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Bethany Rushworth | Anastasios Kanatas

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OXFORD HANDBOOK OF

Clinical Dentistry

SEVENTH EDITION

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Preface

In the previous edition's preface, this handbook was described as a mature adult refusing to leave home. However, as it rapidly approaches its 30th birthday the time has now come for this invaluable reference tool to enter a new chapter in its life and move forward, following a substantial update and revision, under new guardianship.

While the format and approach remains the same, all sections have been revised, with the addition of a newly created chapter dedicated solely to implant dentistry, an ever-expanding field with increasing numbers of general dental practitioners now routinely providing this service. With new images, tables, and resources, the text has been brought into line with current evidence and guidelines (at the time of publication), allowing it to serve as an aide-memoire, revision guide, and reference text for dentists and dental students worldwide.

As with all editions of the handbook we are very much indebted to the numerous contributors whose knowledge and expertise over the years have helped to make this book what it is today. However, as with any academic reference book, we would encourage readers to amend or add to the text in response to new evidence, clinical experience, and errors or omissions.

Finally we are hugely grateful to the parents of the book, David and Laura Mitchell, who created, nurtured, and developed the text through six editions into an incredible resource to be used by many generations of dentists over its lifetime. Their encouragement and support has been invaluable as we have endeavoured to make the seventh edition of the *Oxford Handbook of Clinical Dentistry* the most comprehensive and relevant version to date.

BR
AK

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Once again the staff of OUP deserve thanks for their help and encouragement.

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Symbols and abbreviations

Some of these are included because they are in common usage, others because they are big words and we were trying to save space.

▶	this is important
➲	cross-reference
Δ	diagnosis
$	supernumerary
–ve	negative
+ve	positive
&/or	and/or
↑	increase(d)
↓	decrease(d)
→	leading to
<	less than
>	greater than
~	approximately
#	fracture
µ	micro (e.g. µm)
?	question/ask about (when ? appears alone)
∴	therefore
1°	primary
2°	secondary
3°	tertiary
$\overline{5}$; $\overline{\text{inc}}$	lower second premolar, lower incisor
2; inc	upper lateral incisor, upper incisor
3-D	three dimensional
ACS	American College of Surgeons
ACTH	adrenocorticotrophic hormone
ADJ	amelo-dentinal junction
Ag	antigen
AI	amelogenesis imperfecta
AIDS	acquired immune deficiency syndrome
ALS	advanced life support
AOB	anterior open bite
AP	anteroposterior
ASAP	as soon as possible
ATLS	advanced trauma life support
BCC	basal cell carcinoma
bd	twice daily
BDA	British Dental Association
BIPP	bismuth iodoform paraffin paste
BMA	British Medical Association
BNF	British National Formulary
BOP	bleeding on probing
BP	blood pressure
BPE	Basic Periodontal Examination
BRON(J)	bisphosphonate-related osteonecrosis (of the jaw)
BSP	British Society of Periodontology
BSS	black silk suture
b/w	bitewing
Ca^{2+}	calcium
CAD/CAM	computer-aided design/ computer-aided manufacture
C&S	culture and sensitivity
CBCT	cone beam computed tomography
CDS	Community Dental Service
C/I	contraindication/ contraindicated
Class I	Class I relationship
Class II/1	Class II division 1 relationship
Class II/2	Class II division 2 relationship
Class III	Class III relationship
CLP	cleft lip and palate
cm	centimetre
CMV	cytomegalovirus
CNS	central nervous system
CPD	continuing professional development
CPITN	Community Periodontal Index of Treatment Needs
CPR	cardiopulmonary resuscitation
CQC	Care Quality Commission
CSF	cerebrospinal fluid
CT	computed tomography
CXR	chest X-ray
DCP	dental care professional

