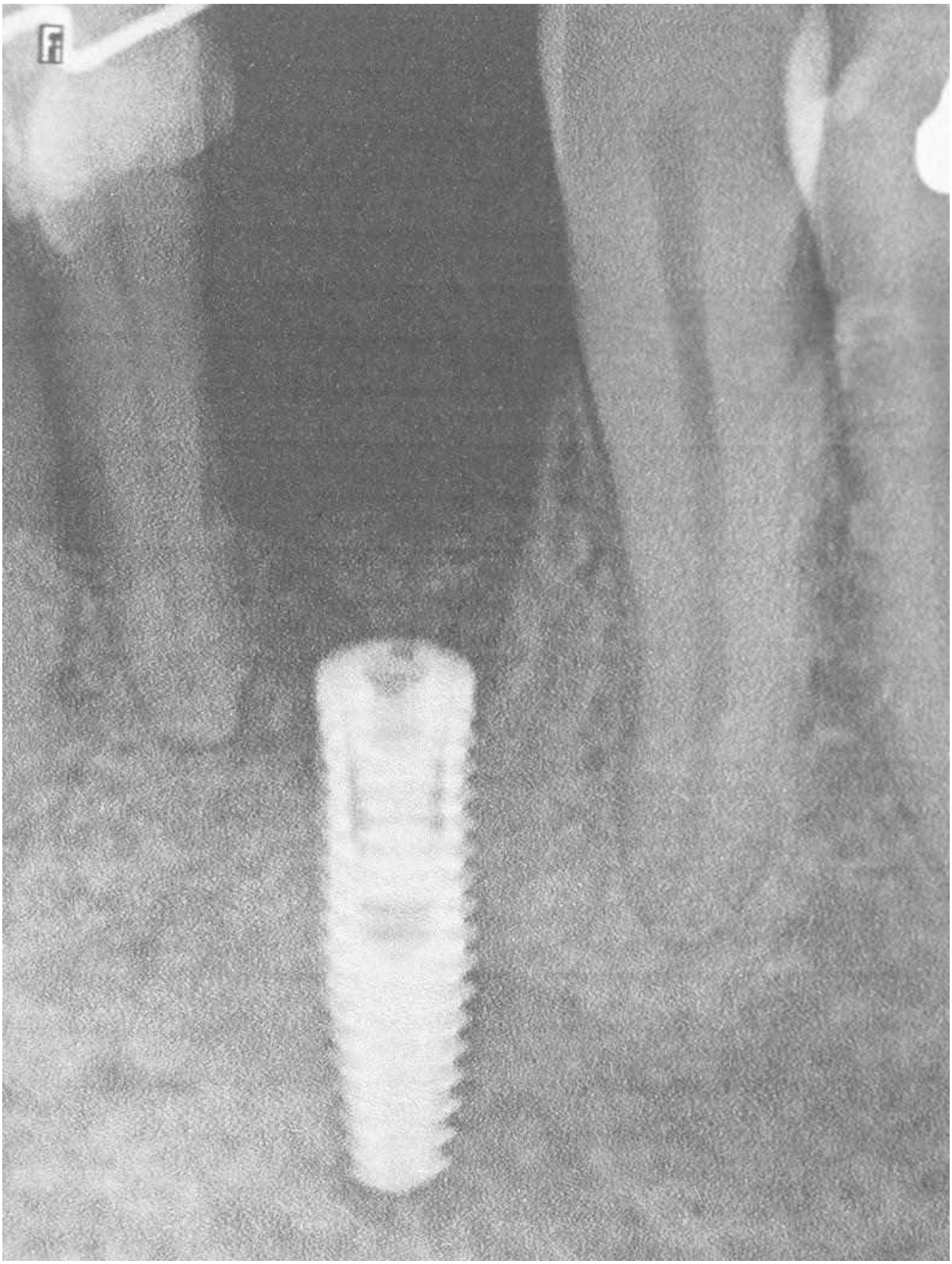


Figure 17.30 Two-stage placement showing first-stage implant fixture in place.

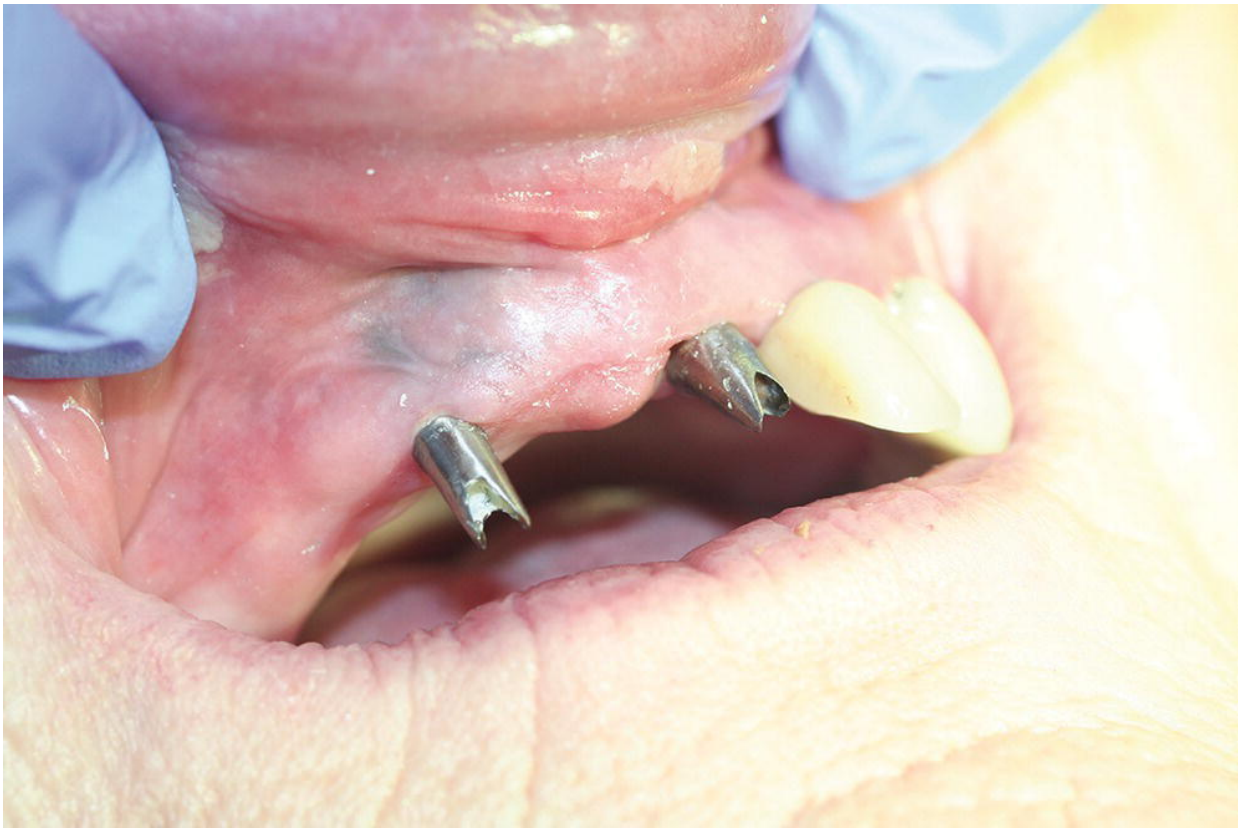
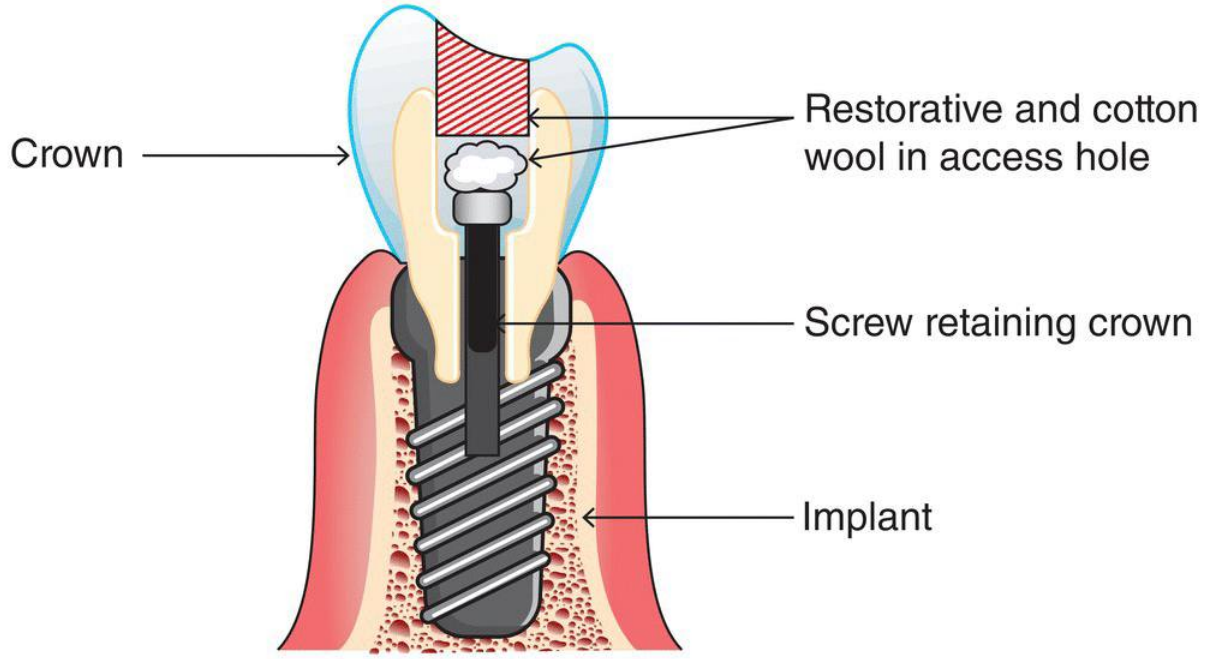


Figure 17.31 Abutments attached to implants.

Figure 17.32 Superstructure in place.

(a) Screw-retained crown



(b) Cement-retained crown

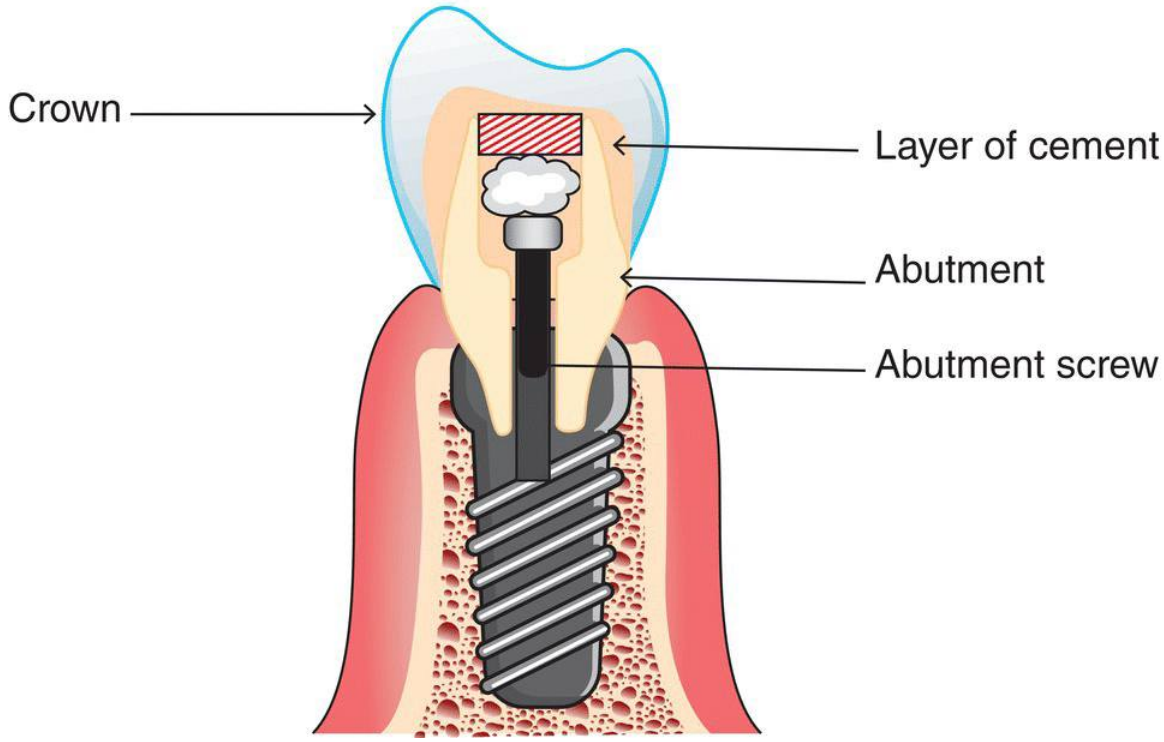


Figure 17.33 (a) Screw-retained crown. (b) Cement-retained crown.

Once a patient has been assessed and considered suitable for implants, using impressions, radiographs and three-dimensional scans, decisions are made on the implant placement technique (one- or two-stage) and the type of implant to be used.

The general surgical instruments required are listed in Table 17.2, although the handpiece and irrigation system are specialised for implant placement surgery to ensure a copious supply of sterile irrigant (see Figure 16.73).

The implant placement surgery broadly involves the following stages and is illustrated in Figure 17.34 for a solid implant using a two-stage technique.

- Initial incision along the crest of the alveolar ridge, with relieving incisions at either end so that the mucoperiosteal flap can be peeled off the underlying bone (similar to a mucoperiosteal flap for a surgical extraction).
- Crest of the ridge is flattened using a bone file or bur, so that the neck of the implant will be in full contact with the bone once placed.
- At the previously chosen site for the implant along the flattened crest, a guide hole is made in the bone using a pilot drill so that a purchase point is made for the twist drills to locate, otherwise the drills would slip across the surface of the bone.
- The twist drills are used to create the required length of hole in the bone, then the required diameter drill is used to widen the hole for the implant placement in a procedure called an **osteotomy** (where a hollow implant is to be inserted, a trephine mill is used to cut out a ring of bone only).
- The angulation and depth of drilling (and therefore the length of the implant) will have been predetermined from the three-dimensional scan and radiographs, and will be guided by depth markings on the twist drills and the drilling guide within the implant kit.

- The inner surface of the hole is prepared to receive the implant by the manual insertion and then removal of the correct diameter screw tap, using a screw tool and torque ratchet (Figure 17.35).
- The solid implant is then screwed into the prepared bone to the correct depth using the torque ratchet and a cover-screw is placed using a screwdriver from the implant kit.
- The surgical flap is realigned and sutured back into position while the bone grows around the implant and attaches to it by osseointegration.
- Once the implant is firmly held to the bone, the surgical site can be reopened and the superstructure stage completed.
- A typical surgical implant kit is shown in Figure 17.36.

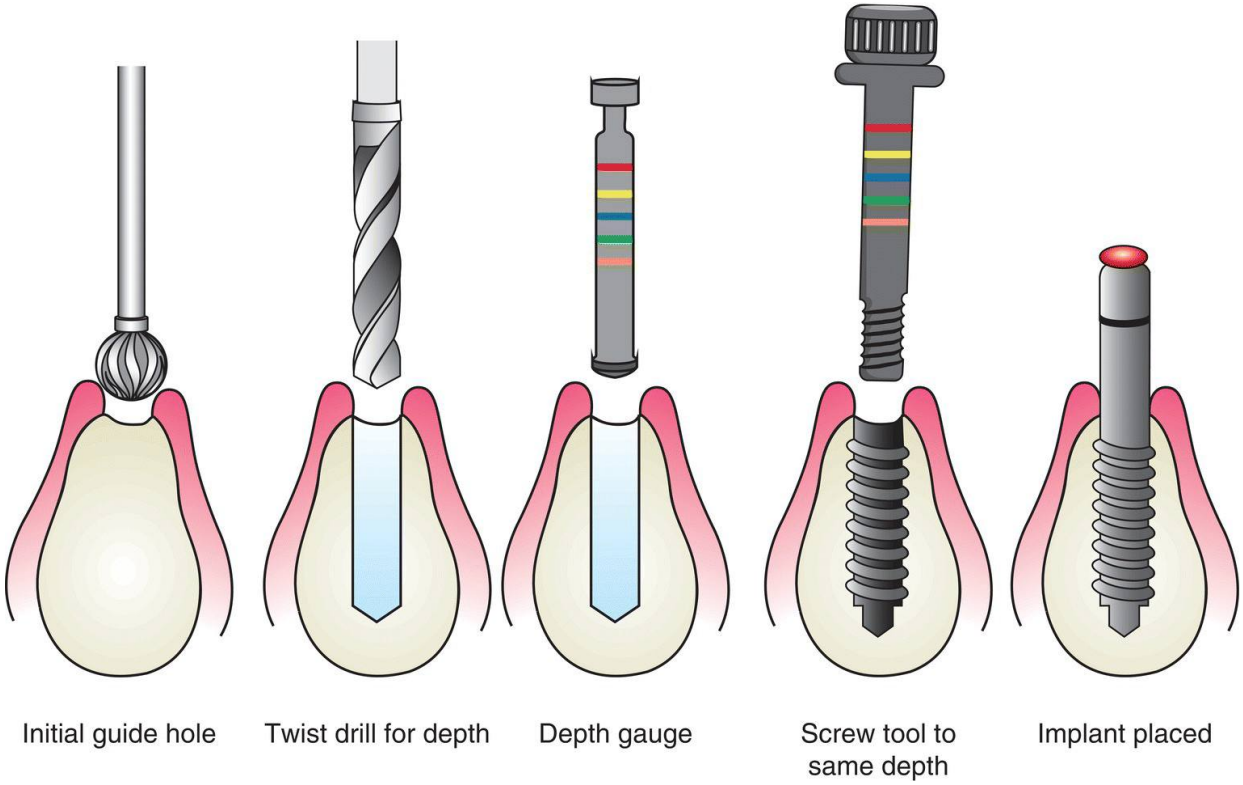


Figure 17.34 Illustration of the implant placement procedure.

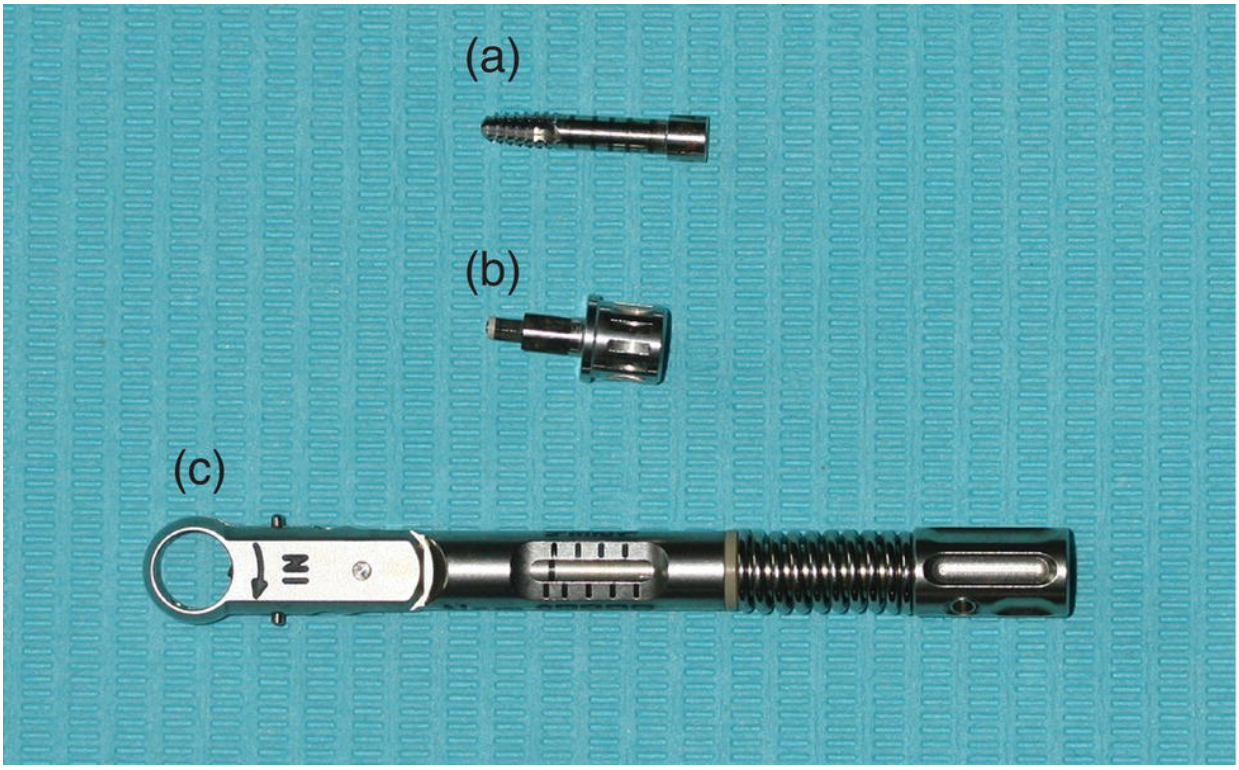


Figure 17.35 (a) Screw tap. (b) Short screw tool. (c) Torque ratchet.

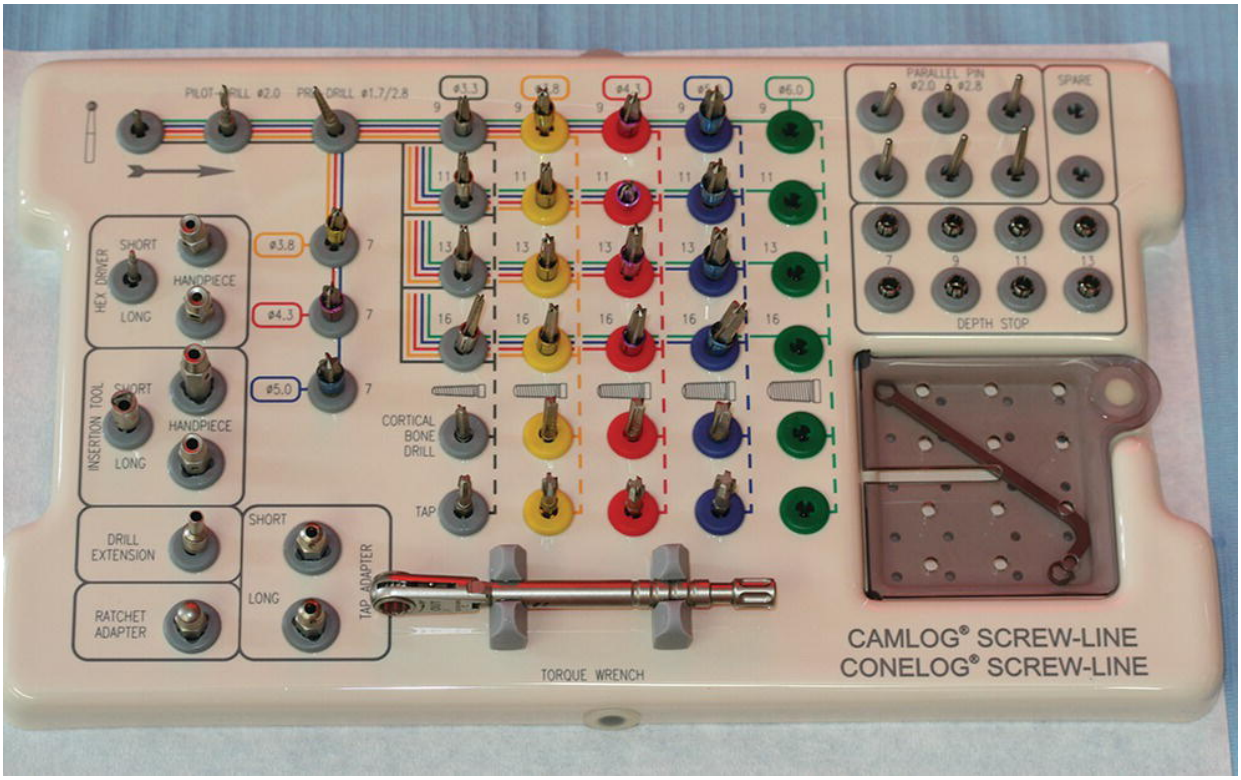


Figure 17.36 Camlog surgical kit for implant placement.

Implant maintenance and possible complications

Because an implant is used to replace a tooth, some may believe that good oral hygiene is irrelevant for their aftercare but this is incorrect. One of the main reasons for implant failure is poor oral hygiene around them: in this situation a tooth will develop periodontal disease while an implant will develop a similar type of inflammation called **peri-implantitis**. Consequently, the following oral hygiene advice should be given to all implant patients, and they should attend for dental examination on a regular basis so that the dental team can monitor the implants, as well as any natural teeth still present.

- Brush twice daily, including around the implant (electric brushes are suitable).
- Interdental brushes, dental tape or Superfloss should be used daily around the implant and its superstructure, just as for other fixed prostheses.
- Recommended mouthwash should be used regularly, as instructed by the dental team.
- Where removable dentures are implant-supported, the denture should be removed overnight and cleaned as for normal dentures.
- Regular dental examinations must include an oral hygiene assessment of the implant by the dental team, and advice reinforced where necessary.
- In particular, tobacco smoking is contraindicated for all implant patients as research has clearly shown a higher implant failure rate in smokers.

Periodic radiographs to check bone levels around the implant, as well as probing to detect any pockets, should also be carried out regularly by the dental team. As with all dental disease, the earlier it is detected, the better the options are to treat it.

Complications can occur with implants, and patients should be advised to seek dental care if any of the following occur:

- Pain, bleeding or the presence of pus around the implant: peri-implantitis is likely and will need investigating and treating quickly to avoid damage to the implant support tissues.
- Looseness of the superstructure restoration: screw-retained restorations may become loose if the screw slackens off, while cement-retained restorations can be lost due to a loss of cement seal, as for other fixed restorations. Both situations can usually be remedied.
- Looseness of the implant: this indicates either a fracture of the implant or loss of the osseointegration between the bone and the implant. Both may be catastrophic and require urgent dental attention.
- Development of pockets around the implant: this will be detected by the dentist and indicates a long-standing localised infection around the implant. Successful treatment will depend on the severity of the problem.
- Fracture of elements of the superstructure: this may occur as for conventional prostheses, and can be repaired in a similar fashion or the superstructure can be replaced.

Patient monitoring during minor oral surgery procedures

Any type of extraction or minor oral surgery procedure can be a worrying prospect for the patient, and this is especially so for younger patients and some of those with special needs – when it may be difficult for them to appreciate why the procedure must be carried out – as well as those patients with an abnormal fear of the procedure (a *phobia*).

A friendly, supportive and calming attitude throughout by the dental nurse will help to pacify the patient to some extent, as will talking to them and encouraging them when appropriate. However, extractions and minor oral surgery procedures, including implant placement surgery, are procedures where patients often request the use of anxiety control techniques such as conscious sedation. This topic is covered in detail in Chapter 14.

Actual monitoring of the patient to determine signs of any complications include the ability to notice the following:

- **Pain**: signs of pain may be seen as patients grimacing, wincing or crying and should be pointed out to the dentist, as the local anaesthetic administered may not be sufficient.
- **Colour**: the patient may feel faint and become pale and clammy, so the procedure must be stopped while action is taken to restore their cranial blood flow (usually by dropping the dental chair so their head is below their feet).
- **Choking**: debris or a tooth may be lost to the back of the mouth, causing choking, and immediate action is required to prevent a serious medical emergency.
- **Medical emergency**: anxiety can precipitate angina or a cardiac arrest in vulnerable patients, so patient response levels and vital signs should always be monitored by the whole team. This is particularly important when the patient is being treated under conscious sedation.
- **Tooth complications**: unexpected complications can occur, and the dental nurse should maintain a calm manner while

assisting during the complication, especially by using suction and aspiration to retrieve debris, or applying pressure during primary haemorrhage.

- **Bleeding**: immediately after the extraction, primary haemorrhage is quite normal but should stop after up to 5 minutes of pressure with a suitable dressing, so any recurrent bleeding must be reported to the dentist immediately, and the patient must not leave the surgery until all bleeding has stopped (this may involve assisting in placing haemostats or sutures).

Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

18
Extended Duties of the Dental Nurse

Key learning points

A **factual knowledge** of

- difference between basic nursing skills and extended duties
- requirements needed to undertake extended duties

A **working knowledge** of

- selection of extended duties to be carried out alone
- selection of extended duties to be carried out on prescription
- extended duties to be carried out under the direction of another registrant

A **factual awareness** of

- assessment styles
- enhanced CPD requirements for extended duties

In the UK, all dental nurses must be qualified in their basic duties and registered with the GDC to legally work at the chairside, or they must be a student on an approved training course working to gain their basic registrable qualification. The basic duties of a dental nurse are those which they are expected to carry out to provide clinical and other support to registrants and patients and are fully listed in the GDC's *Scope of Practice* documentation.

Extended duties are those skills which may be developed by registered dental nurses after their initial qualification to enhance their scope of practice, following appropriate training to a suitable level of competency, and with suitable indemnity insurance in place. It involves undergoing appropriate training in the workplace, which is delivered by a team member who is already trained and competent in the same skills, rather than by attending a formal training course

elsewhere. This training is often referred to as being delivered in-house, meaning that it has occurred on the workplace premises.

Details of the in-house training must be retained to prove that it has actually been given, and the most suitable format is as a mini handout which lists the information that has been passed on to the registrant. Records should be kept of each time that the registrant then carries out the supervised extended duty (including in the patient's records when the skill is used directly on a patient) until the registrant is deemed to be competent; this should also be recorded. Ideally, the workplace can develop and use assessment sheets to provide a record of the supervised tasks.

Once deemed competent, the registrant's indemnity insurance should be arranged to include cover for extended (or extra) duties, rather than cover just for basic duties. At all times, all GDC registrants must carry out their duties in accordance with the GDC's standards document *Standards for the Dental Team* and ensure that they never attempt to provide care or carry out tasks which fall outside their scope of practice. The standards and scope of practice documentation is available to download at www.gdc-uk.org.

Extended duties

Once the dental nurse has qualified in their basic duties (covered in the previous 17 chapters) and become a GDC registrant, additional skills that could be developed following appropriate in-house training include the following:

- Further skills in oral health education and oral health promotion (see later).
- Assisting in the treatment of patients who are under conscious sedation (see later).
- Further skills in assisting in the treatment of orthodontic patients (see later).
- Intraoral and extraoral photography (see later).
- Pouring, casting and trimming study models (see later).
- Tracing cephalographs (see later).
- Further skills in assisting in the treatment of patients with special needs.
- Shade taking.

All these skills can be carried out without direct intervention from another registrant once the required level of competence has been achieved. Throughout their working career, the dental nurse should then attend suitable and verifiable CPD activities in those areas of extended duties which involve direct access to patients, so that their knowledge and skills are maintained. Regular monitoring of their competence can also be carried out in the workplace by other, suitably trained and knowledgeable, colleagues.

Further additional skills can also be developed in the following areas but only on prescription from another registrant: a more senior registrant has made the decision that the task is a necessity for a particular patient, and has delegated its completion to a suitably trained and competent dental nurse. In the case of taking radiographs (pressing the exposure button), this task must be carried out under the direct supervision of a suitably qualified team member.

- Taking impressions to the prescription of the dentist or a clinical dental technician (CDT) (see later).
- Measuring and recording plaque indices (see later).
- Application of fluoride varnish to the prescription of the dentist, or directly as part of a structured dental health programme (see later).
- Constructing mouthguards, bleaching trays and vacuum-formed retainers to the prescription of the dentist (see later).
- Removing sutures after the wound has been checked by the dentist (see later).
- Taking radiographs: specifically, pressing the exposure button when instructed to do so (see later).
- Placing rubber dam.
- Applying topical anaesthetic to the prescription of the dentist.
- Constructing occlusal registration rims and special trays.
- Repairing the acrylic component of removable appliances.

Further skills in oral health education and oral health promotion

The two main oral diseases – dental caries and periodontal disease – are both caused by an accumulation of plaque, either on the tooth surface or within the gingival crevice or periodontal pockets (when present) respectively. Instruction from the dental team in how to remove this plaque effectively, as well as appropriate dietary advice, is the mainstay of good oral health promotion to prevent dental disease in patients.

Only the most dedicated of patients are likely to maintain a high standard of oral hygiene without any intervention or advice from the dental team, so it is likely that many patients will require regular reinforcement of key oral health messages throughout their time with the practice. As this patient support is often best delivered in one-to-one sessions and can be time-consuming, a dental nurse with appropriate training in these extended duties is a huge benefit to the workplace, by allowing the dentist and other DCPs to provide treatment to some patients while the dental nurse delivers personal oral health education to others.

Simple brushing, flossing and interdental cleaning instructions

The aim of conventional toothbrushing is to remove plaque from the gingival crevice area around each tooth, and from the labial, buccal, lingual, palatal and occlusal surfaces of the teeth. Conventional toothbrushing will not clean the interdental areas unless a sonic brush is used, or an electric brush with an interdental adaptation (Figure 18.1).

Figure 18.1 Example of interdental attachment for electric brush.

Flossing (or the use of dental tape) and the use of interdental brushes are recommended for thorough interdental cleaning of the mesial and distal contact points of teeth.

To ensure that the patient learns from the oral hygiene advice and is willing and able to carry out the instructions given by the dental nurse at home afterwards, the instruction session must achieve all of the following:

- Be delivered at a level of understanding suitable for each individual: this involves the use of terminology relevant to each patient, as well as the use of good communication skills. This topic is covered in detail in Chapter 13 of this book and in *Diploma in Dental Nursing Level 3*, 3rd edn (C. Hollins, 2014, Wiley-Blackwell).
- Be sensible in the advice given: this will involve giving valid reasons for the actions explained and the points made so that the patient can understand why the advice is relevant to them.

- Be easily remembered by the patient: this will involve helping the patient to develop a systematic approach to their oral hygiene regime, one that they can follow each day without having to think about it.
- Be reinforced appropriately: this will involve the use of relevant patient information leaflets and handouts which the patient can take home and refer to at a later date.
- Be recorded in the patient's notes: this allows the advice given to be re-evaluated at a later date by the dental nurse (or other team members) and adjusted accordingly, to ensure that the patient achieves a consistently good level of oral hygiene

Toothbrushing

Simply chatting to the patient about toothbrushing techniques will have little effect in improving their skills; they need to be able to see what is being discussed, and ideally to be able to 'have a go' themselves while being advised by the dental nurse (a typical 'tell–show–do' learning experience). A good supply of relevant oral hygiene products and aids is therefore essential to the success of the session (Figure 18.2), as well as a large mirror so that they can watch themselves while brushing. When discussing a child's brushing techniques with a parent, the dental nurse should demonstrate on the child themselves so that the parent learns how to correctly supervise the child's brushing until they are of an age to carry it out successfully alone (see Figure 13.2).

Figure 18.2 Examples of aids and products for use during OHI sessions.

Technique

- Briefly discuss the aims of adequate toothbrushing with the patient, with particular reference to any problems already identified with their current technique (such as missing the lower teeth by keeping the mouth closed, taking too little time).
- Demonstrate the required toothbrushing technique on a dental arch model, so that the patient can see the correct toothbrush manipulation and which areas are to be cleaned.
- Allow the patient to 'have a go' at toothbrushing on the model, so that the correct brush angulation and speed and force of brushing are achieved.
- Using the model, divide each dental arch into three sections – left side, right side and front – and then divide each section further into actual tooth surfaces.

- Refer to these areas in terms the patient can understand: cheek side, tongue side, biting surface, and so on.
- Ask the patient where they normally start and finish their toothbrushing, and then develop a systematic routine of including each of the eight tooth surface areas in both arches into that regime, so that no surface is missed.
- Provide the patient with a waterproof bib and then use a disclosing tablet to expose their plaque retention areas; these can be viewed in the large mirror.
- Allow the patient to 'have a go' at brushing the disclosed plaque off their teeth using the new regime that has just been discussed, reinforcing and updating the advice as necessary if they keep missing certain areas.
- By the time the disclosed plaque has been fully removed, the patient should have developed a methodical approach of their own to brush all tooth surfaces in their mouth, which they can then repeat at home on a daily basis so that it becomes a subconscious routine.
- Effective full-mouth brushing should take around 2 minutes, and patients can be advised to use an egg timer or alarm call to help them learn to pace themselves accordingly.
- The patient should be instructed not to rinse their mouth after spitting out the excess toothpaste at the end of the brushing session. Any toothpaste remaining around the teeth is an important source of topical fluoride.
- A small-headed, multi-tufted, medium nylon bristled toothbrush is suitable for the vast majority of patients, and is likely to need replacing every 3 months or as soon as the bristles show signs of wear (see Figure 13.3).
- The dentist will have recommended a suitable toothpaste for the patient to use, depending on whether they require a good-quality fluoride toothpaste or one with additional additives for a particular dental problem (Figure 18.3).
- Good-quality rechargeable electric toothbrushes can also be recommended, especially those that use a sonic method of

cleaning as these take the hard work out of the task for the patient.

- The vibratory action of the electric brushes, especially when accidently caught on other teeth as they are moved around the mouth, does take time and perseverance by the patient to get used to them. The dental nurse should encourage this perseverance, as the level of cleaning is likely to be far better than that achieved manually for the vast majority of patients.
- The patient should also be instructed to clean their teeth over a sink and with the lips closed around the electric toothbrush during use. This limits the amount of 'dribbling' of the toothpaste solution that always occurs with their use, and avoids spillages onto clothing.
- The benefits of electric toothbrushes should be reinforced to suitable patients whenever necessary.
    - More effective cleaning than manual toothbrushing.
    - Sonic effect allows some interdental cleaning to occur.
    - Head adaptations allow a variety of uses, including specific interdental cleaning.
    - Many have 2-minute timers incorporated, to ensure brushing occurs for long enough.
    - Many have 30-second audible beeps to remind patients to move to the next quadrant, which ensures full-mouth cleaning.
    - Many have sensors to detect excessive pressure during use that stop the brush from working briefly and helps teach the patient to use the correct brushing force.
    - Heads are interchangeable, so one base unit can be used for several patients within a family, each with their own toothbrush head.
    - Heads tend to last longer than manual brushes (up to 6 months).
- A similar demonstration session to that described for manual brushes can be carried out by the dental nurse for patients new to

the use of electric toothbrushes, and very often the manufacturer supplies explanatory patient leaflets.

Figure 18.3 Examples of various toothpastes.

Flossing and interdental cleaning

These skills are required to assist the patient in removing interdental plaque on a regular basis, where regular toothbrushing alone is ineffective. Again, a clear demonstration of the correct techniques and assisted by good aids and products is the key to engaging the patient in learning these skills and enabling them to carry them out at home (see Figures 13.8, 13.9 and 13.10).

Technique

- The technique used to clean interdentally will depend to a large extent on the dexterity of the patient, the options being:
  - use of conventional dental floss or tape
  - use of prethreaded Flossette-type devices
  - use of interdental or interspace brush (Figure 18.4)
  - use of electric brush adaptations.
- Wood sticks are not recommended for routine interdental cleaning as they are designed more for occasional use to dislodge food particles that have become stuck interdentally.
- A discussion of any prior attempts by the patient to clean interdentally will help to determine the technique that may be suitable for them.
- Using conventional dental floss and tape, many patients find waxed tape more successful than floss, as the wax allows the material to slide more easily into the interdental areas without forcing it through and risking cutting into the gums, and the tape then provides a larger surface area for tooth cleaning.
- A demonstration is given of how to wrap the floss/tape around the fingers to provide a suitable length which can be guided into the interdental area and manipulated across the tooth surfaces using the fingers or thumbs (Figure 18.5).
- Once proficient, the patient can be supervised to insert the floss/tape into an interdental area and wrap it around one of the tooth surfaces (mesial or distal), and then use a sawing action to

clean the tooth surface as the floss/tape is withdrawn from the area (Figure 18.6).

- They then unwrap a small section of floss from one finger and wrap it onto the other finger so that a clean section becomes available. This is then guided back into the same interdental area and used to clean the opposing tooth surface in the same way.
- Patients who struggle with this technique for their posterior teeth can be instructed in the use of Flossette-type devices in the same way to clean these interdental areas.
- It may take several devices to clean the interdental areas fully, as the floss/tape is secured in the prongs and cannot be changed once soiled. The patient should be discouraged from continuing to use a heavily soiled Flossette as they are merely transferring plaque and food debris from one interdental area to another, rather than cleaning the tooth surfaces.
- Suitably sized interdental brushes will be the method of choice for interdental cleaning for some patients.
- Determine the size necessary for the patient (Figure 18.7) and demonstrate how the brush end can be angled to access posterior interdental areas more easily (Figure 18.8).
- Allow the patient to 'have a go' at inserting the interdental brush in various areas of their mouth, and then using a brushing and twisting action to clean the tooth surfaces before withdrawing it (Figure 18.9).
- The brush can also be used with a smear of toothpaste, so that fluoride and cleaning agents are introduced into the area.
- Large interdental brushes or interspace brushes are more suitable where large gaps are present between teeth, such as where a tooth is missing from the arch.
- The brushes can be rinsed clean and reused, but must be discarded when the bristles show signs of wear.
- For those patients who routinely use an electric brush to carry out their oral hygiene regime, or those who are suitable to be advised to do so, various interdental and interspace head

adaptors are available with good-quality varieties, which are used to simulate the manual techniques described.

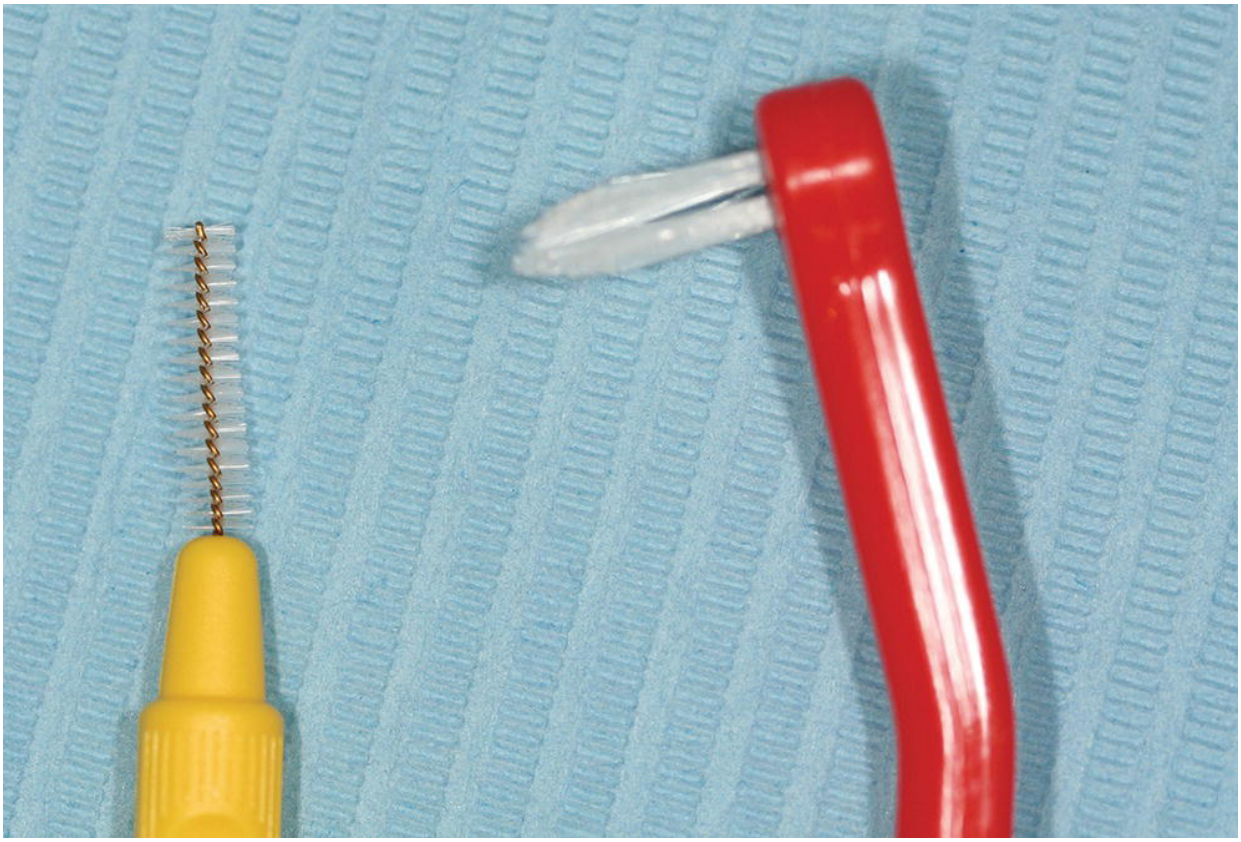


Figure 18.4 Interdental and interspace brushes.

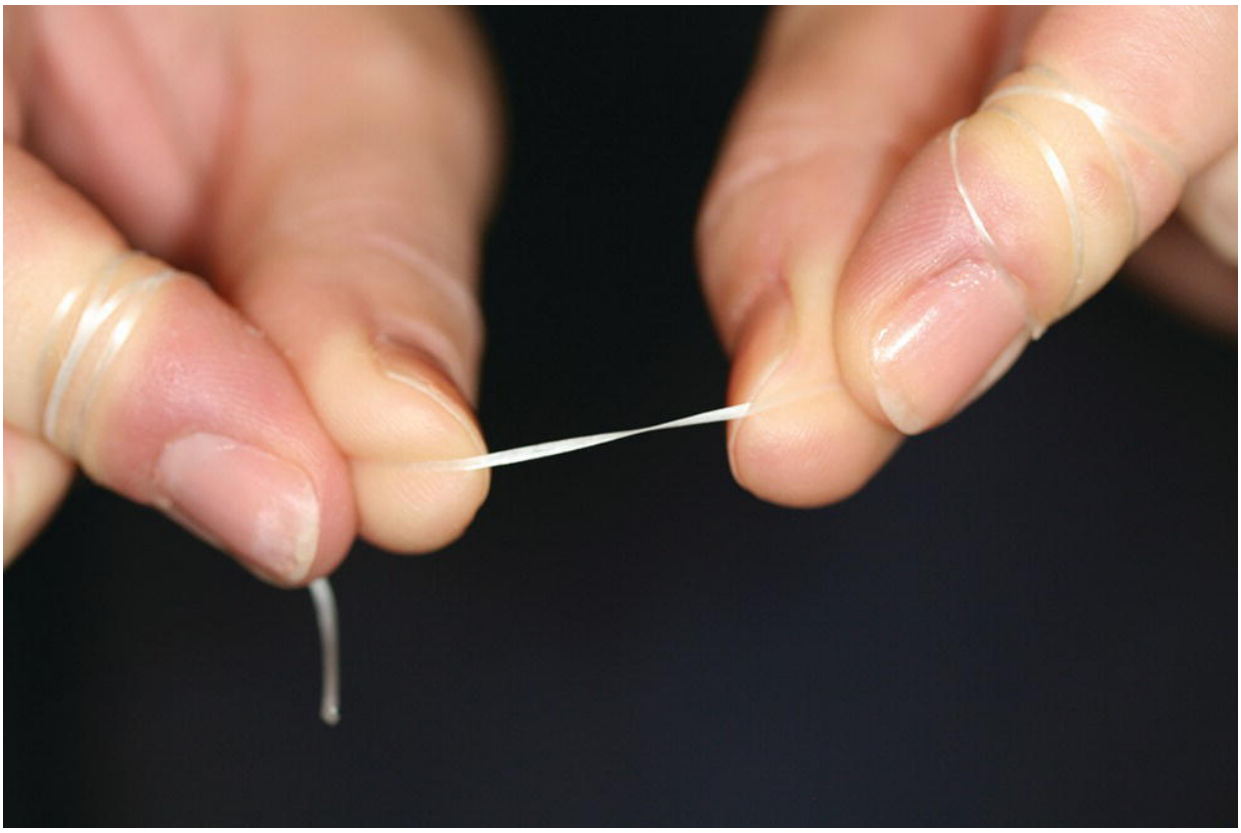


Figure 18.5 Correct positioning of floss around fingers and thumbs.

Figure 18.6 Correct flossing technique.

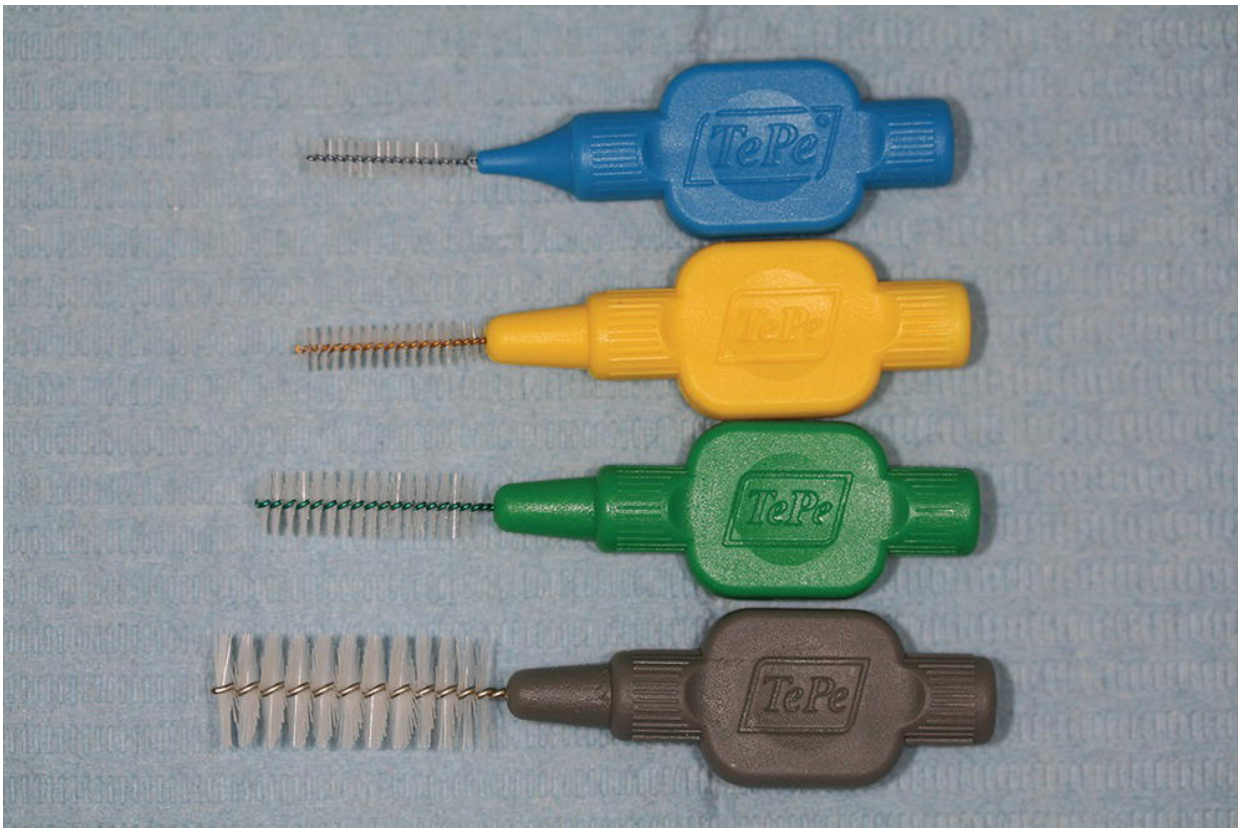


Figure 18.7 Size ranges of interdental brushes.

Figure 18.8 Interdental brush angled for easier use.

Figure 18.9 Use of interdental brush for cleaning posterior teeth.

Diet advice

Regular and efficient plaque removal will help prevent caries, gingival and periodontal problems from developing, but the incidence of caries is also greatly influenced by the patient's diet. A diet containing regular free sugars (similar to those previously referred to as non-milk extrinsic sugars) and dietary acids will always have the potential to allow caries to occur, no matter how effective the oral hygiene regime.

The vast majority of patients are aware of the potential for obvious foods and drinks, such as chocolates, cakes, carbonated drinks, biscuits and so on, to cause caries. What many are unaware of are the 'hidden sugars' in many food and drinks (see Figure 13.19), the role that acidic products have in causing caries, and the importance of frequency and timing of the consumption of these products in the development of caries. Dietary advice should be geared around these areas.

To give effective diet advice, the patient's dietary contents and habits first need to be known, and the most effective way of discovering this information is to have the patient complete a diet sheet like the one shown in Table 18.1. The aim is to have an accurate record of the following points on a daily basis:

- What food and drinks are consumed.
- What time they are consumed throughout a 24-hour period.
- What time any oral hygiene procedures are carried out during the same time cycle.
- What variations there are from day to day, with both the products consumed and the oral hygiene procedures undertaken.

Table 18.1 Example diet sheet.

Tuesday	Food or drink	Oral hygiene
6 a.m.	Cereal with sugar, orange juice	
7 a.m.		Toothbrushing, fluoride toothpaste
8 a.m.		
9 a.m.		
10 a.m.	Biscuit, coffee with 2 sugars	
11 a.m.		
12 p.m.	Pizza, chocolate muffin, diet coke	
1 p.m.		Chewing gum, not sugar-free
2 p.m.		
3 p.m.	Diet coke, chocolate biscuit	
4 p.m.		
5 p.m.	Cheese and onion crisps	Chewing gum, not sugar-free
6 p.m.		
7 p.m.	Chicken burger and chips with side salad, glass of white wine	
8 p.m.	Glass of white wine	
9 p.m.	Glass of white wine	Toothbrushing, fluoride toothpaste and general-use mouthwash
10 p.m.		
11 p.m.	Glass of diet lemonade	
12 a.m.		

To be effective, the patient has to be totally honest, and this must be emphasised before proceeding with a dietary recording and analysis, otherwise there is little point in continuing. The desire to help the patient avoid future restorative dental treatment (and its cost) and to

maintain a healthy smile should be stressed from the outset by the dental nurse.

A selection of packaging from various food and drink products containing hidden sugars may be used as 'props' to help convince the patient that the advice is given on a non-judgemental, purely helpful basis by the dental nurse. Again, good communication skills are required if the patient is not to be alienated by the whole procedure.

Once the diet sheet (or sheets if there is a large variation between weekdays and weekends, for example) has been completed and returned to the practice by the patient, it should be carefully analysed to determine the answers to the four questions set above. The dental nurse may discuss the findings with the dentist or another competent DCP, making notes of the relevant points to discuss with the patient. The patient then attends for an oral hygiene instruction and promotion session with the dental nurse.

The information contained in the diet sheet example in Table 18.1, and to be discussed with the patient, is as follows.

Food and drink consumed in this scenario

- Several obvious sugar and acid episodes
  - Sugar on cereal and in coffee.
  - Orange juice and carbonated drinks.
  - Biscuits and muffin.
  - Wine.
- Several hidden sugar episodes
  - Cereal: even plain examples such as wholewheat cereal and cornflake-style products contain sugar.
  - Pizza: the tomato paste base contains sugar, as do most tomato sauce or paste products.
  - Chewing gum: unless stated as 'sugar-free' these products will contain sugar.
  - Chicken burger: if additions such as mayonnaise or relish are used.

Time of consumption in this scenario

- The sugar and acid ‘hits’ occur frequently throughout the day.
- This allows potentially harmful levels of food debris and plaque acids to lie in direct contact with tooth surfaces for prolonged periods of time, causing demineralisation.

Time of oral hygiene procedures in this scenario

- Toothbrushing occurs within the hour after breakfast, so some food debris and plaque will be removed.
- No other oral hygiene measures occur for the following 14 hours.
- This allows all sugars and acids consumed in that time to potentially cause some caries, especially interdentally where no cleaning technique has been carried out for the whole 24-hour period.
- The beneficial effects of the bedtime toothbrushing and mouthwashing procedures will be cancelled out by the consumption of the carbonated drink less than 2 hours later.
- This acidic drink then has the following 7–8 hours to lie undisturbed and erode the tooth enamel overnight.

Any variations between completed diet sheets for different days can be analysed in a similar manner. Armed with all this information, the dental nurse can give the necessary dietary advice to the patient in an effort to educate them in reducing the potential harm that their dietary habits may cause. It is unrealistic to expect the patient to change their diet completely, and it is highly unlikely that an average diet would avoid all sources of hidden sugars. Consequently, the advice given should focus on reasonable and achievable goals for that particular patient, including the following suggested points.

Food and drink consumed

Suggest healthier alternatives, as follows:

- Artificial granulated sweetener on the cereal and in the coffee.

- Savoury biscuits and cheese (although there is likely to be a hidden sugar content).
- Fruit or yoghurt instead of crisps (although the yoghurt may contain hidden sugar if it is flavoured).
- Limit the carbonated drinks, or have squash drinks instead; even 'diet' drinks are potentially harmful if they are fizzy, because they are acidic.
- Plain water instead of any other overnight drink.
- Also give accurate advice on 'healthy' sugar alternatives which the patient may believe are safe alternatives to table sugar (see Chapter 11 and Table 11.1 for further details).
- White wine contains less sugar than many other alcoholic drinks, such as ciders, sherries and mixers with spirits, but is still acidic so the length of drinking time should be monitored by the patient.

Time of consumption

- The same foods and drinks consumed in two or three set meals rather than spread over the 14-hour period will cause less tooth damage, as there are less sugar and acid 'hits' on the teeth.
- The orange juice should be taken before the cereal at breakfast, so that the acid is much reduced before toothbrushing is carried out. The combination of softened enamel from acid exposure and toothbrushing can cause increased enamel loss.
- In particular, the overnight drink of lemonade has the potential to cause massive demineralisation if carried out on a regular basis, and should be replaced by plain water.

Time of oral hygiene procedures

- Much plaque develops in the mouth overnight, so suggest that the teeth be brushed both before breakfast (to remove that already present) and after breakfast (to remove that developing from the food just consumed). This will remove the maximum amount of harmful plaque.

- Suggest that a lunchtime oral hygiene procedure be carried out, ideally toothbrushing with a fluoride toothpaste or the use of a good-quality mouthwash.
- If not, sugar-free chewing gum will stimulate saliva flow to wash away some debris, and physically pull some particles off the teeth too.
- As a last resort, swilling the mouth with plain water after a meal will have some beneficial effect.

Procedures

- If acids are likely to be consumed on a regular basis, advise on the use of enamel repair products to minimise the erosive effect (see Figure 13.7).
- Avoid brushing immediately after finishing acidic drinks, including alcohol. Wait for at least 20 minutes to allow the acids to be neutralised, or use a mouthwash rather than brushing.
- Introduce an interdental cleaning procedure into the regime: bedtime may be ideal as the patient is likely to have more time than in the morning before work.
- If time is an issue, advise the use of a good-quality sonic electric toothbrush that will clean interdentally on a regular basis.
- Use sugar-free chewing gum as a cleaning aid when other procedures are not possible, but do not chew gum excessively as this will encourage tooth wear on the biting surfaces of the teeth. Generally, when the flavour has gone the gum has completed its cleaning aid role and should then be disposed of appropriately.

In summary, any amount of this information and these oral health instruction and promotion techniques can be developed by the dental nurse into personalised oral health education sessions with the patient. The information here covers the basics of oral health instruction and promotion techniques and can be used in total or as a starting point for the development of a suitable training programme.

To be successful in this extended duty, the dental nurse must be adequately trained to become competent in all the following skills:

- Tailor the information to the direct needs of each patient.
- Ensure the information is correct and in line with the policies and beliefs of the workplace.
- Communicate effectively so that the oral health messages are correctly delivered.
- Maintain an up-to-date level of knowledge of the topics they are likely to discuss with patients.
- Know the limits of their knowledge and understanding, and be willing to ask a senior colleague for their input when necessary.

Several post-registration qualifications in oral health education are available for dental nurses in the UK, which train students to a much greater depth of knowledge in this topic and provides them with a recognised qualification. Further details are available at www.bda.org/ohecourse and www.nebdn.org.

Assisting in the treatment of patients who are under conscious sedation

Conscious sedation is an anxiety control technique used to allow fearful (or phobic) patients to undergo routine dental procedures, as well as to allow regular patients to undergo fearful or traumatic dental procedures. The two techniques most frequently used in general practice are:

- single-drug intravenous sedation
- inhalation sedation (previously referred to as relative analgesia).

As an extended duty where both techniques are used, the role of the dental nurse may include any or all the following skills:

- Be able to set up the equipment and materials to carry out intravenous sedation.
- Be able to read a pulse oximeter machine.
- Be able to take the patient's blood pressure.

- Be able to carry out basic safety checks on the inhalation sedation machine.
- Be able to monitor the patient during a conscious sedation session, and record their vital signs where necessary.
- Be able to assist the team during a medical emergency to the level of ILS, using a nasopharyngeal airway (see Figure 14.27) or a supraglottic airway (see Figure 14.28).

In workplaces where only one or the other technique is used, the level of competency of the dental nurse is limited to that technique alone, and to the specific tasks that they have been trained to carry out only. The role of gaining informed consent in written form before a conscious sedation procedure is a regulatory requirement and is the responsibility of the dentist rather than a duty for the dental nurse to carry out.

Intravenous sedation

This is a technique of conscious sedation for adult patients where a single drug is injected intravenously into them so that:

- their anxiety of dental treatment is significantly reduced
- they are willing to receive dental treatment
- they remain conscious throughout and therefore do not require intubation.

Examples of the equipment and materials that may be required to be set out for the induction procedure are shown in Figure 18.10, and the functions of all the potential items required are as follows:

- Midazolam (Hyponovel) ampoule: the drug that is injected intravenously to produce the sedation.
- Flumazenil (Anexate) ampoule: the reversal drug to bring the patient out of the sedation in the case of emergency.
- Syringes (5 ml) and long needles: to draw up the midazolam (and flumazenil when required).
- Cannula: a Venflon to administer the midazolam.

- Alcohol wipe: to clean the injection site before the cannula is used.
- Tourniquet: to fasten around the upper arm or wrist to raise the vein.
- Arm splint: to keep the arm stationary throughout the procedure if necessary, in particular to avoid the patient snagging the cannula on their clothing and potentially dislodging it.
- Micropore tape: to secure the cannula in the vein throughout treatment, and to hold a cotton wool roll over the site after the cannula has been removed (alternatively a plaster may be used).
- Pulse oximeter (multifunction where possible): the machine connected to the patient throughout the procedure by a finger probe, which reads their oxygen levels (as a percentage) and their pulse rate (as a number counted per minute), and is also able to read blood pressure (Figure 18.11).
- Blood pressure machine: a dedicated separate device that is used to record the patient's blood pressure before, during and after the procedure (Figure 18.12).
- Oxygen cylinder and nasal cannula: to administer oxygen to the patient during the procedure if their oxygen level is at 90% or below for more than a minute, or if their oxygen level keeps dipping.
- Mouth props: for use during the procedure to keep the patient's mouth open wide, otherwise they will keep closing it while in a relaxed state (see Figure 14.23).

Figure 18.10 Example of intravenous sedation items layout.

Figure 18.11 Example of multifunctional pulse oximeter, showing oxygen level, pulse rate and blood pressure readings.

Figure 18.12 Dedicated blood pressure machine in use.

Induction procedure

The nurse's role during the induction procedure is as follows:

- Assist with taking the patient's blood pressure before starting the induction, or actually take the blood pressure using an automated machine.
  - Place the cuff around the upper arm in the correct location (this is usually marked on the cuff itself, for the left or right arm).
  - Use the Velcro strip to secure the cuff in place.
  - Ensure the cuff tubing is connected to the machine correctly.
  - Press the start button to inflate the cuff.
  - Follow the deflation of the cuff and make a note of the automatically recorded blood pressure reading, writing the

systolic pressure over the diastolic pressure on the monitoring sheet (see below).

- Help to keep the patient as calm and relaxed as possible during the induction, by talking quietly but encouragingly to them, by holding their hand if possible (or getting someone else to do so).
- Assist the dentist by passing the necessary items to carry out the induction, in the correct order: tourniquet → alcohol wipe → cannula → micropore tape → midazolam syringe.
- Close the vein with a finger above the tubing while the Venflon needle is removed.
- Assist with applying the micropore tape to secure the cannula.
- Release the tourniquet when told to do so.
- Assist with attaching the syringe end to the Venflon injection port.
- Assist with applying the arm splint when used.
- Attach the finger probe correctly to the patient, using a finger on the injection side (left or right). The diode window side is usually marked with a fingernail pictogram on the probe, so that it is not placed upside down.
- Switch on the pulse oximeter and ensure the alarm is on and is automatically set at 90%; this level can be raised if necessary but only on the direction of the dentist.
- Ensure the blood pressure cuff is placed on the arm not used as the injection site, otherwise the readings taken during the procedure will prevent the finger probe from monitoring the oxygen levels and pulse rate as the cuff tightens.
- Record the first oxygen and pulse readings, and the time they were taken on the monitoring sheet.

Monitoring the patient during the procedure

The patient must be monitored throughout the procedure, with a written record kept of their oxygen levels and pulse rate at 10-minute intervals. Their blood pressure should also be measured and recorded several times during the procedure.

Using the monitoring sheet provided (example shown in Figure 18.13), complete all sections by recording the following information:

- Any relevant medical history, such as being asthmatic.
- ASA level (to be provided by the dentist): a grading system (I to V) used to signify how healthy the patient is to undergo intravenous sedation. In general dental practice, only patients of ASA I (full health, no medical issues) or II (minor medical issue which will not affect treatment under sedation) should be treated.
- Preoperative and postoperative blood pressure readings.
- Several blood pressure readings taken during the procedure.
- Oxygen saturation levels at 10-minute intervals.
- Pulse rate at 10-minute intervals.
- Sedation drug used, amount given, time of first and last increments.
- Batch number and expiry date of all drugs given.
- Details of any problems or additional information, such as the provision of oxygen.
- The level of responsiveness of the patient at discharge (able to walk with assistance, talk coherently, and listen to instructions given) and the time of discharge.
- Their escort details: name and relationship to patient.

In addition, the patient should be monitored visually during the procedure for signs of the following:

- Their facial/lip colour, especially any blueness which indicates lack of oxygen.
- Their chest movements, especially whether they are regular and steady or not, which indicates a possible respiratory obstruction.
- Their level of responsiveness, especially whether they respond to verbal commands or not, which indicates their level of sedation

may be too deep and they are at risk of passing into unconsciousness.

- Whether they are tapping their finger or clenching their hand with the finger probe on, as this will send false readings to the pulse oximeter, as well as setting off the alarm.
- Whether they are moving their arm where the cannula has been inserted, as this may snag on their clothing and dislodge it; an arm splint may be required.

IV SEDATION SESSION RECORD

NAME: DATE:

IV DRUG	EXPIRY DATE	BATCH NUMBER	INCREMENTS		TOTAL DOSE
MIDAZOLAM			FIRST	LAST	ml

MH checked:

ASA: I or II

VENOUS ACCESS?	SITE	CANNULA
YES DIFFICULT NO	ACF HAND WRIST	23G BUTTERFLY 22G VENFLON

MONITORING TIME	OXYGEN SATURATION	PULSE	BLOOD PRESSURE

RECOVERY SITE	SURGERY ON DENTAL CHAIR		
FIT FOR DISCHARGE	WALK	TALK	LISTEN
POST-SEDATION INSTRUCTIONS	TO ESCORT VERBAL WRITTEN		
TIME OF DISCHARGE			
CLINICIAN NURSE			

Figure 18.13 Example of an intravenous sedation session monitoring sheet.

Sedation patients are understandably anxious before the induction session begins and will appreciate the presence of a friendly and empathetic dental nurse to 'hold their hand', whether physically or emotionally. During the session the patient will be relaxed and will often have to be given the same instructions several times before they respond (turn their head, open their mouth wider, breathe through their nose, and so on), so it is important that they are spoken to pleasantly and calmly and that they are constantly reassured by the dental nurse throughout the session.

Although midazolam does cause a period of amnesia (memory loss) during its use, the patient is not deaf so no inappropriate comments or personal chatting should occur during the session: the dental nurse should be wholly focused on the welfare and comfort of the patient throughout.

Recovery period

The dental nurse's role during the recovery period is as follows:

- Remain with the patient and monitor their visible and vital signs.
- Talk to the patient to help their recovery.
- Assist with, or take, a postoperative blood pressure reading.
- Assist with the removal of the cannula and place a dressing.
- Ensure the monitoring sheet is fully completed when the patient is ready to be discharged.
- Check with the escort that the postoperative instructions are understood and will be followed.
- Report any problems to the dentist.
- Assist the patient safely from the premises.

Inhalation sedation

This is a conscious sedation technique suitable for child and adult patients, where they inhale a variable mixture of gases so that:

- their anxiety of dental treatment is significantly reduced
- they are willing to receive dental treatment
- they remain conscious throughout and therefore do not require intubation.

The equipment to set out for the procedure is as follows:

- Inhalation sedation trolley which is connected to the oxygen and nitrous oxide gas supplies. The gas flow and percentage of nitrous oxide delivered is controlled with the machine dials.
- Nasal hood with tubing: this is placed over the patient's nose for them to inhale the gas mixture during the session without impeding access to the mouth (Figure 18.14).
- Scavenger tubing: removes exhaled air from the operative area so that waste gases do not build up, as the dental team will be affected by the sedative gas mixture otherwise.

Figure 18.14 Inhalation sedation machine in use with nasal hood in place.

The pulse oximeter and blood pressure machine do not have to be used with inhalation sedation, but it is good practice to do so and record the readings as for IV sedation.

Preoperative checks

The inhalation sedation machine must be checked prior to every use on a patient to ensure that it is working correctly, and this is carried out as follows:

- Check the oxygen and nitrous oxide cylinders are switched on and that the gas is flowing (Figure 18.15).
- The level of nitrous oxide in the cylinder can only be determined by weighing the cylinder, so it cannot be assumed that the dial reading is accurate
- The pin index system on the pipe connections prevents the incorrect connection of the gas cylinders to the delivery machine

when the colour coding is followed.

  - Oxygen: white tubing from the black-with-white-collar tank.
  - Nitrous oxide: blue tubing from the blue tank.

- On the machine, the reservoir bag is filled and checked for any leaks by listening for a gas escape and by squeezing the bag to ensure it does not deflate.
- The oxygen flush button is checked for its correct working, so that the patient can be given 100% oxygen in an emergency (Figure 18.16).
- The nitrous oxide cut-off facility is checked to ensure the flow switches off automatically if the oxygen flow stops, so the machine will not operate without a minimum oxygen flow. Both gas flows are turned on and will show on the vertical flow dials, then the oxygen flow is turned off and the nitrous oxide flow should automatically cut off.
- The minimum flow is set at 30% oxygen, and this is also checked to ensure the flow cannot be reduced any further, so that the maximum nitrous oxide delivery can only be 70%.
- The flow dial calibrations are checked to ensure they work correctly, so if 30% oxygen is given the nitrous oxide should read 70%; if 50%, then 50%, and so on.

Figure 18.15 Nitrous oxide tank with flow dials.

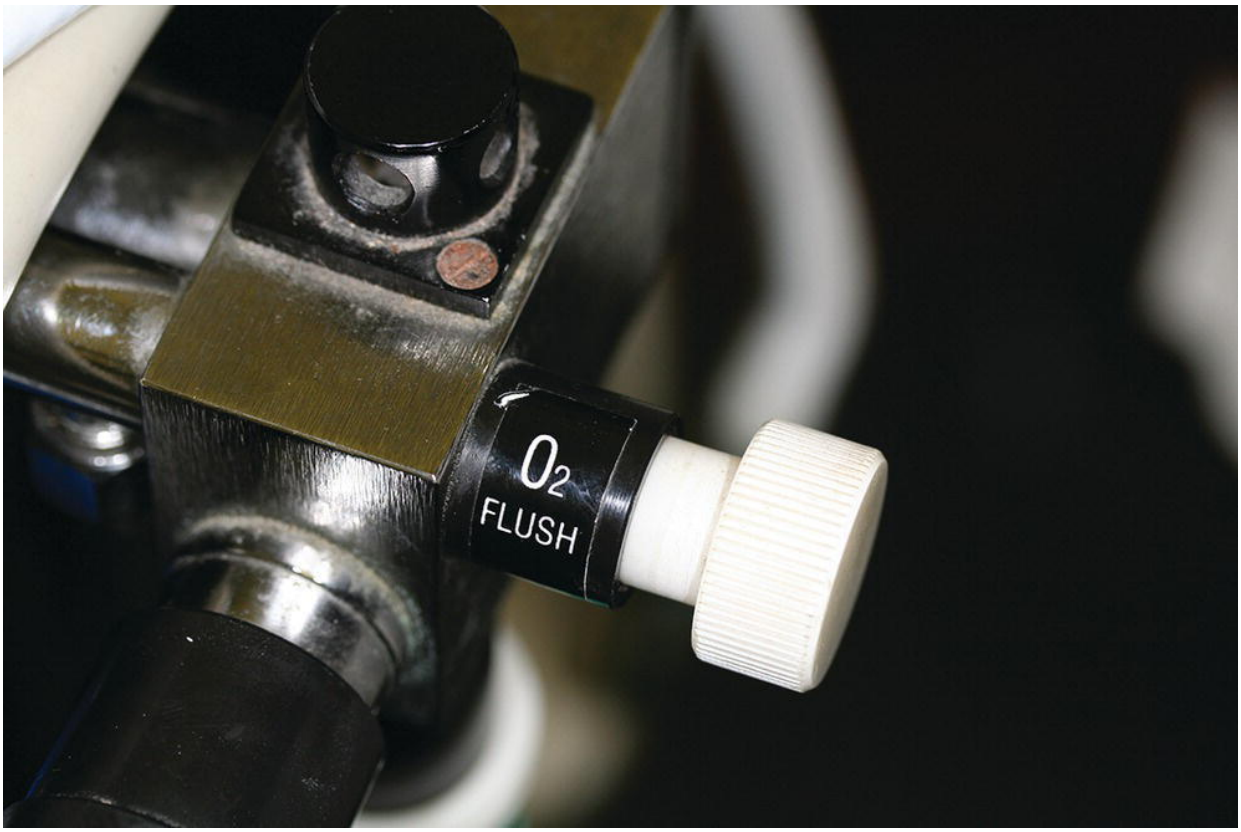


Figure 18.16 Oxygen flush button.

If any of these are inoperative, the machine is not safe to be used and the matter must be reported to the dentist.

Induction and treatment

The role of the dental nurse during induction and treatment is as follows:

- During induction, the nasal hood is placed on the patient and the gas mixture is gradually altered to increase the percentage of nitrous oxide until a suitable level of sedation is achieved.
- The patient may need to be reminded to breathe through their nose and not to talk during induction.
- The technique allows the patient to respond well to a degree of hypnotic suggestion, and it is important not to interrupt the induction during this phase, but still help to keep the patient calm by hand holding for example.

- During the session the patient should be visibly monitored as for IV sedation.
- Keep a note of the maximum percentage of nitrous oxide given to the patient, and whether active or passive scavenging was used. Ideally, scavenging should always be active so that the waste gases are physically drawn away from the area and expelled (it is likely that this will become a compulsory requirement).
- The patient must be given a minimum of 2 minutes of 100% oxygen at the end of treatment before removing the nasal hood and disconnecting the machine, otherwise they will develop diffusion hypoxia.
- Nitrous oxide does not cause patient amnesia, so no inappropriate comments must be made throughout the session.
- The gas does have some analgesic properties, but it is unlikely to be enough for undergoing dental treatment without local anaesthetic.
- The patient should be able to leave the premises within 15 minutes of the end of the inhalation session, and adult patients do not need an escort.
- The machine must be closed down correctly, by switching off the cylinders, flushing out the machine, and disposing of the single-use liner of the nasal hood.

A post-registration qualification in dental sedation nursing is available for dental nurses in the UK, which trains students to a much greater depth of knowledge in both techniques. The qualification awarded is a usual employment requirement for those wishing to work with conscious sedation techniques in the dental hospital setting. Further details are available at www.nebdn.org.

Further skills in assisting in the treatment of orthodontic patients

In the UK, most orthodontic treatment is carried out in specialist practices or clinics so many dental nurses have little or no access to the speciality in general practice. For those dental nurses who do work in this speciality, one with extended duties in this area of dentistry is a valuable member of the team in delivering this treatment, along with the dentist and the orthodontic therapist. The extended duties that can be developed include any and all of the following:

- Recognition and laying out of the specialist orthodontic instruments and materials: although this area of dentistry is included in the dental nurse curriculum of the registrable qualification, the knowledge required is only to a basic level.
- Setting up of brackets and tubes for the bonding of fixed appliances.
- Specific oral hygiene instruction for orthodontic patients.
- Measurement and recording of plaque indices before, during and after treatment (this skill can be gained as a separate extended duty; see later).
- Tracing cephalographs (this skill can be gained as a separate extended duty; see later).

Laying out instruments and materials

The majority of orthodontic treatment carried out on younger patients in the NHS involves the use of removable, functional or conventional fixed appliances (see Chapter 16 for further details). Many of the instruments and materials required for the fitting/bonding, adjustment, and removal of these appliances are unique to this speciality and are therefore unlikely to be familiar to many dental nurses. Table 18.2 lists the most likely instruments to be required for removable appliances (Figure 18.17) and conventional fixed appliances (Figure 18.18) and their functions. Those to be laid

out will be determined by the appliance involved and the stage of the treatment that is being undertaken.

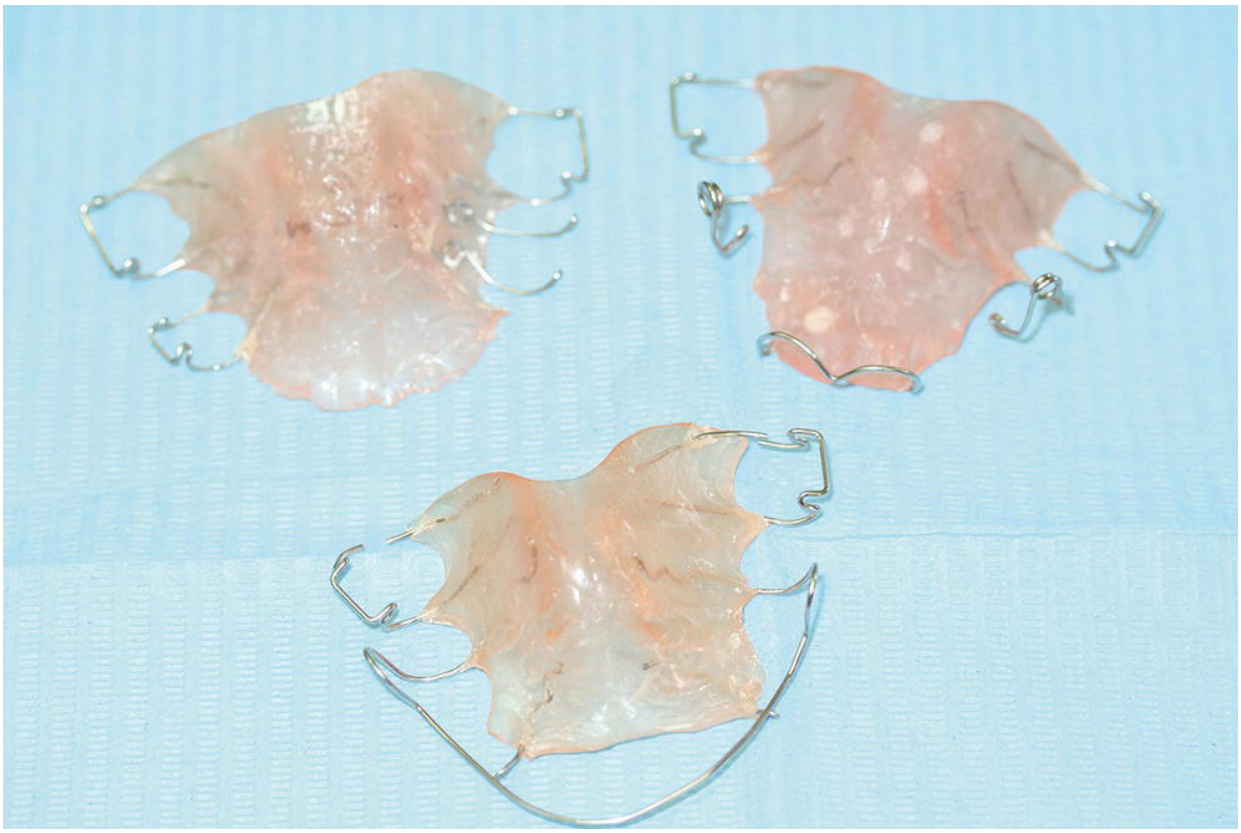


Figure 18.17 Examples of removable orthodontic appliances.

Figure 18.18 Conventional upper fixed appliance in place.

Table 18.2 Instruments required for removable appliances and conventional fixed appliances.

Item	Function
Adam's pliers (see Figure 16.63)	Removable appliance: to tighten cribs, adjust springs and retractors
Straight handpiece with acrylic bur (see Figure 16.64)	Removable appliance: to trim the acrylic base plate of the appliance
Measuring ruler (Figure 18.19a)	Removable and fixed appliances: to take accurate measurements of tooth movements, such as the overjet
Bracket holders (Figure 18.19b)	Fixed appliance: to pick up, hold and position individual brackets during their bonding onto the teeth
Alastik/elastic holders (Figure 18.19c)	Fixed appliance: ratcheted design to pick up and tightly grip alastiks and elastics as they are used to tie in the archwire to the bracket (alastik) or to provide traction to teeth (elastics)
Archwire (end) cutters (Figure 18.19d)	Fixed appliance: angled wire cutters to trim off the excess ends of the archwire from directly behind the molar band or tube, often with a self-gripping attachment so that the cut piece of wire can be safely removed from the mouth
Wire cutters (see Figure 16.58a)	Fixed appliance: straight wire cutters to trim off the ends of wire ties or ligatures
Bracket removers (see Figure 16.58b)	Fixed appliance: chisel-ended pliers to remove brackets from the teeth at the end of treatment or when a bracket needs removing and repositioning

Item	Function
Band removers (see Figure 16.58c)	Fixed appliance: chisel-ended blade and a plastic stopper to remove bands at the end of treatment. The stopper rests on the occlusal surface of the tooth while the other blade is located at the gingival rim of the band, and then the pliers are squeezed together to dislodge the band from the tooth

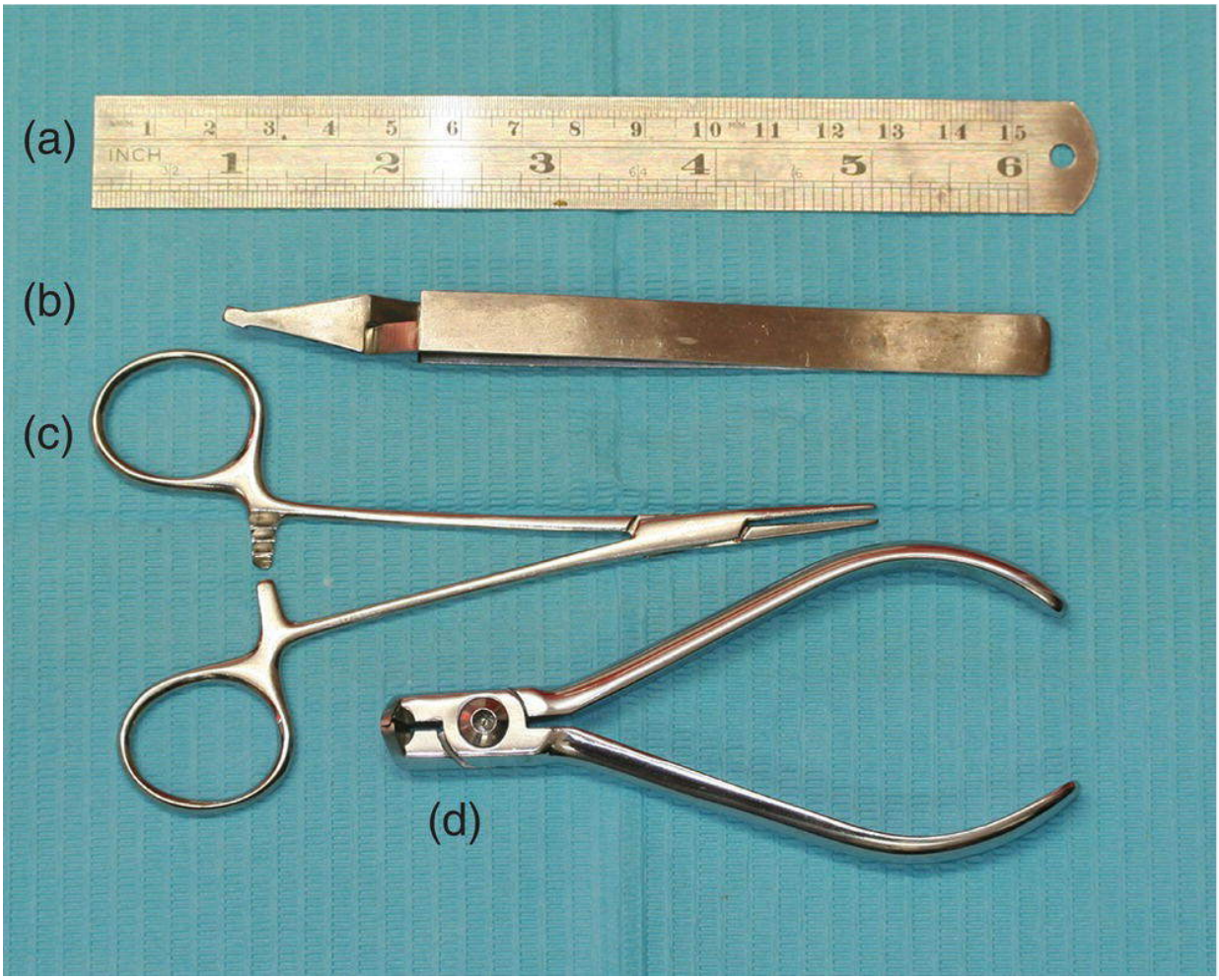


Figure 18.19 (a) Measuring ruler. (b) Bracket holders. (c) Alastik/elastic holders. (d) Archwire end cutters.

The materials that may be required to be laid out are as follows:

- Alginate impression material and water for preoperative and postoperative study models, and for the working model when a removable appliance is to be constructed (Figure 18.20).

- Acid etch and a suitable bonding agent when a fixed appliance is to be placed.
- Luting cement for the cementation of molar bands (see Figure 15.40).

Figure 18.20 Equipment and materials for taking a set of simple study models.

Setting up for a bonding procedure

Bonding a conventional fixed appliance to an upper, lower or both arches is a fiddly and sometimes time-consuming procedure, and forward preparation is a key element in the smooth running of the appointment, for both the patient and the dentist.

The dental nurse can assist greatly by being trained to set out the brackets and molar tubes beforehand. This is best done using an orientation card with a sticky backing on which the brackets and tubes can be firmly located, ready for the procedure. Each bracket and tube is designed for use on a specific tooth only and great care must

be taken in orientating each one correctly. Brackets have coloured dots placed on their distogingival wing by the manufacturers to assist in their identification, but the colours used may vary between suppliers, so bracket sets should not become mixed together. The exception is lower incisor brackets which have a rounded base that follows the gingival margin of the tooth but can otherwise be used on any of the lower incisors. Canine brackets can also have distogingival hooks placed by the manufacturer for use with elastic traction. Molar tubes have distally orientated hooks which are set gingivally, so upper right molar tubes can also be used on lower left molars, and upper left molar tubes can also be used on lower right molars.

When placing the brackets, the dental nurse should use the bracket holders so that they become familiar with their use and handling.

A correctly laid out orientation card for an upper bonding is shown in Figure 18.21.

Figure 18.21 Orientation card laid out for upper arch bonding.

Orthodontic oral hygiene instruction

Both removable and fixed appliances provide many more stagnation areas in the patient's mouth than would exist without the appliance *in situ*, and the high level of oral hygiene that must be maintained throughout orthodontic treatment is imperative if permanent tooth damage and localised gingival problems are to be avoided. The patient must be taught how and when to clean adequately around their appliance, as well as any necessary dietary controls to be followed during the treatment phase. This oral hygiene instruction can be delivered by a suitably trained dental nurse.

Over and above any general oral hygiene advice and instruction which is relevant to all patients, that specific to those wearing removable or fixed appliances is as follows:

- Food and drink must be confined to mealtimes rather than having snacks throughout the day, as the teeth will need cleaning every time something has been consumed so that food debris is not held against the teeth by the appliance.
- The quantity of food and drink containing free sugars and acids must be kept to an absolute minimum, to reduce the potential of causing cavities during treatment.
- The removable appliance must be removed and cleaned twice daily with a toothbrush and toothpaste, taking care not to damage any springs or clasps while doing so.
- Cleaning should be carried out over a sink of water so that, if dropped, the appliance will not break.
- Both fluoride mouthwash (see Figure 13.15) and toothpaste should be used during the treatment phase on a daily basis, to provide maximum protection against caries.
- Patients should be encouraged to self-disclose their teeth on a weekly basis to ensure their oral hygiene regime is adequate.
- If extraction spaces are present in the dental arch, the patient should be instructed in the use of an interspace brush to clean the area effectively until space closure occurs.
- Patients wearing fixed appliances should be instructed in the use of interdental brushes to clean around each bracket where the archwire passes over, as this is a particular stagnation area where

ordinary manual toothbrushing is not sufficient (see Figure 16.59).

- Alternatively, the patient can be instructed in the use of an electric toothbrush with an orthodontic head attachment to clean these areas (Figure 18.22).

Figure 18.22 Orthodontic head for an electric toothbrush.

In either form of orthodontic treatment, if a less than adequate level of oral hygiene is being maintained by the patient then the dental nurse can provide a one-to-one disclosing and cleaning session, to emphasise the problem areas and help the patient to improve their plaque removal.

A post-registration qualification in orthodontic dental nursing is available, which trains students to a much greater depth in this speciality and is particularly useful for those dental nurses wishing to work in a specialist orthodontic workplace. Further details are available at www.nebdn.org.

Intraoral and extraoral photography

Photographs are an important diagnostic and assessment tool for the clinician, as well as being a powerful method of convincing patients that a dental problem exists or of showing them the before and after appearance of suggested dental treatments. Digital images in particular are extremely useful when a second opinion is required about a case (especially potentially suspicious soft tissue lesions), as they can be securely emailed to a specialist. Away from the hospital environment, photographs are used a great deal to assist in orthodontic assessments and to provide before and after views once orthodontic treatment has been completed. A suitably trained dental nurse can be tasked to take both intraoral and extraoral photographs for these purposes.

Old-style clinical photography involved the use of 'instamatic' type cameras, which produced a hard-copy 'polaroid' image within a few minutes. Digital imagery produces instant images without the need for film, and these can be loaded directly onto a computer and also downloaded onto a disk or a flash-drive, or as hard copy if required. Once on the computer screen, they can be 'zoomed in' so that the image (or a section of it) can be enlarged, although the clarity of the picture deteriorates after a certain point. An example of a suitable camera and attachments for clinical photography is shown in Figure 18.23.

Figure 18.23 Example of a digital camera with ring flash attached.

The particular features of the camera and its potential uses are as follows:

- The camera body has interchangeable lenses: the one required for intraoral (close-up) photography is a macro lens.
- The ring flash targets sufficient diffuse light directly at the object, rather than a bright burst of intense light in the surroundings as produced by an ordinary flash. It is simply screwed onto the camera body top and to the lens with a ring adapter.
- The mode dial on top of the camera body allows the camera to automatically set itself to take images in the selected mode: portrait, landscape, close-up, night shot, moving, and so on.
- The lens focus mode switch on the side of the lens is used to change between automatic focus (AF) and manual focus (MF). Usually AF is used, but when intraoral images are taken looking into the mouth, sometimes the camera automatically focuses on the lip or an anterior tooth, when the image required is more posterior. In these cases MF should be used and the lens focused manually by the operator onto the required focal point. The use of a tripod stand in this situation is particularly useful to ensure the camera remains steady during exposure and the image is not blurred.
- When taking intraoral images, the soft tissues often need retracting either by hand, with a mouth mirror, or using specific lip retractors (Figure 18.24).
- Difficult to see areas such as the upper arch or lingual to the lower incisors can be viewed more easily with the use of oral mirrors (see Figure 11.20). These are best run under cold water before use to prevent them misting as the patient breathes.
- Figure 18.25 shows a typical portrait-style view, while Figure 18.26 shows an intraoral view of a prepared cavity in the upper right first molar tooth. The lens focus mode was set to MF to avoid the camera automatically focusing on the anterior teeth.
- Images can be viewed immediately on the camera viewer or they are loaded onto the computer for a larger and more detailed image.
- The memory card from the camera is removed and inserted into the correct entry port of a card reader device; an adapter may be

necessary for some card types (Figure 18.27).

- A USB cable connects the card reader to the computer and the images will be present in the 'removable disk device' option. They can then be uploaded en masse as a file to the computer, or individually as a JPEG.
- As the images are accessible immediately, any that require retakes can be carried out while the patient is still present.

Figure 18.24 Lip retractors in use during clinical photography.

Figure 18.25 Typical portrait view.

Figure 18.26 Intraoral view of a cavity in the upper right first molar tooth.

Figure 18.27 Examples of memory card readers and adapters.

Pouring, casting and trimming study models

Study models enable the dentist to study the patient's dentition and occlusion outside the mouth and from all angles. This 'extra dimension' is often invaluable in determining diagnoses and issues that were not obvious simply by looking in the mouth. They are particularly useful for orthodontic assessments, occlusal analyses, partial denture design, and as a permanent record of the dentition at a point in time when conditions such as non-carious tooth surface loss are being monitored. They are produced as stone casts poured into alginate impressions and are usually made in the dental laboratory. However, where many study model sets are required in the dental workplace on a regular basis, the task can be carried out by the dental nurse on the premises following adequate training, so that the models are produced more speedily and at a much-reduced cost to the workplace. In addition, accurate study models can be produced as soon as the alginate impressions have been taken and disinfected on the premises, rather than awaiting collection and transfer to the laboratory some days later.

There are three stages to the production of a set of study models.

- **Pouring**: the initial accurate filling of each disinfected alginate impression with a flowable mix of dental stone material, to record the tooth and soft tissue detail of each arch.
- **Casting**: the shaping of the study model itself by the hardening (setting) of the dental stone within the mould of the alginate impression.
- **Trimming**: the addition and accurate trimming of plaster bases to the study models in their correct occlusion, so that the study model set can stand alone and be viewed from all angles with the teeth recorded in their actual bite positions.

Pouring

The alginate impressions and bite record (either a simple wax bite record or a full arch bite registration; see Figure 16.20) are disinfected in the usual manner and any excess fluid is removed from their surface by careful shaking of the impressions into the sink. Excess

fluid droplets on the alginate surface are likely to result in air blows and a poor dental stone surface on the model.

Dental stone is a hardened calcium-based plaster material which does not react with impression materials, and which is able to reproduce fine detail and sharp margins when set, so the study models produced are very accurate. Coloured dies are usually added to the material: yellow for study models and pink or green for even harder products used for crown and bridge work.

Although a conventional alginate mixing bowl and spatula can be used to mix the stone, the technique is quite different from that used to mix alginate (see later). The mixed dental stone must have the following properties to provide an accurate casting of the impression:

- Correct water to powder ratio to produce a flowable mix that can be poured into the impression.
- No lumps of unmixed powder present.
- No excess water present.
- No air bubbles present.

Unfortunately, achieving the correct mixing ratio comes with experience rather than by measuring a set weight of powder and mixing it with a set volume of water – differences in manufacturer alone creates variable mixes. Fortunately, dental stone is inexpensive and practice makes perfect!

Dental stone is mixed and poured as follows:

- Cold water is run into the mixing bowl: the volume depends on whether the two study models are being cast from one mix or from two mixes, but as an average use 50 ml.
- The powder is sifted onto the top of the water and allowed to sink in until only a little free water remains (Figure 18.28).
- The powder and water are then carefully **folded** together to create a smooth slurry consistency, with no lumps of powder or unmixed water remaining (Figure 18.29).

- Stirring and spatulation actions must **not** be used as this will incorporate air bubbles into the mix.
- A vibration plate can be used to ensure that air bubbles are removed from the mix before pouring, but holding the mixing bowl lightly on the top of the ultrasonic bath while running provides an adequate alternative method.
- When ready, the flowable mix is poured into the impression at either the right or left most distal tooth and then the tray is tipped to allow the mix to flow from this point around the full arch to the other distal tooth in one motion. This tends to push air before it and out of the impression recesses as the mix flows around the impression (Figure 18.30).
- The mix should fill the impression to above the gingival margins of the teeth and be prevented from pouring out of the back of the impression by raising and supporting the back of the tray (Figure 18.31).

Figure 18.28 Sifted stone powder in water before mixing.

Figure 18.29 Slurry consistency of mix before pouring.

Figure 18.30 Running the stone mix around the impression to eliminate air trapping.

Figure 18.31 Filled impression with back end supported to avoid run-off.

Casting

At this point, more powder can be added to any unused mix to make a stiffer dental stone which can be carefully loaded onto the top of the impression. This produces a more robust model for handling later, rather than a weak horseshoe-shaped rim recording the teeth only, which is likely to fracture when removed from the impression. The 'construction' produced can either be left in this position to set fully, or it can be turned upside down so that the stiffer mix forms a flat base to the cast (Figure 18.32). Either way, care must be taken to ensure that the mix does not come into contact with the edges of the impression tray itself during setting, as this will make it difficult to remove the tray and impression later without fracturing the teeth of the casting produced.

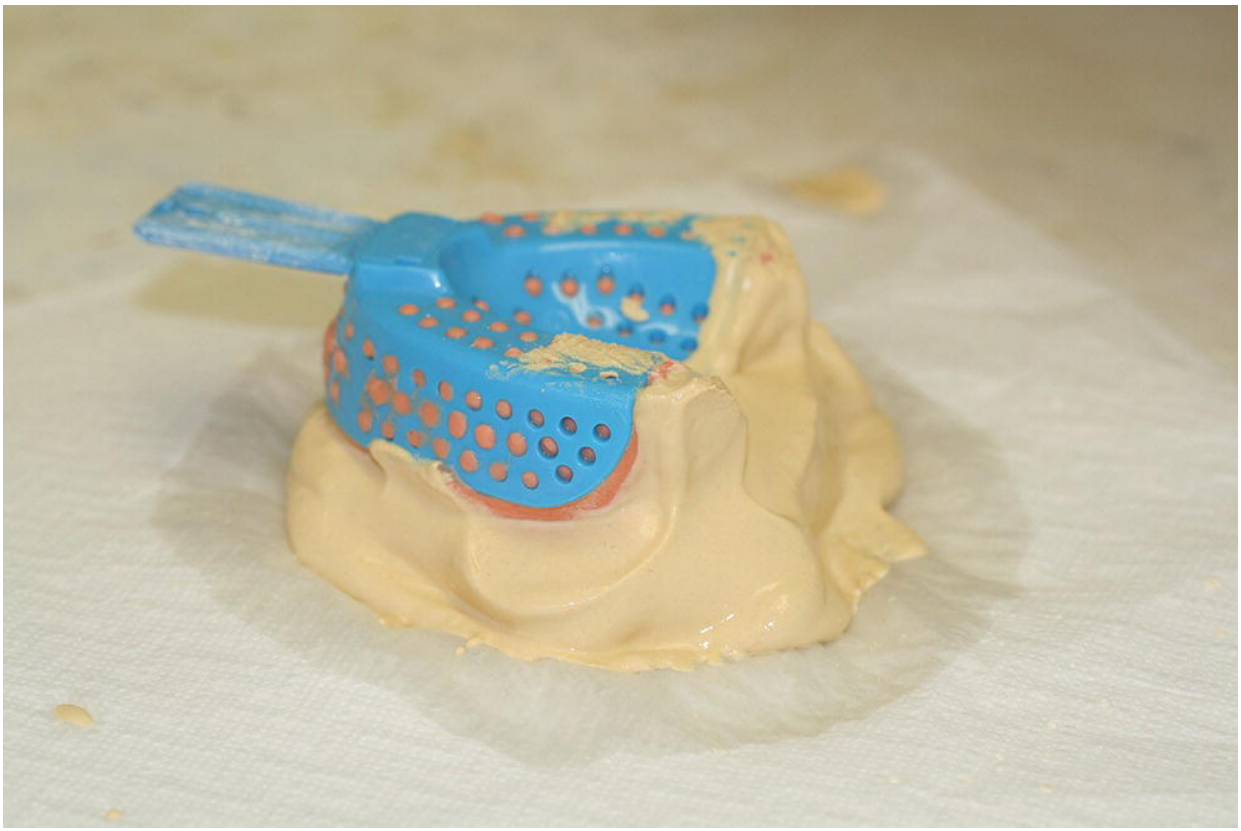


Figure 18.32 Loaded impression on stone base during casting.

The setting reaction is exothermic (gives off heat) and the dental stone will feel warm to the touch. Once the casting is cold to the touch it can be assumed that setting is complete, but it is best to leave the casting untouched for several hours to ensure full setting has occurred.

The easiest way of ensuring that the casting does not fracture as it is removed from the impression is to remove the tray first, using an instrument such as a spatula or wax knife to lever it off the casting while leaving the impression intact (Figure 18.33). The revealed impression can then be carefully peeled off the model in pieces so that fractures are avoided. Although fractures destroy the impression, if the casting produced is faulty (such as having air blows present) the impression could not have been reused anyway and a new impression will be required.

Figure 18.33 Tray removed before impression is peeled from casting.

Trimming

The dental stone castings now need to be positioned together in correct occlusion so that they can be viewed by the dentist in a reproducible position while diagnoses and treatment plans are formulated. This involves placing the bite registration so that the castings occlude correctly, then seating them into shaped bases made of dental plaster which, once set, allows the study models to be viewed separately and then repositioned into their correct occlusion repeatedly. Alternatively, the castings are seated onto unshaped mounds of plaster and then shaped by hand. In either technique, the base of the lower model must be parallel to the occlusal plane so that the models are not set in a 'tipped' position. Dental plaster is used as

it is not as hard as dental stone and therefore easier to trim using a carborundum wheel. This technique was often used in the dental laboratory, while that using pre-shaped plastic bases with alignment tags (Figure 18.34) tends to be used now in both the laboratory and the dental workplace. The key to success is to ensure that the back edges of the pre-shaped bases are exactly in line with each other during setting and with the bite registration in place using the alignment tags, so that the study models can only be placed in their correct positions once the bases are formed.

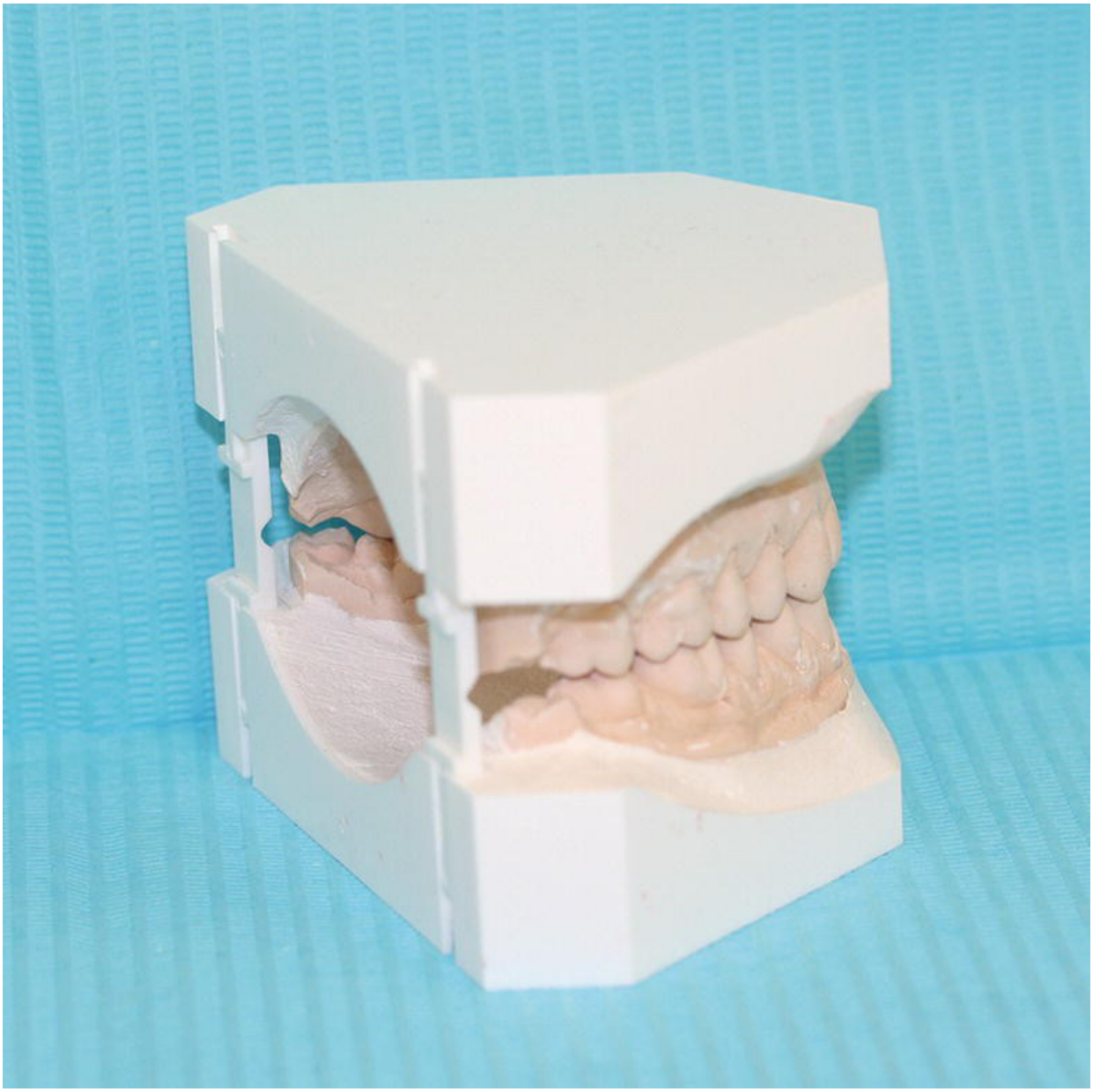


Figure 18.34 Pre-shaped plastic bases and alignment tags used to complete the study model set.

Dental plaster is mixed in the same way as dental stone but to a much stiffer mix which is able to support the casting while the plaster base sets, without the casting sinking into it.

Once the final set of study models have been trimmed accordingly, they can be used by the dentist as necessary (Figure 18.35).

Figure 18.35 Completed set of trimmed study models.

Tracing cephalographs

In simple terms, a cephalograph is a tracing made from a lateral skull radiograph which is used in orthodontics for various reasons.

- To help determine the skeletal pattern of the patient before treatment.
- To help determine the likelihood for orthognathic surgery to correct more severe cases.
- To monitor the skull and jaw growth of the patient.
- To assess skeletal changes that have occurred due to orthodontic treatment and natural growth.

While the skill of tracing the various points on the cephalograph is a useful extended duty for dental nurses working in specialist orthodontic environments, the interpretation of the findings is for the dentist to understand and act upon. Consequently, only the basics of tracing skills is discussed here.

The typical lateral skull radiograph (Figure 18.36) is produced as a two-dimensional 'side view' of the patient's skull with no horizontal distortion, so the earpieces used to hold the patient's head immobile are superimposed directly over each other and appear as one on the image.

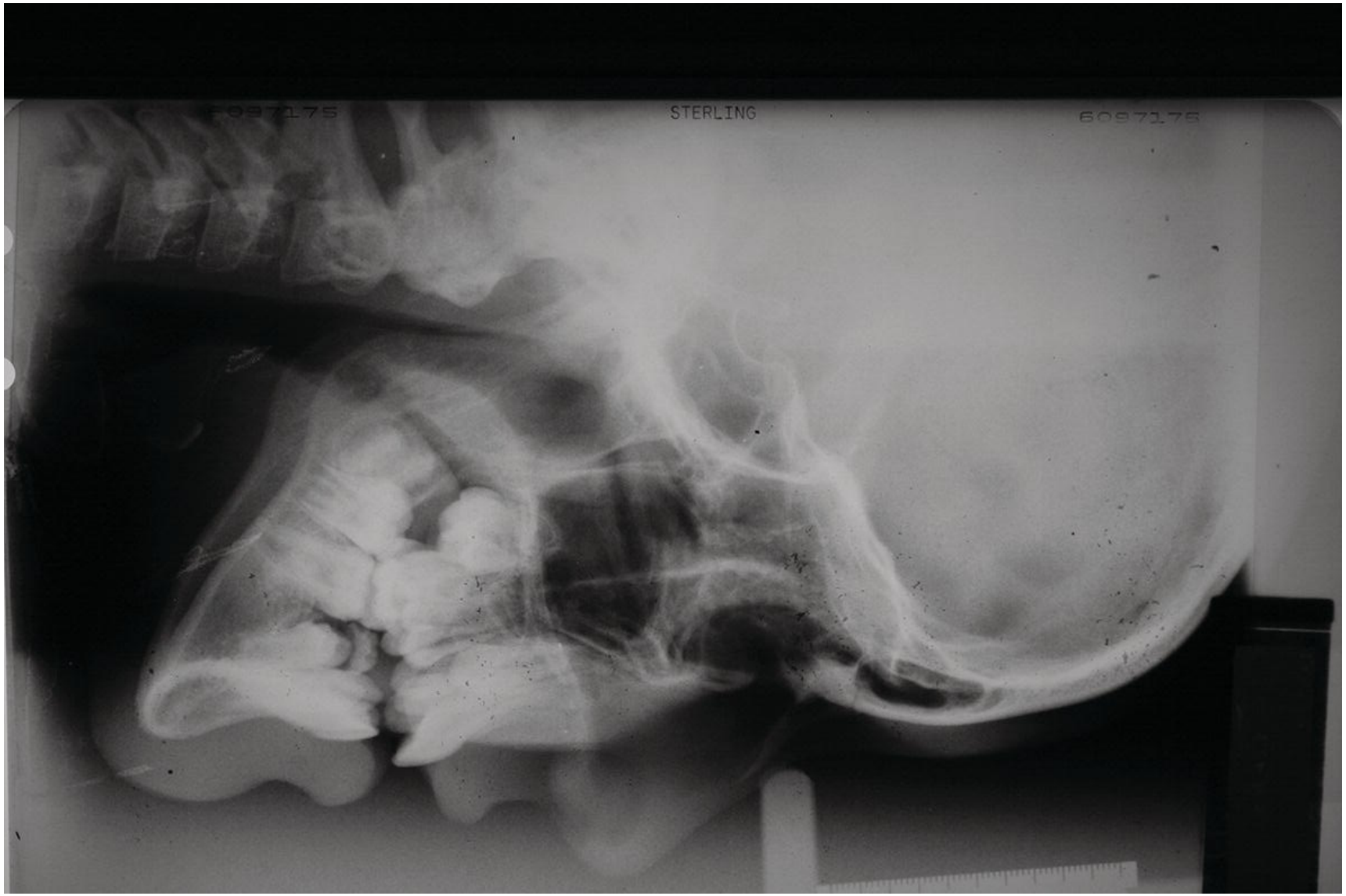

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Figure 18.36 Lateral skull radiograph on viewer showing side view of the patient's skull.

Once the radiograph has been processed (or printed as hard copy if a digital technique is used) the image is taped to an X-ray viewing screen and overlaid with either a taped sheet of tracing paper or a taped sheet of acetate film, which is more durable. Taping the radiograph and overlay in place prevents unwanted movements during tracing and therefore produces a more accurate result.

Using a hard pencil or a fine felt-tip pen, the soft tissue outline of the patient's face is traced from the radiograph followed by the following features, all shown in purple in Figure 18.37.

- The junction of the frontal bone with the nasal bone (a).
- Sella turcica: the bony depression in the sphenoid bone where the pituitary gland lies (b).
- Outline of the upper central incisor in the alveolar ridge (c).
- Anterior and posterior nasal spines of the palate (d).
- Outline of the lower central incisor in the alveolar ridge (e).
- Lower border of the mandible to the ramus (f).

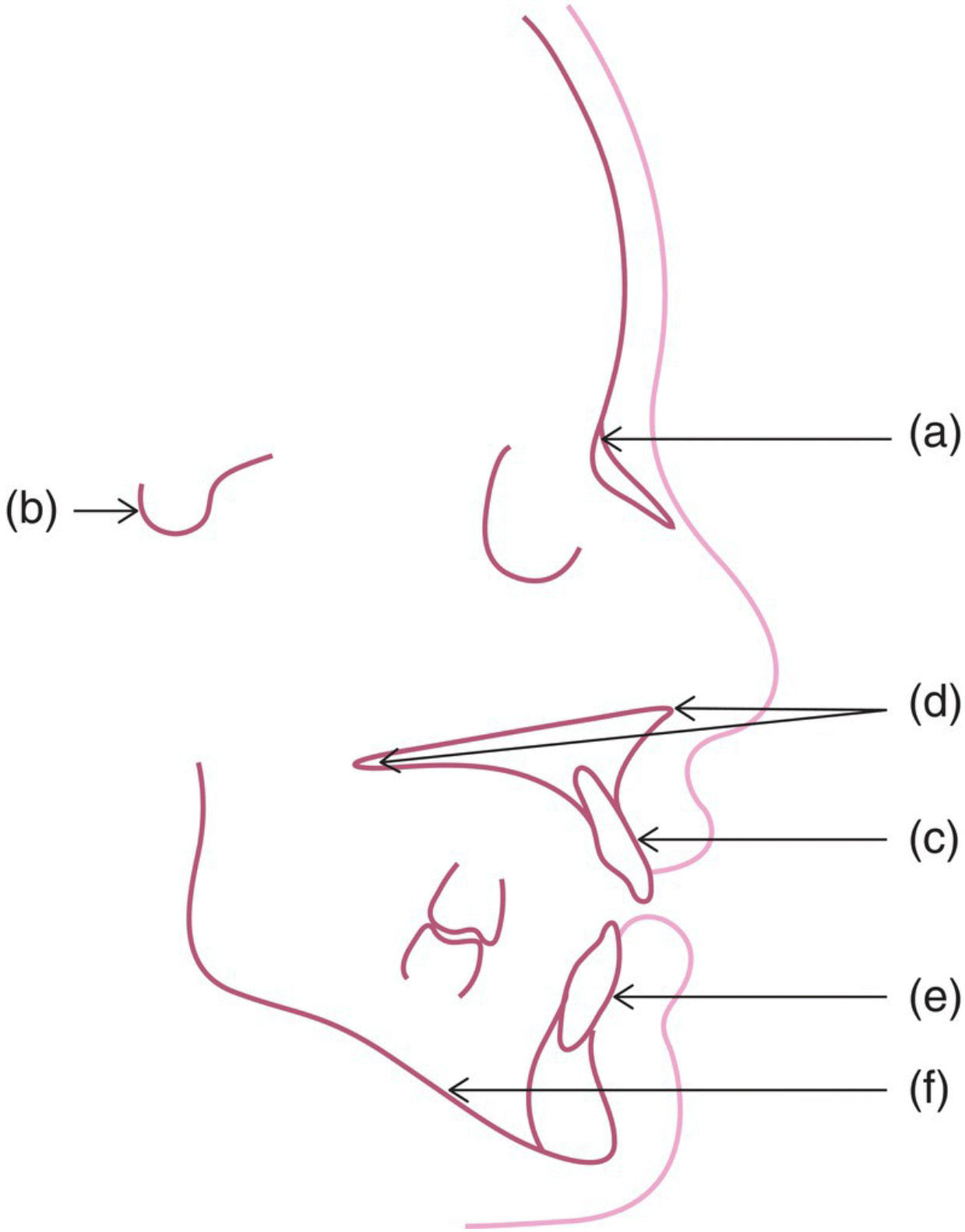

Figure 18.37 Initial traced features of cephalograph.

With these features traced, the following points can then be marked on the cephalograph (the anatomical descriptions have been simplified where possible), all shown in blue in Figure 18.38.

- Point S: the centre-point of the sella turcica.
- Point N: the nasion, the most anterior point of the frontonasal suture (at the bridge of the nose).
- Point A: the deepest point of the upper alveolar ridge.
- Point B: the deepest point of the lower alveolar ridge.

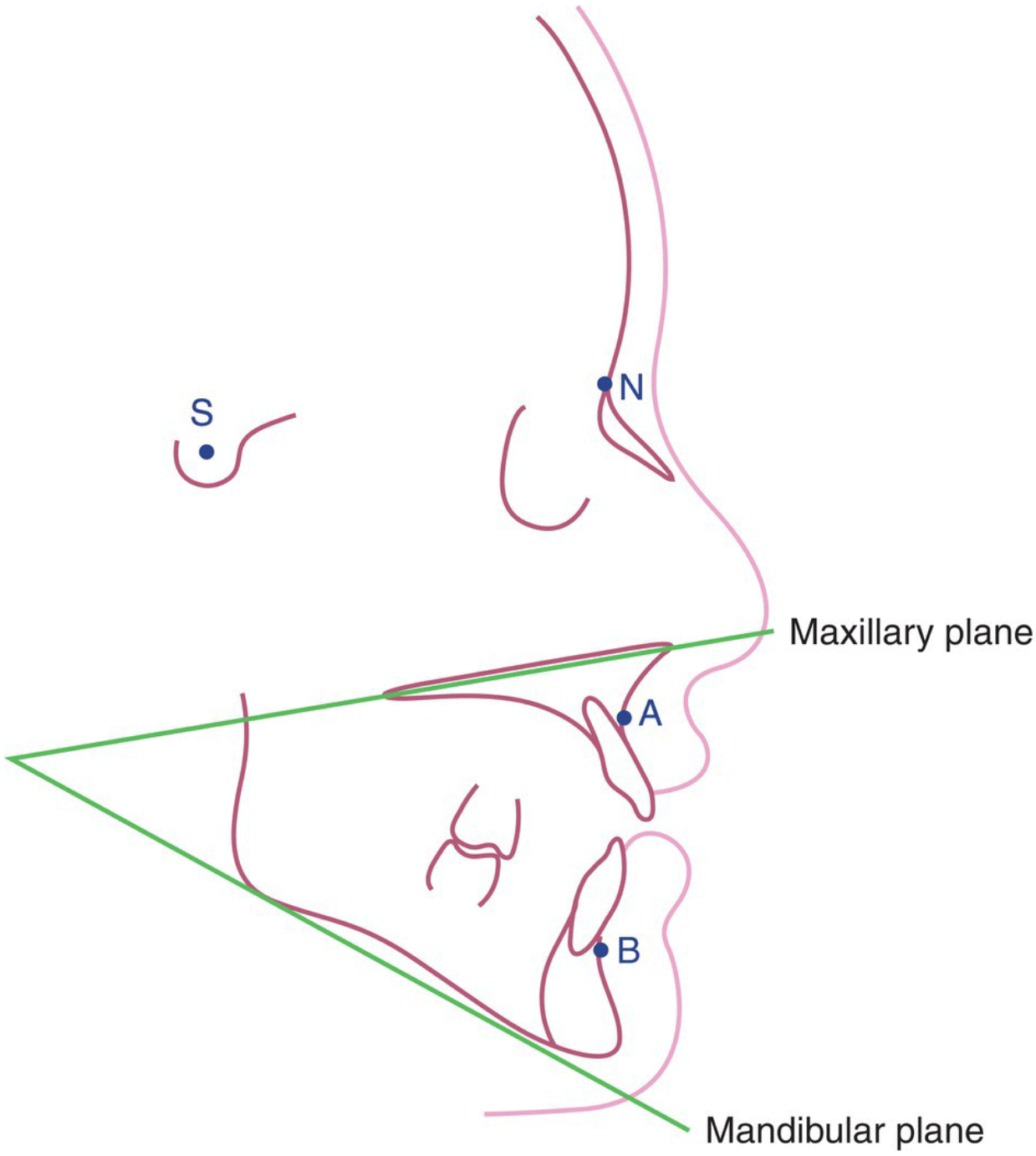

Figure 18.38 Points and planes recorded on the tracing.

Finally, the maxillary plane can be drawn as a line between the anterior and posterior nasal spines, and the mandibular plane as a line representing the lower border of the mandible; both shown in green on Figure 18.38.

The radiograph is removed from the viewer so that just the tracing remains. Lines are then drawn between the various anatomical points and the necessary angles measured to provide the cephalography information for orthodontic analysis:

- SNA angle
- SNB angle
- ANB angle
- M/M angle (maxillary–mandibular planes angle).

A completed tracing with the angles measured is shown in Figure 18.39. This can then be passed to the dentist for analysis.

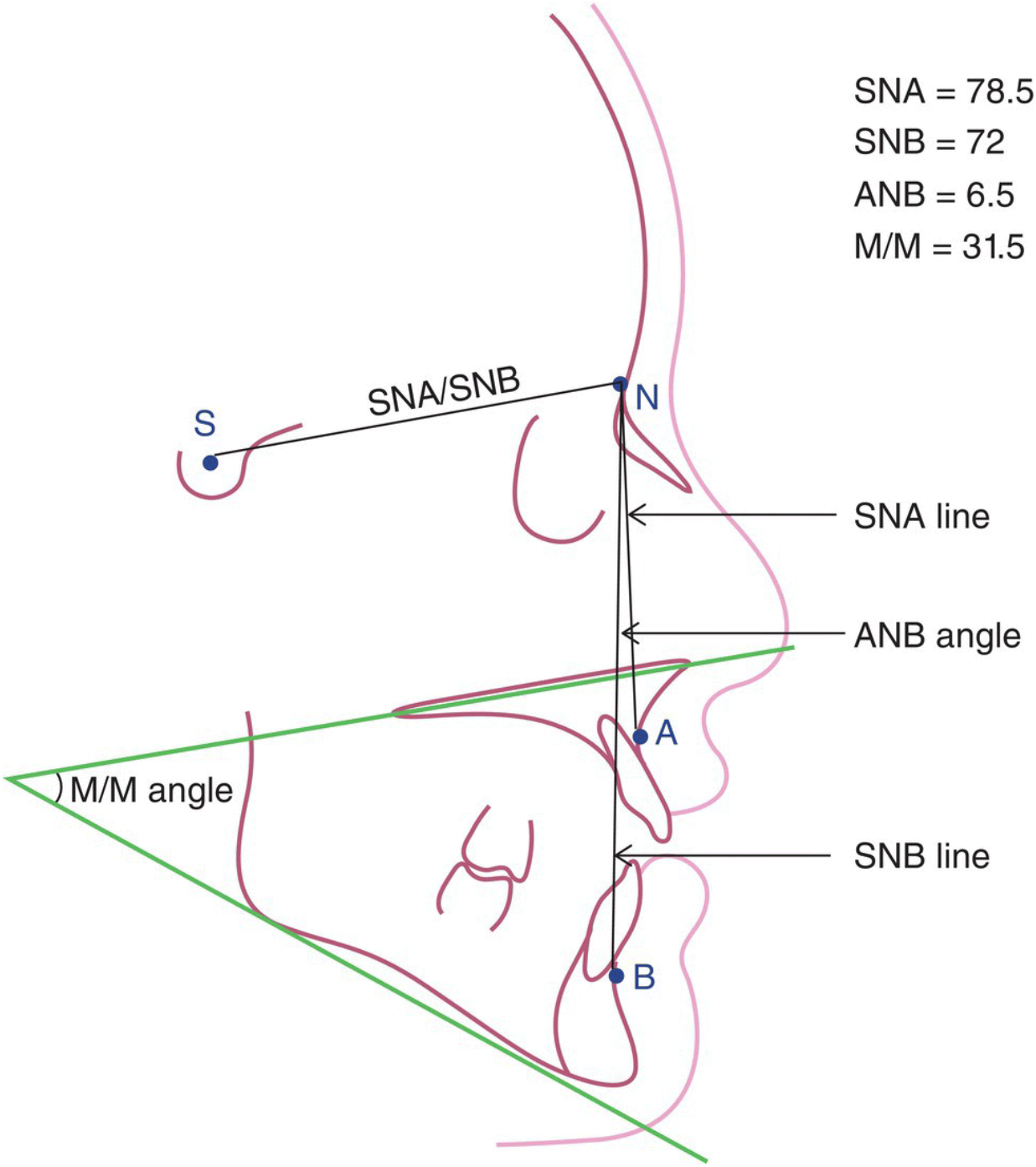

Figure 18.39 Completed tracing of cephalograph.

Taking impressions

Alginate impressions are the most frequently taken and widely useful of the impression materials available. They are used to produce study models in various fields of dentistry, to produce opposing models and initial models in fixed and removable prosthodontics, and to produce models for the construction of mouthguards, vacuum-formed retainers and whitening trays (see later).

A trained and competent dental nurse who is able to take consistently good-quality and therefore useful alginate impressions is an asset to any dental workplace. The stages involved in taking alginate impressions are as follows:

- Selection of the patient: many patients are fearful of undergoing impression taking, as they believe they will choke, gag or vomit, and excessively fearful patients are best left to the dentist to handle.
- Selection of the trays.
- Mixing of the alginate and loading of the trays.
- Insertion of the loaded trays.
- Removal of the trays after setting.
- Monitoring and handling of the patient throughout.

The equipment and materials required to take a set of study models are shown in Figure 18.40.

Figure 18.40 Equipment and materials for taking a set of simple study models.

Selection of the trays

It is usual for single-use perforated box trays to be used for alginate impression taking, with the correct tray handle inserted before use, although metal trays with an adhesive applied can also be used. Tray handles should always be used otherwise the trays may be difficult to remove once the alginate has set.

Suitably sized trays should just fit over the dental arch in either jaw, without being excessively wide (they will be difficult to insert through the oral aperture of the lips), without being excessively long (they need go no further posteriorly than the end of the dental arch), and without being excessively short (they must record the full length of the dental arch). A trial tray insertion must always be carried out on the patient before proceeding with the impression taking, to avoid poor-quality impressions which will need to be retaken. When a chosen tray has been inserted, it should be lifted up and down over

the dental arch; if there is any catching on the teeth, or any resistance to being fully seated, then the tray is too narrow. This is demonstrated in Figure 18.41.

(a) (b)

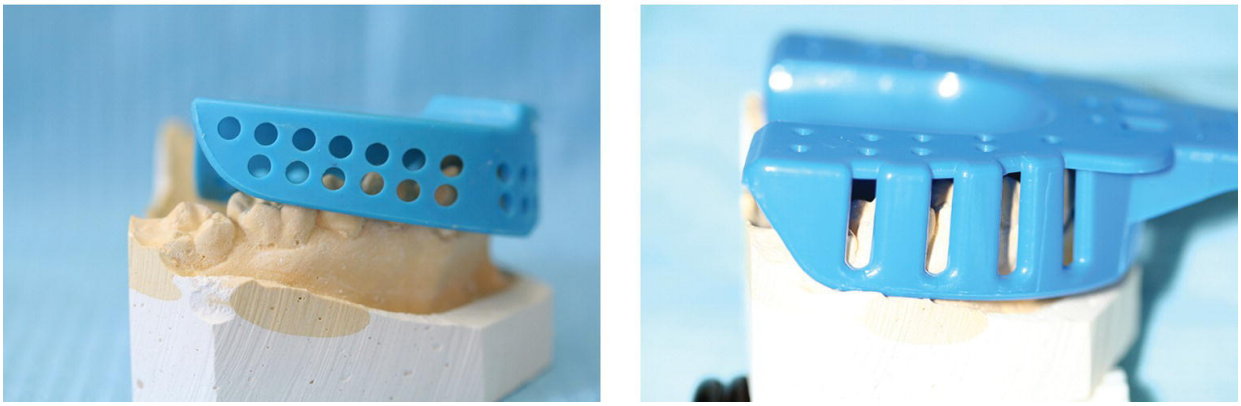

Figure 18.41 Sizing of tray for impression taking. (a) Tray catching molar teeth: too narrow. (b) Correct tray size, just covering the dental arch.

Usually, upper trays are used for upper impressions and lowers for lower impressions. However, on occasions when the palate does not need to be recorded (such as with retainers and bleaching trays) a suitably sized lower tray may be used in the upper arch, and this is also less likely to stimulate a gag reflex in some patients.

Mixing of the alginate and loading of the trays

All dental nurses will be familiar with the correct mixing of alginate, and the technique is summarised below.

- Ensure the powder measuring scoop and the water measure are for the same material, otherwise the 1:1 powder to water proportions will be incorrect.
- Shake the powder container to mix the contents.
- Use full and levelled scoops of powder – usually two are required for each impression.
- Make a well in the powder in the mixing bowl and pour the room-temperature water into the centre of the well (Figure 18.42a).

- Fold the powder into the water initially, then vigorously mix and spatulate the mixture against the sides of the bowl (Figure 18.42b).
- Ensure all the powder is mixed in and that no air bubbles have been introduced into the mix. When fully mixed it should have a uniform consistency (Figure 18.42c).

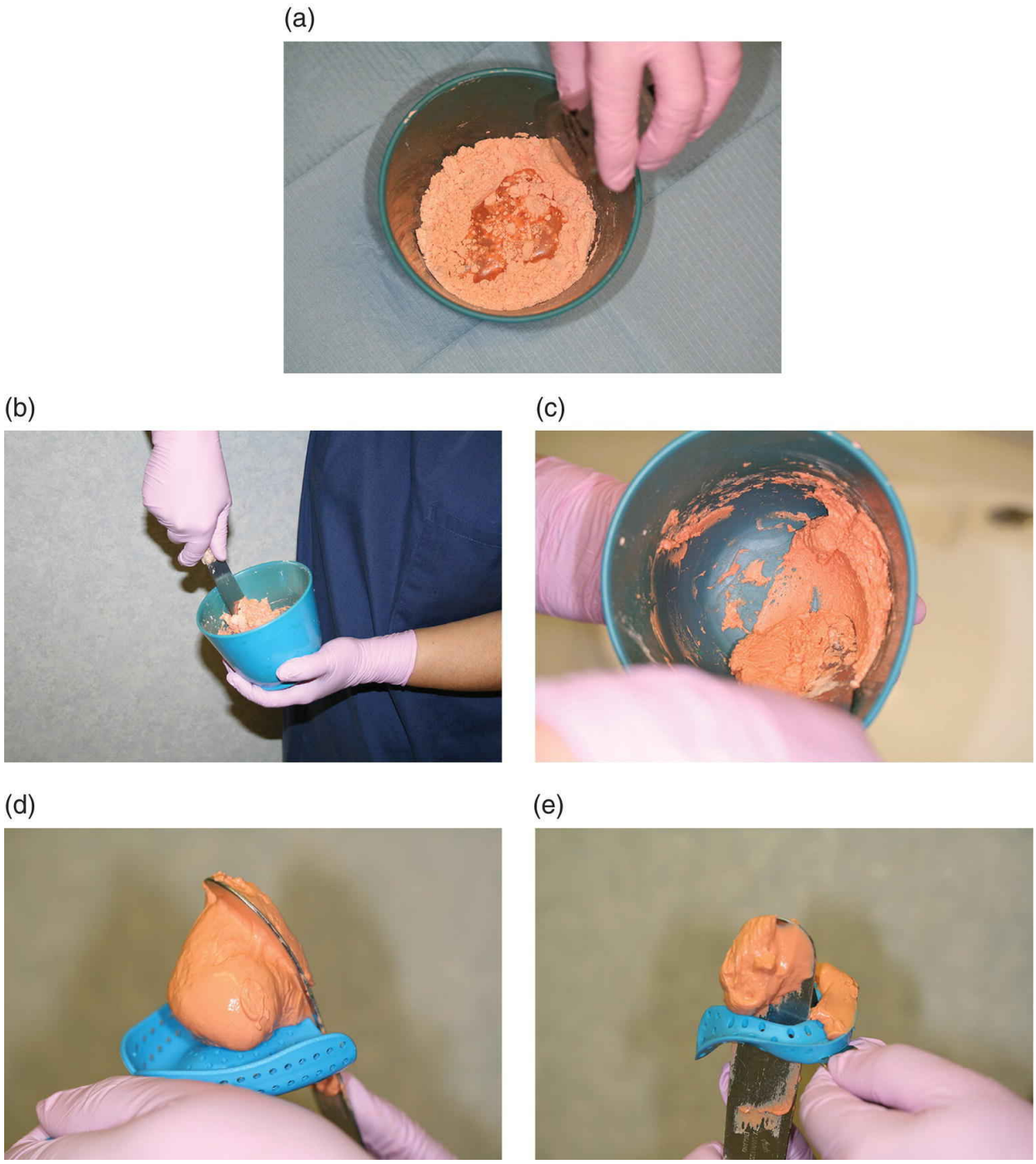

Figure 18.42 (a–e) Alginate mixing and tray loading.

Upper trays are loaded with the full mix gathered on the spatula, and from the back of the tray forwards so that it is loaded uniformly across its whole width and length (Figure 18.42d).

Lower trays are loaded in two stages with half the mix gathered on the spatula for each. The first half of the mix is loaded into one half of the

tray from the inner side of the tray arch, and the second half into the other side (Figure 18.42e) so that the tray is equally filled with the impression material.

Insertion of the trays

Each impression is mixed, loaded, inserted and removed one at a time. The insertion technique is as follows:

- The patient will be wearing a waterproof bib, and sitting upright in the dental chair.
- They will be instructed to relax their lips and to breathe at a normal rate through their nose while the impression is in their mouth.
- The lower impression is inserted while standing in front of the patient, by angling the loaded tray so one end passes through the oral aperture first and then swung over to that side of the dental arch. This brings the other side of the tray through the oral aperture and over the other side of the dental arch.
- A right-handed dental nurse will find the process easier if the left side of the tray is inserted first, and the left hand is used to gently retract the lips as the right side is inserted after (and the opposite for a left-handed dental nurse).
- Once the full tray is hovering over the full lower arch it is gently pushed down onto the teeth, ensuring that the teeth are in the centre of the tray all around the arch (so not too close to either the buccal or lingual side of the tray).
- The lower lip may be pulled out and 'rolled' up over the front of the tray, to ensure the labial sulcus is fully recorded.
- The tray is held evenly in this position with the fingers until setting occurs. In particular, it must be held firm if the patient swallows as the tray would lift up otherwise.
- The patient is asked to waggle their tongue from left to right, and then touch the outer surface of their top lip with it. This moulds the inner edge of the impression and avoids the tongue being recorded in the impression instead of the teeth.

- The upper impression is inserted while standing behind the patient, to their right (for a right-handed dental nurse) or to their left (for a left-handed dental nurse).
- Again, the tray is inserted by angling first one side and then the other through the oral aperture while retracting the lips with the other hand (right side first for right-handed dental nurse).
- Once the full tray is hovering below the full upper arch it is gently pushed up onto the teeth, from the back forwards to prevent material being pushed into the patient's throat.
- Again, ensure that the teeth are in the centre of the tray all around the arch.
- The upper lip may be pulled out and 'rolled' down over the front of the tray to ensure the labial sulcus is fully recorded.
- The tray is supported evenly in this position with the fingers until setting occurs.

Removal of the trays after setting

Any excess impression material can be squeezed to determine if setting has occurred; that in the patient's mouth will have set quicker still because the oral cavity will be a warmer environment. Otherwise, the impression material lying in either labial sulcus can be touched to determine if it has fully set. It should feel firm and not leave any impression material on the gloves when the finger is pulled away.

Once set, the trays are removed by exerting a firm upward pressure on the tray handle of the lower tray, and a firm downward pressure on the tray handle of the upper tray. Sometimes, a finger run around the buccal and labial sulci will be necessary to break the suction force around the edges of the impression before it can be dislodged. The impression can then be gradually eased over the teeth and out of the mouth, reversing the angle and swing action of the insertion process so that the patient's soft tissues are not uncomfortably stretched.

On removal, the impression should be checked for accuracy before being sent for disinfection; if it is not adequate then the impression taking must be repeated. For example, the impression shown in Figure 18.43 has well-rolled edges and no air blows, but the upper

right molar tooth has not been fully recorded in the impression, and this may require a retake.

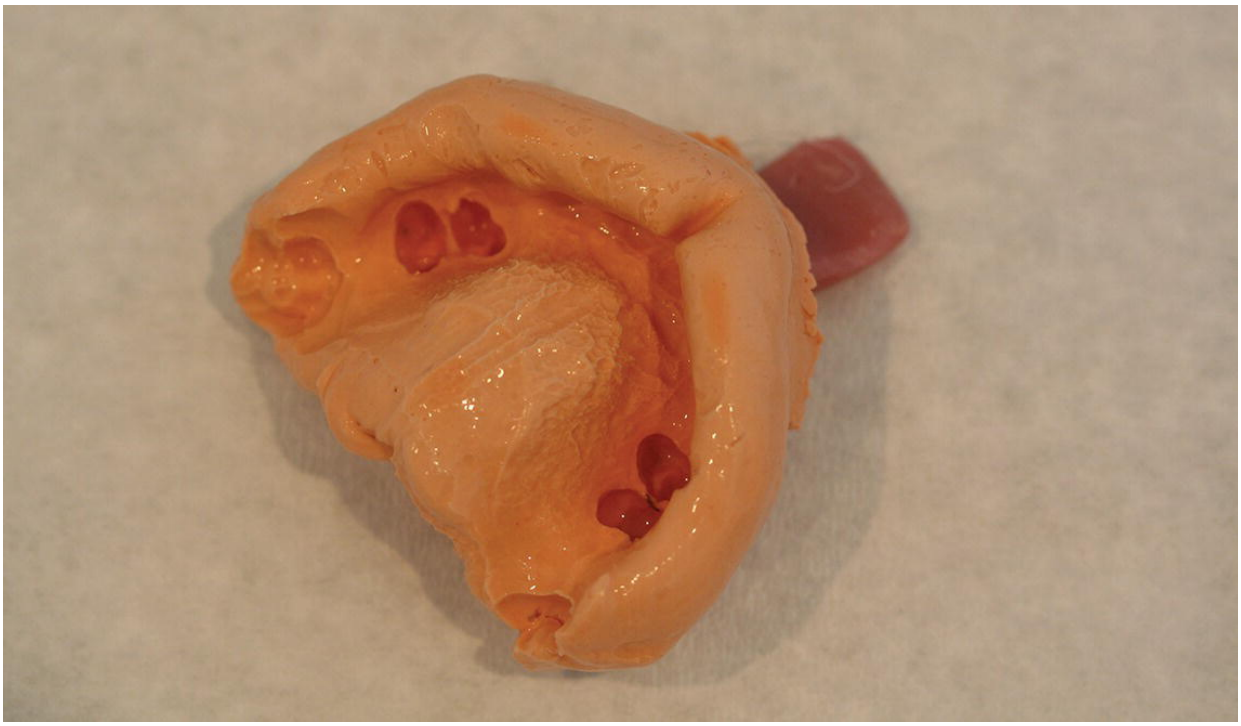

Figure 18.43 Example of an upper alginate impression.

If the impressions are acceptable they are disinfected in the usual manner: rinsed, soaked, rinsed, packaged with damp gauze in a sealed bag, and correctly labelled.

Monitoring and handling of the patient

Suitable PPE must be provided and worn by the patient, and the dental nurse must wear clinical gloves throughout the whole procedure. The dental nurse must always be aware of the fear and trepidation that some patients may exhibit when told they require impressions to be taken, and they should be empathetic to the patient's concerns. Any patient who is overly anxious should be referred to the dentist.

Some patients prefer to know what is involved in the procedure beforehand, others prefer not. Where possible a short and simplified explanation should be given to all patients, and in particular the following points should be mentioned:

- The material sets relatively quickly, and the impressions will be removed as soon as possible.
- The material will feel cold on the teeth initially.
- Stay calm and breathe at a normal rate through the nose throughout the procedure.
- If patients begin to panic and try to remove the trays, their mouth will be covered in unset impression material which is difficult to remove. They must concentrate on their breathing and allow the procedure to continue.
- Allow the lips to remain relaxed so that they can be retracted and manipulated as necessary by the dental nurse.
- Follow the tongue instructions carefully.
- Once the impressions are in place, they may tip their head forwards if they wish; this reduces the choking fear.
- Do not worry if they begin dribbling while the impression is still inserted and setting – the waterproof bib will prevent any clothing damage.
- Some considerable effort may be required to remove the impressions in some patients (because they have undercuts which 'lock' the impression in place), but it is *not* enough to pull their teeth out.
- Give a distraction technique if necessary to overly anxious patients, for example ask them to concentrate and count backwards from 300 in 3 s in their mind once the trays are in place (so 300, 297, 294, 291, and so on).

During the procedure, the dental nurse should also remain calm and in control of the situation. Make supportive and encouraging comments throughout: 'concentrate on breathing gently through your nose'; 'you're doing really well'; 'we've nearly finished now'; 'well done', and so on.

Once the impressions are removed, help the patient to have a rinse and then check and remove any extraoral impression material from their facial area – never send the patient away looking a mess. Also check if any impression tags are stuck between their teeth and

provide floss for the patient to dislodge it. Congratulate them on ‘surviving’ the ordeal and reiterate how well they did.

Measurement and recording of plaque indices

A plaque index is a method used to measure the amount of plaque present in the patient's mouth at any time, and when carried out repeatedly at further visits it provides a record of a patient's progress in their oral hygiene standard. It therefore allows a numerical value to be placed on the level of oral hygiene, which can then be used to monitor progress over a period of time, and the use of a numerical value makes the information more understandable to the patient – they can quantify their own progress. Plaque indices can be used for any patient but are particularly useful with potential and ongoing orthodontic patients because they provide information that can be used in the following ways:

- A high plaque index in a potential orthodontic patient prevents the start of treatment until improvement is seen. It therefore 'weeds out' unsuitable patients who are most likely to develop caries if treatment would have proceeded otherwise.
- It gives the patient something to aim for if they desire treatment: to reduce the numerical value to an acceptable level.
- It monitors the compliance of the patient during treatment: if problems are identified, they can be resolved before tooth damage occurs.
- If problems continue, the treatment can be abandoned with a recorded (and therefore irrefutable) good reason, and hopefully before tooth damage occurs.
- When treatment has been successfully completed, a lowered index provides a retrospective record of the need for the treatment initially. The patient's oral hygiene has improved as cleaning became easier while their teeth became well-aligned during the orthodontic treatment.

Two established methods are available for measuring and recording the amount of plaque present in the patient's mouth. One method involves every tooth present, while the other involves just six teeth as a representative sample of the mouth as a whole and is therefore a speedier procedure.

Method 1

- Assume each tooth is divided into six sites: mesial, mid and distal on both the buccal and lingual/palatal sides.
- Multiply the number of teeth present in the patient's mouth by 6. A typical teenager is likely to have all but their third molars present, so 28 teeth × 6 = 168.
- The presence or absence of plaque at each site is determined by running a blunt probe along the gingival margins of each tooth, or by thoroughly disclosing the patient and looking directly at the teeth (see Figure 11.26).
- Total the number of sites (out of 168) where plaque is present. For example, say 102 sites out of 168 had plaque present, thus 102/168.
- Multiply this fraction by 100 to give a percentage plaque index (=60.7%).

A plaque index this high indicates the patient has a poor standard of oral hygiene and is not suitable for orthodontic treatment until their plaque index has been much reduced and then maintained at a reduced level consistently. The quantified information can be used to motivate a keen patient to improve their oral hygiene, or to justify the denial of treatment to an insistent patient who has little interest in improving their oral hygiene, but wants treatment anyway.

Method 2

- Six teeth are chosen as a representative sample of the mouth: the upper right first molar (UR6, 16) and lateral incisor (UR2, 12), and the upper left first premolar (UL4, 24); the lower left first molar (LL6, 36) and lateral incisor (LL2, 32), and the lower right first premolar (LR4, 44).
- The presence or absence of plaque is determined on four sites of each tooth: mesial and distal of both the buccal and lingual/palatal sides.
- The plaque is scored as follows:

    - No plaque = 0
    - Plaque present by blunt probing = 1
    - Visible plaque = 2
    - Extensive plaque = 3
- The average plaque scores of each tooth are added together and then divided by 6 (the number of teeth that have been recorded) to give a single figure that is taken as a representative average for the mouth as a whole. This is the patient's plaque index.
- Using the following example:
    - UR6 = 2
    - UR2 = 0
    - UL4 = 2
    - LL6 = 3
    - LL2 = 3
    - LR4 = 2
- Total = 12 ÷ 6 = plaque index 2.
- Using this qualitative and quicker method, the plaque index will range from 0 (excellent) to 3 (poor), so again this patient is currently unsuitable for orthodontic treatment.

The plaque index can be calculated by the dental nurse at any point during treatment and compared with the preoperative scores to monitor the oral hygiene progress of the patient and highlight any potential problems as they occur and before any tooth damage is likely to have happened. The plaque index can be recorded at the examination or recall appointment of any patient, not just those considering orthodontic treatment, and is a useful method of monitoring routine oral hygiene standards and the patient's compliance with any previous oral hygiene instruction.

Methods of recording the information to determine the plaque index vary widely, but probably one of the simplest ways is to use a preprinted dental arch diagram with coloured dots to indicate the presence of plaque (method 1; Figure 18.44a). Alternatively, a

variation of a standard periodontal diagnosis and treatment chart can be used. The chart comprises the preprinted buccal, lingual and palatal surfaces of each tooth, and plaque can be recorded as either a coloured dot at each site (method 1) or as a numerical value at each site (method 2; Figure 18.44b).

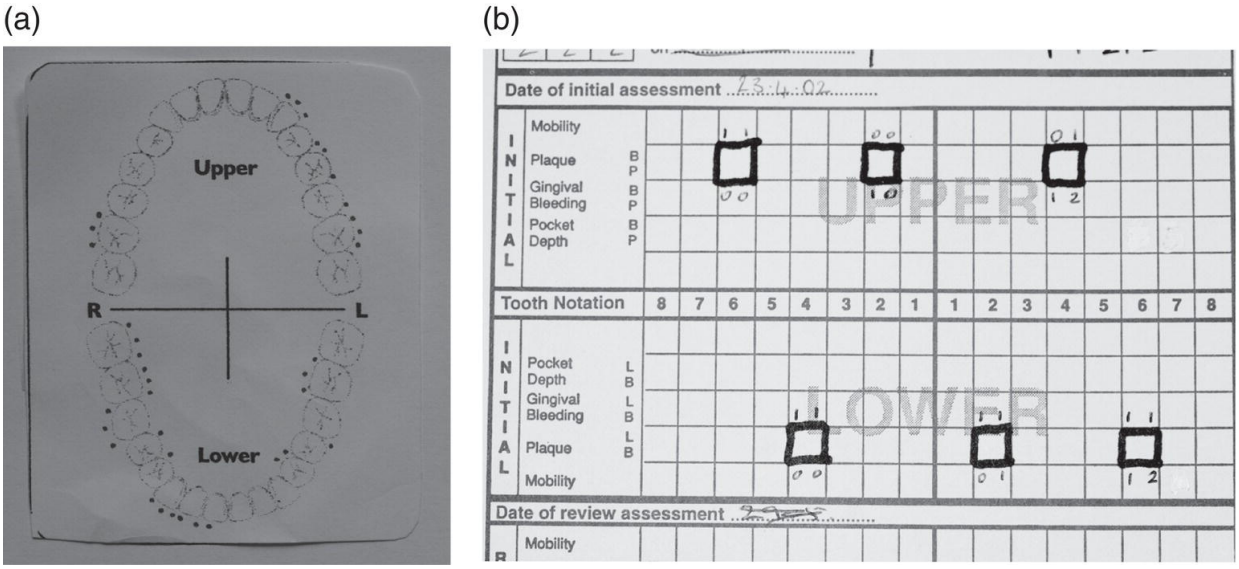

Figure 18.44 Examples of plaque index recording methods. (a) Preprinted dental arches with coloured dots (method 1). (b) Variation of standard periodontal chart with numerical scores (method 2).

Although plaque indices are usually used for orthodontic patients, they can be used in any situation where elective dental treatment is being considered but the patient's oral hygiene needs to improve first, or simply where oral hygiene requires improvement generally and the patient concerned is willing to engage with the dental team when evidence is provided that their advice is sound.

Application of fluoride varnish

Studies have shown that a twice-yearly application of fluoride varnish to both deciduous and adult teeth significantly reduces the caries experience of patients, so is a proven method of preventing dental caries in both adults and children. As the fluoride varnish acts by sealing the dentinal tubules of the tooth, it is also a proven method of reducing hypersensitivity to cold in adult patients. Previously the technique was only carried out on children, especially where oral hygiene maintenance was an issue, and using upper and lower application trays loaded with a thick fluoride gel. Modern techniques are more patient-friendly and involve the use of direct tooth-by-tooth applications using pleasant-tasting fluoride varnishes in a simple procedure. It is therefore an ideal skill to be developed as an extended duty for dental nurses, both in the dental practice setting or on a larger scale as a public health initiative via clinics and hospital dental departments.

Patients chosen to undergo fluoride varnish application are likely to fall into one of the following categories, although oral health advice should also be given where necessary.

- Children aged 3–6 years living in areas with no water fluoridation.
- Children aged 3–6 years showing evidence of early caries, where the caries is likely to be arrested by the fluoride application without restorative intervention.
- Children and young adults who are classified as special needs, including due to the daily use of sugar-containing medications.
- Children over the age of 7 years and young adults, especially those likely to develop caries due to diet, circumstance or medications, or those undergoing orthodontic treatment.
- Adult patients with risk factors for caries.
    - Active caries at several recall appointments.
    - Dry mouth or other predisposing factors, including medications.

    - Exposed roots due to gingival recession or toothbrush abrasion.
    - Extensive dental restorative work present.
    - Special needs.
- Adult patients with risk factors for tooth surface loss due to erosion.
- Adult patients with generalised dental sensitivity.

Care should be taken to avoid fluorosis (overdose of fluoride systemically) with patients living in fluoridated areas (local authority or water supplier will be able to advise on this in each area) and with younger patients who are taking systemic fluoride supplements such as drops or tablets. The dentist is responsible for prescribing the application of fluoride and determining those patients who are suitable and will benefit from the procedure. The dental nurse may then apply the fluoride on their prescription.

Various fluoride varnishes are now available for the procedure (Figure 18.45), usually as a 5% sodium fluoride varnish (equivalent to 22,600 ppm) of varying colours; obviously, white varnish materials are especially popular for use on adults.

Figure 18.45 Examples of available fluoride varnishes.

Application technique

Once a patient has been selected for fluoride application and a written prescription for the procedure recorded in their notes, the simple technique is as follows:

- Some patients will require specific teeth or surfaces to be treated only, while others will be prescribed a full-mouth application. Ensure the notes have been read beforehand and are followed accurately.
- Where a full-mouth application is required, the mouth is best treated quadrant by quadrant (so upper left, upper right, lower left and lower right).
- Any gross plaque or tartar will have been removed previously by the dentist, therapist or hygienist. This must not be carried out on the day of fluoride application (see later).

- Most materials work best when a recent general prophylaxis has been carried out beforehand, with all the prophylaxis paste removed thoroughly by the patient with copious rinsing.
- Simple moisture control is achieved in each successive quadrant using either the triple syringe or by wiping the relevant tooth surfaces with cotton wool.
- High-speed aspiration is not required, but the use of a saliva ejector will help with tongue control when working on the lower quadrants and may make the procedure more comfortable for the patient as they do not have to keep swallowing.
- The amount of fluoride varnish dispensed will depend on the number of teeth to be treated and some products are conveniently provided in single-use dose cups of between 0.25 and 0.4 g (see Figure 18.45). No more than one dose cup should be used per application, and any remaining product must be disposed of rather than used on another patient.
- The dispensed fluoride varnish is stirred to ensure an even consistency throughout, and then carefully applied to the required teeth and surfaces using a micro-brush (Figure 18.46).
- The varnish should not come into contact with the gingivae during application.
- Where a preventive full-mouth application is undertaken the varnish is applied to all pits, fissures and approximal surfaces (mesial and distal at each interdental point) in each quadrant.
- Once the full quadrant has been treated, the varnish is allowed to become moist either naturally with saliva or by gentle rinsing. This thickens the varnish to a more gel-like consistency and enables the material to remain in place for several hours.
- The procedure is repeated in all required areas according to the individual prescription from the dentist.
- The patient is given the following verbal postoperative instructions, and a written handout reiterating the points, to take home.

    - Avoid eating, drinking or toothbrushing for a minimum of 30 minutes.
    - Have a soft-food diet for the remainder of the day.
    - Avoid the use of mouthwashes for the remainder of the day, particularly those containing fluoride or alcohol.
    - The varnish will slough off naturally over the next few days, but this is not an issue as the preventive action begins immediately upon contact with the tooth.
- The application process can be repeated every 3–6 months as required.

Figure 18.46 Fluoride varnish application with a micro-brush, avoiding contact with the gingivae.

Precautions and contraindications

Fluoride varnish is intended for use as a topical application, directly to the outer surface of the tooth or root and not as a systemic

application, taken internally. It should therefore not be used on children under 3 years of age who are most likely to swallow some of the product during application. Fluoride overdose (fluorosis) is also a potential hazard in patients taking other fluoride supplements at the time of application, and they must be advised accordingly.

Fluoride application is contraindicated (not advisable) in all patients with ulcerative gingivitis or stomatitis and should not be used when any level of gingival inflammation is present (such as immediately after gross scaling) as the fluoride can gain systemic entry to the bloodstream and the body through these inflamed tissues. One of its constituents may also cause hypersensitivity or even allergic reaction in susceptible patients and is therefore not to be used in patients diagnosed with bronchial asthma, or other allergy-like reactions requiring hospital admission. Finally, as with many other medicaments, the effects of fluoride on the fetus or newborn are unknown and consequently fluoride application in pregnant or nursing mothers is strongly inadvisable.

For the vast majority of patients then, regular and targeted fluoride varnish application is an extremely useful technique in the prevention or control of early caries and dental hypersensitivity. A suitably trained dental nurse carrying out the procedure under prescription is an asset to the dental team, able to assist many patients of all ages to prevent future problems while allowing other team members to proceed with more advanced oral healthcare procedures.

Constructing bleaching trays

Bleaching trays, mouthguards and vacuum-formed retainers are constructed in a similar process to each other, the difference being the material used for each one. The technique used to construct bleaching trays will be described here. These are devices made for patients to use at home when carrying out tooth whitening. Mouthguards are worn by patients who have a bruxing habit (tooth clenching and grinding habit) that is causing tooth wear and/or tooth fracture, or jaw joint discomfort, and vacuum-formed retainers are the gum shield-type retainers worn by patients after completing a course of orthodontic treatment (see Chapter 16).

Each device is made by pulling a warmed sheet of varying thickness EVA tray material (Figure 18.47) over a stone model of the patient's dental arch, which is then sucked tightly onto the model under vacuum. Bleaching trays are made from very thin EVA sheets, while orthodontic retainers and mouthguards are constructed from thicker materials.

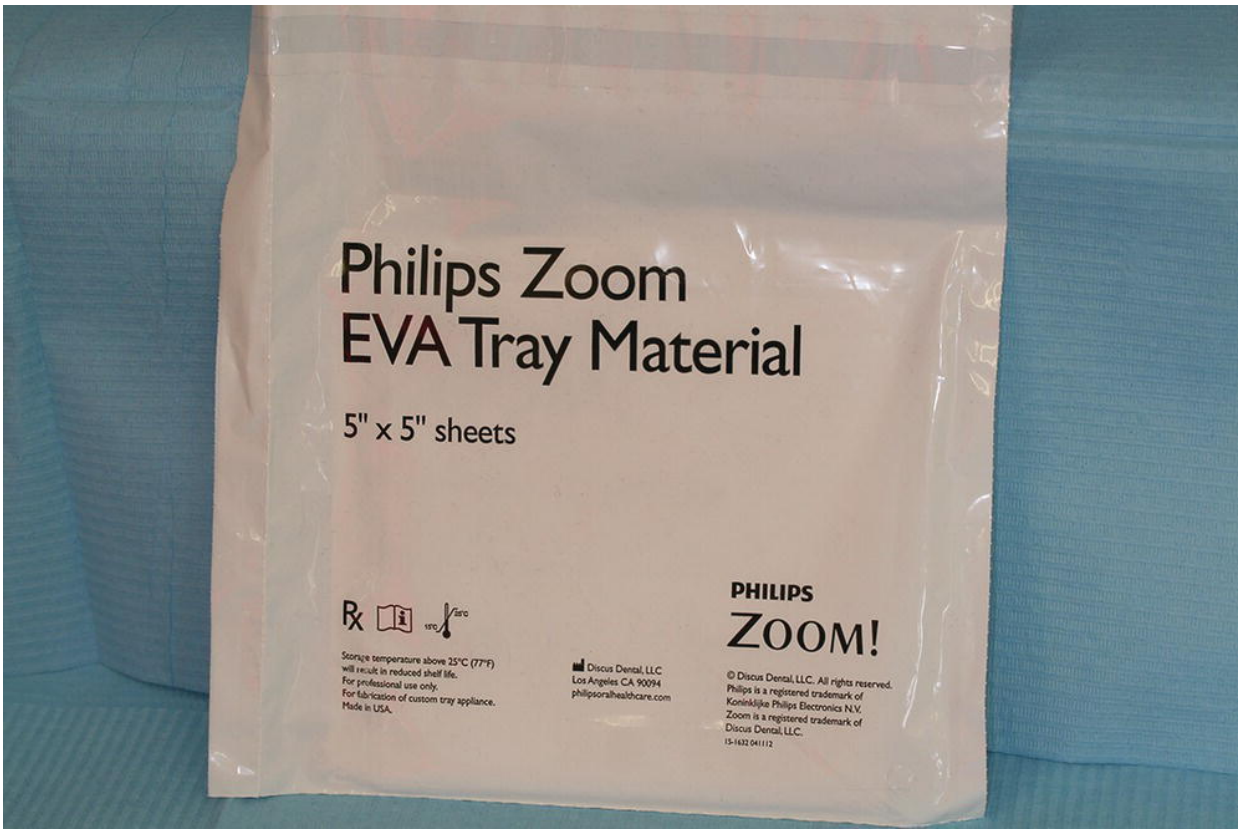

Figure 18.47 Example of EVA tray material pack.

Once the tray has been removed from the model and carefully trimmed, a unique device is produced which is a perfect fit over the patient's own teeth. As the fit is so accurate, it cannot be placed into the mouth in any but the correct position (so it is easy for the patient to wear), it fits tightly but comfortably onto the teeth (so it does not fall out or become loose), and the material used is transparent so the device is not obvious to others while being worn.

An example of a vacuum machine used for tray construction is shown in Figure 18.48.


DISCUS DENTAL
ON
OFF
VACUUM
ON
OFF
HEAT

Figure 18.48 Example of vacuum tray-forming machine.

The technique for producing the bleaching tray is as follows:

- The stone models of the dental arches to be bleached are provided by the laboratory, or cast up on site (see previously).
- They will have been trimmed to remove the sulci areas, and upper models will have had the palate removed or a hole placed through so that the suction under vacuum can be applied to all sides of the model.
- The teeth to be bleached (this varies between patients) will have a spacer material present on the labial surfaces, so that a well is formed during tray construction for the application of the bleaching gel (the spacer used in the images is blue wax).
- The model is placed on the base of the machine and a sheet of EVA loaded and locked into the tray reservoir above it.
- The heater above the material is switched on to warm the sheet. It is ready to be pulled over the model when the warmed sheet hangs about 1.5 cm below the reservoir (Figure 18.49).
- The tray reservoir is pulled sharply down to the bottom of the machine so that it lies over the model, and the vacuum is switched on immediately (the heater can be switched off at this point).
- The suction produced pulls the sheet tightly over the model to produce the tray (Figure 18.50). The vacuum should be left to run for a minimum of 30 seconds.
- Once the construction is complete the machine is switched off and the model and tray are left to cool before handling.
- Bleaching trays are carefully trimmed to follow the gingival line of the teeth, producing a scalloped edge (Figure 18.51).
- Orthodontic retainers and mouthguards are trimmed to leave a 2-mm extension beyond the gingival margins, so that the tray edge lies on the gingivae.
- The trimmed edges are smoothed to avoid any soft tissue trauma (an emery board or similar file is ideal).

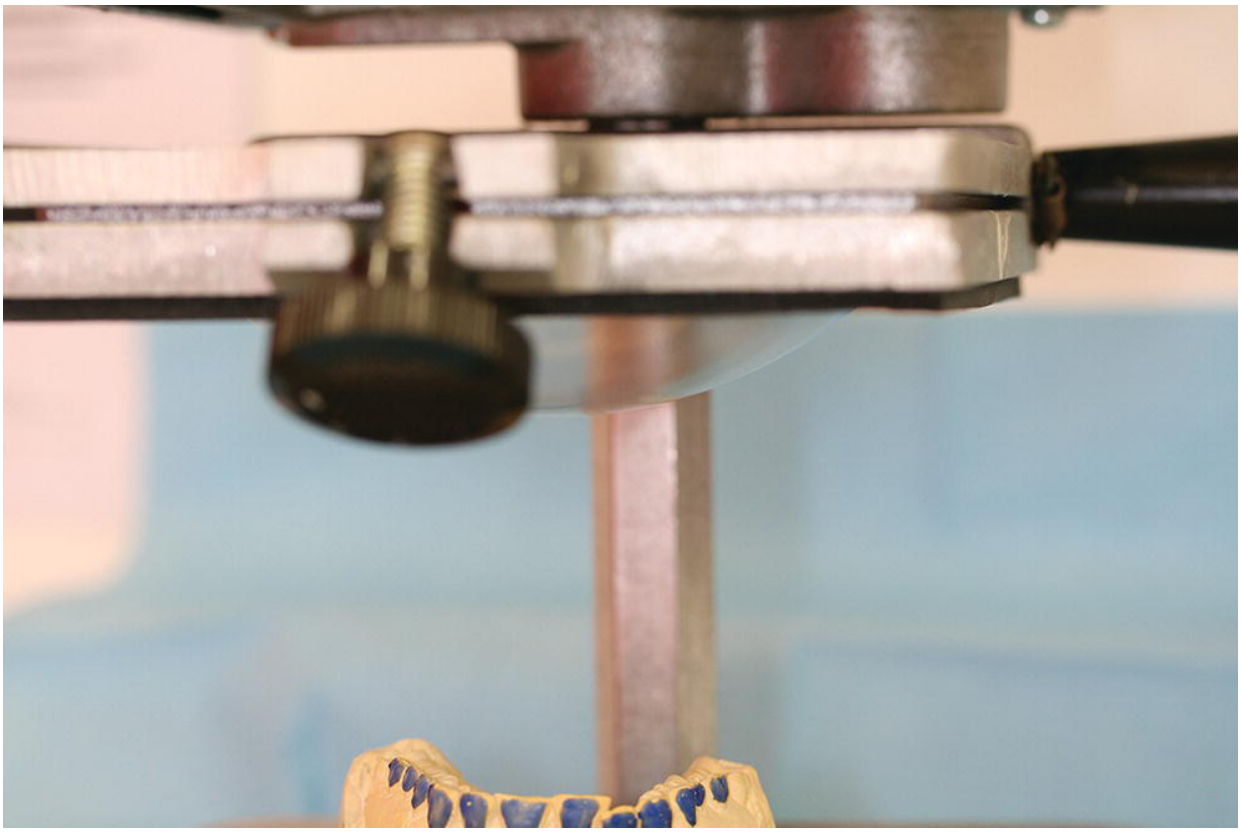

Figure 18.49 Warmed EVA sheet distended over model and ready for use.

(a)

(b)

Figure 18.50 (a) Vacuum action as EVA sheet is pulled down onto model. (b) Sheet sucked completely over model to form tray.

Figure 18.51 Upper bleaching tray trimmed and ready for use.

Removing sutures

Sutures are used to close a surgical site and hold the edges of a flap of soft tissue in position while the tissues heal, after surgery or trauma. Once the site has been checked by the dentist to ensure that full healing has occurred without any inflammation or infection present, the sutures can be carefully removed by a suitably trained dental nurse.

The procedure is often time-consuming because care must be taken not to pull the healed surgical area as it will hurt the patient, and often there are several sutures to be removed too.

The sterile instruments required for suture removal are a mouth mirror, a pair of college tweezers and a pair of suture removal scissors (Figure 18.52) or a suture removal blade (effectively, a curved scalpel blade which is used without a handle). The scissors have a half-moon cut out of one blade so that the suture loop can be located here and held while being cut. With an ordinary pair of scissors the loop would ride along the blade during cutting and pull uncomfortably on the wound. In the oral cavity, the use of scissors rather than a suture removal blade is the safest option.

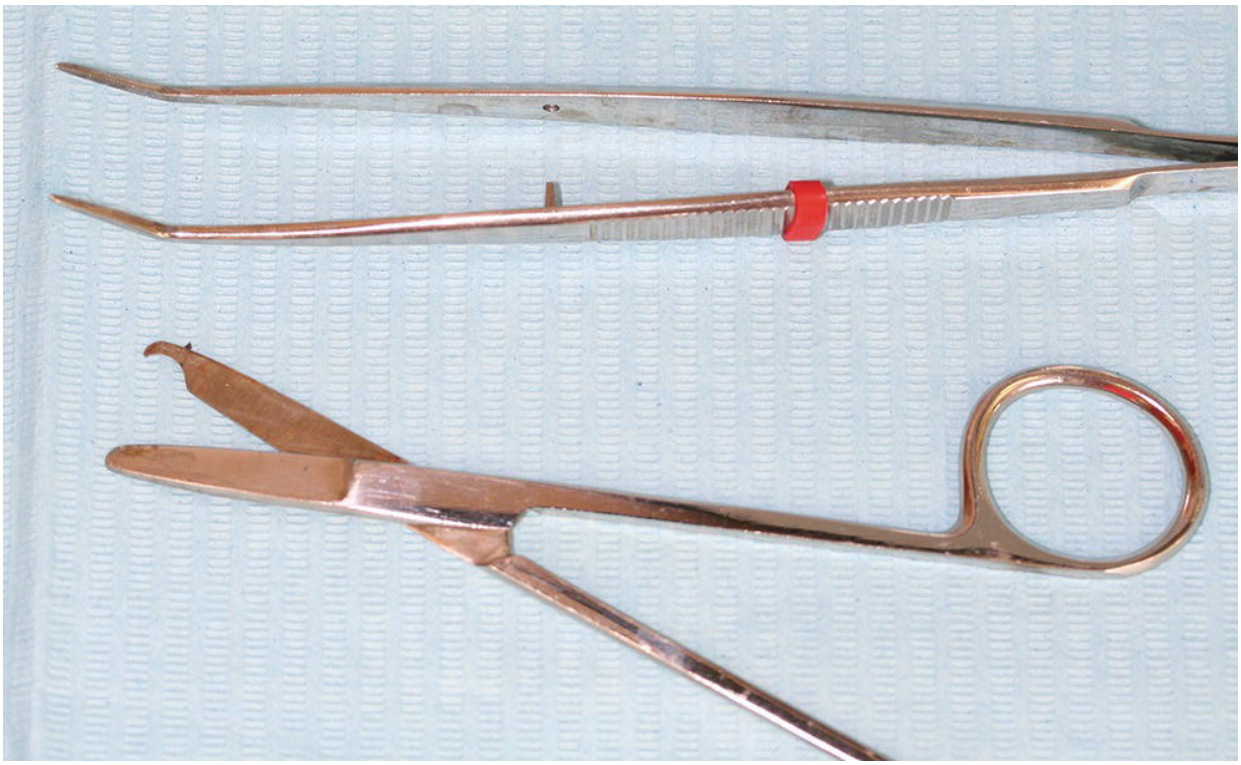

Figure 18.52 Suture removal instruments.

The technique of suture removal is as follows:

- The dental nurse and the patient wear appropriate PPE.
- Angle the dental chair and light to provide easy access to the sutures.
- Use the mouth mirror to retract soft tissues if necessary; sometimes a second dental nurse may be required to carry this out when the sutures lie posteriorly.
- Remove any food debris from the sutures with a small-bore aspirator if necessary.
- Count the number of sutures present and check with the procedure notes that they tally. If not, ask the patient if they were aware of losing any sutures (black braided silk is often used and may appear as a piece of black cotton to the patient) and refer back to the dentist for advice.
- Gently find and hold one tied end of the suture with the tweezers, and then pull to hold it taut.

- This should lift the top of the suture loop off the soft tissues, allowing the suture scissors to be placed beneath it with the cut-out blade closest to the surgical tissues.
- The suture loop needs to be located in the half-moon cut out of the blade so that the suture thread remains in place during cutting (Figure 18.53).
- When correctly positioned, make the cut while holding the suture end taut with the tweezers.
- Once cut through completely, the suture is removed from the mouth and placed on a tissue.
- Repeat the process for all the sutures.
- Count the number removed again, and then check that each one has been fully removed. They should each appear as a cut loop of thread with a knot and two tied ends present.
- If any problems occur, seek the advice of the dentist. Do not undertake any further tasks than the training allows.

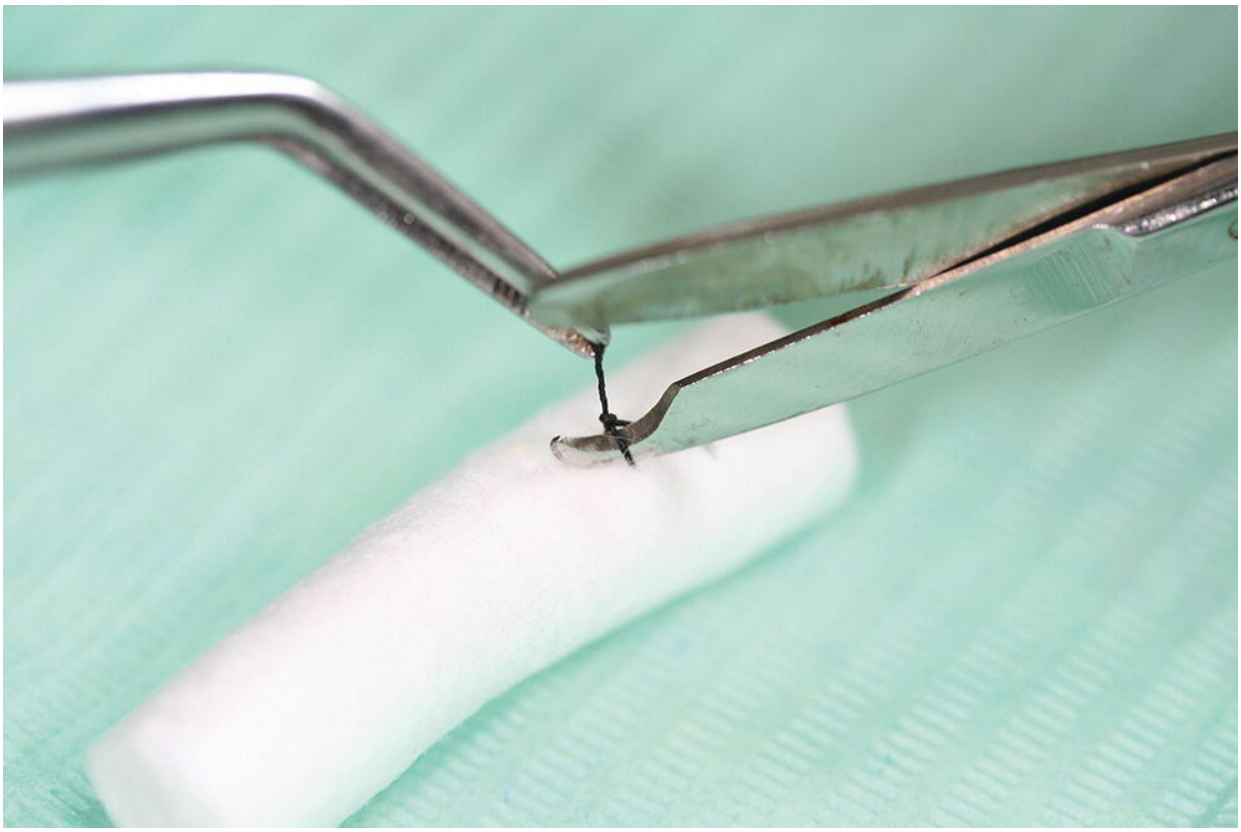

Figure 18.53 Holding the suture end taut while cutting through the loop.

Postoperative advice

The patient should be advised to continue hot salt water mouthwashes for the next few days to assist the area to heal completely now that the sutures have been removed. They can carry out their routine oral hygiene techniques in this area without fear of catching the sutures, and they can eat and drink as normal. They should not touch the area with their fingers, as they may introduce infection.

Taking radiographs: pressing the exposure button

While this task may seem a blatantly obvious skill to perform, the potential for harm to both the patient and the dental team from X-ray exposure if not carried out correctly has warranted its inclusion here.

During the taking of dental radiographs, whether intraoral or extraoral and digital or conventional, the point at which the exposure button of the X-ray machine is pressed is the point at which the X-ray beam is activated and fired at the patient and the X-ray film to produce an image. The ability of the dental nurse to act as an operator during this procedure is entirely dependent on their being directly supervised by the 'set-up' operator – the person who has positioned the patient and the film ready for the exposure. Under no circumstances should any dental nurse without a post-registration qualification in dental radiography press the exposure button of any X-ray machine unless in the presence of another, suitably qualified colleague. This also applies to the taking of test exposures for the purpose of quality assurance processes.

See Chapter 12 for full clarification of the correct terminology and roles and responsibilities of the dental team in relation to dental X-radiation.

The exposure button itself is usually connected to the X-ray machine by an extendable electric cable so that the 'button pusher' can stand outside both the controlled area and the safety zone around the X-ray machine (Figure 18.54). The controlled area is a zone of 1.5 m radius from the machine head and should only be occupied by the patient (and their carer or parent in certain circumstances), while the safety zone is deemed as another half metre outside this radius (so 2 m total), beyond which it is safe for the dental team to be positioned.

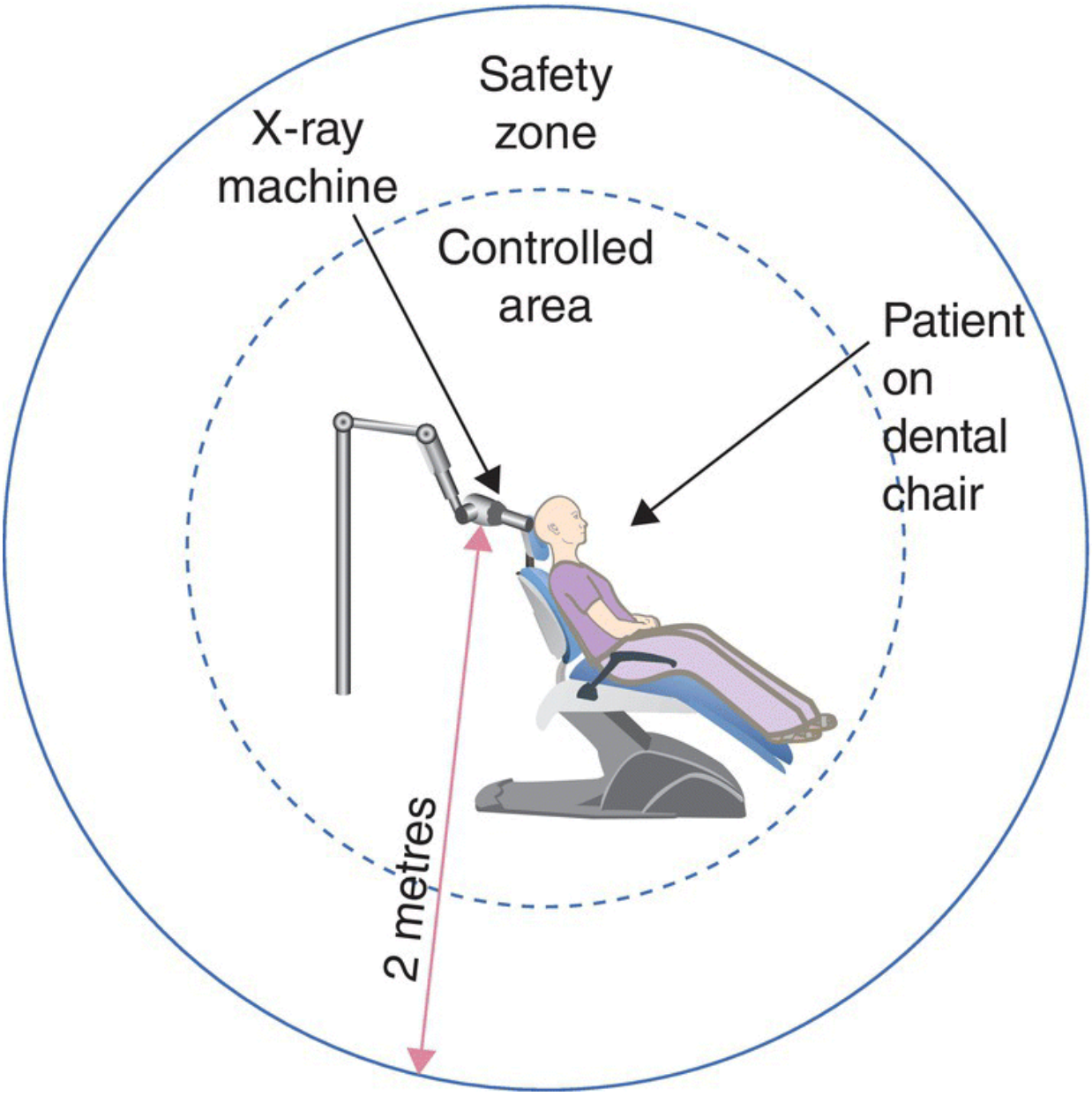

Figure 18.54 Safety zone (2 m) and controlled area (1.5 m) around the X-ray machine head.

Beyond 2 m, the potential amount of scattered radiation from the X-ray machine is considered negligible and the area is therefore safe. To ensure that this is the case, when significant dental exposures are undertaken in the workplace the dental team wear personal dosimetry badges which are regularly analysed by specialists to ensure that no untoward X-ray exposures are occurring.

Procedure

Once a dental radiograph has been justified (it has been deemed necessary to make a diagnosis and/or provide dental treatment for a patient), the following actions will be carried out by the set-up operator:

- Film type and view chosen.
- Patient and film positioned, using a film holder.
- X-ray machine switched on and exposure time chosen.
- Check that everyone except the patient are outside the safety zone.
- Verbal command given to the dental nurse operator to press the exposure button.

During the patient set-up and when instructed to do so by the set-up operator, the dental nurse operator will retrieve the exposure button device from the machine and move out to the safety zone (Figure 18.55). Modern dental X-ray machines will have audible buzzers which are activated during the exposure; some also have visible warnings of the exposure, such as illuminated signs or lights (Figure 18.56). When instructed to do so, and only then, the dental nurse operator will press and hold down the exposure button until the audible alarm stops. The button must not be pressed before requested as someone may still be within the controlled or safety zones, while the button must not be released before the audible alarm stops as it is set as a timed exposure and an early release will be too short to produce an image, the patient will have been exposed unnecessarily and the procedure will have to be repeated.

Figure 18.55 Dental nurse standing outside the safety zone with the exposure button.

Figure 18.56 Illuminated X-ray sign.

Very rarely a machine may malfunction; this is a potentially dangerous situation for the patient and the dental team, as X-ray overexposure may occur. In this situation the audible alarm may continue to buzz and the visible alarm may remain illuminated. It must be presumed under these circumstances that the machine is continuing to emit X-rays and must be shut down immediately. On instruction, the dental nurse operator must release the exposure button and remain outside the safety zone. The set-up operator has the responsibility of isolating the X-ray machine from the electrical supply or giving the command to do so, using the isolator switch located outside the safety zone (the presence of an isolator switch is a legal requirement under ionising radiation regulations). Once isolated, the machine must be marked as ‘out of use’, the patient must be informed of the situation, and the RPA and MPE must be notified of the error incident so that an investigation can be carried out. These actions are the responsibility of the set-up operator.

Summary

Overall, then, there are many opportunities for registered dental nurses to expand their skills in extended duties without having to undertake formal training to do so, and the acquisition of any of these skills will be of great value to any dental workplace. Relevant use of their PDP in line with the GDC's enhanced CPD requirements will ensure that these extended duties remain current during the dental nurse's career, ensuring their respected position as a valued, worthwhile and professional member of a modern dental team.

 Further resources are available for this book, including interactive multiple choice questions and extended matching questions. Visit the companion website at:

www.levisonstextbookfordentalnurses.com

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