dL	decilitre
DN	dental nurse
DOH/DH	Department of Health
DPF	Dental Practitioners' Formulary
DPT	dental panoramic tomogram/ tomography
DVT	deep venous thrombosis
EBA	ethoxy benzoic acid
EBM/D	evidence-based medicine/ dentistry
EBV	Epstein–Barr virus
ECC	early childhood caries
ECG	electrocardiograph
EDTA	ethylene diamine tetra-acetic acid
e.g.	for example
EMD	enamel matrix derivative
ENT	ear, nose, and throat
EO	extra-oral
ESR	erythrocyte sedimentation rate
F	female
F/–	full upper denture (and –/F for lower)
FA	fixed appliance
FB	foreign body
FBC	full blood count
FESS	functional endoscopic sinus surgery
fL	femtolitre
FNAC	fine-needle aspiration cytology
f/s	fissure sealant
FWS	freeway space
g	gram
GA	general anaesthesia/ anaesthetic
GAP	generalized aggressive periodontitis
GCS	Glasgow Coma Scale
GDC	General Dental Council
GDP	general dental practitioner
GDS	General Dental Services
GI	glass ionomer
GIC	glass ionomer cement
GKI	glucose, potassium, insulin
GMP	general medical practitioner
GP	gutta-percha
GTR	guided tissue regeneration
h	hour
HAART	highly active antiretroviral therapy
Hb	haemoglobin
HDU	high dependency unit
Hep B/C	hepatitis B/C
Hg	mercury
HIV	human immunodeficiency virus
HLA	human leucocyte antigen
HPV	human papilloma virus
HSV	herpes simplex virus
HT	hydroxytryptamine (serotonin)
HU	Hounsfield unit
ICP	intercuspal position
ICU	intensive care unit
ID	inferior dental
IDB	inferior dental block
IDN	inferior dental nerve
i.e.	that is
Ig	immunoglobulin (e.g. IgA, IgG, etc.)
IM	intramuscular
IMF	intermaxillary fixation
inc	incisor
INR	international normalized ratio
IO	intra-oral
IOTN	Index of Orthodontic Treatment Need
IRM	Intermediate Restorative Material®
ISO	International Organization for Standardization
ITP	idiopathic thrombocytopenic purpura
IU	international unit(s)
IV	intravenous
K^+	potassium
kg	kilogram
kV	kilovolt
L	litre
LA	local anaesthesia/anaesthetic
LAP	localized aggressive periodontitis
LFH	lower face height
LFT	liver function test
LLS	lower labial segment
LMA	laryngeal mask airway
m	metre
M	male
mand	mandible/mandibular

MAOI	monoamine oxidase inhibitor
max	maxilla/maxillary
MCQ	multiple choice question
MCV	mean corpuscular volume
MEN	multiple endocrine neoplasia
MFDS	Membership of the Faculty of Dental Surgery
mg	milligram
MHRA	Medicines and Healthcare products Regulatory Agency
MHz	megahertz
MI	myocardial infarction
MIH	molar incisor hypomineralization
micromol	micromoles
min	minute
MJDF	Membership of the Joint Dental Faculties
mL	millilitre
mm	millimetre
mmHg	millimetres of mercury
mmol	millimole
MMPA	maxillary mandibular planes angle
MRI	magnetic resonance imaging
MRONJ	medication-related osteonecrosis of the jaw
MSU	mid-stream urine
MTA	mineral trioxide aggregate
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NiTi	nickel titanium
NLP	neurolinguistic programming
nm	nanometre
nocte	at night
NSAID	non-steroidal anti-inflammatory drug
NUG	necrotizing ulcerative gingivitis
NUP	necrotizing ulcerative periodontitis
O_2	oxygen
o/b	overbite
od	once daily
OD	overdenture
O/E	on examination
OH	oral hygiene
OHI	oral hygiene instruction
OHP	overhead projector/projection
o/j	overjet
OMF	oral and maxillofacial
ORIF	open reduction and internal fixation
OTC	over the counter
OUP	Oxford University Press
OVD	occlusal vertical dimension
P/—	partial upper denture (and —/P for lower)
PA	posteroanterior
PCA	patient-controlled analgesia
PCR	polymerase chain reaction
PDH	past dental history
PDL	periodontal ligament
PEA	pulseless electrical activity
PEG	percutaneous endoscopic gastrostomy
PFM	porcelain fused to metal (crown)
PI	Plaque Index
PJC	porcelain jacket crown
PM	premolar
PMH	past medical history
PMMA	polymethylmethacrylate
PO	*per os* (orally)
PPD	probing pocket depth
ppm	parts per million
PR	*per rectum* (rectally)
PRR	preventive resin restoration
qds	four times daily
RA	relative analgesia
RAS	recurrent aphthous stomatitis
RBC	red blood cell count
RCCT	randomized controlled clinical trial
RCF	root canal filling
RCP	retruded contact position
RCT	root canal treatment/therapy
RIG	radiologically inserted gastrostomy
RMGIC	resin-modified glass ionomer cement
Rx	treatment
SC	subcutaneous
SCC	squamous cell carcinoma
SDCEP	Scottish Dental Clinical Effectiveness Programme
sec	second
SF	sugar free
SLE	systemic lupus erythematosus
spp.	species

SS	stainless steel
STD	sexually transmitted diseases
TB	tuberculosis
TC	tungsten carbide
tds	thrice daily
TENS	transcutaneous electrical nerve stimulation
TIBC	total iron binding capacity
TMA	titanium molybdenum alloy
TMD	temporomandibular disorder
TMJ	temporomandibular joint
TNF	tissue necrosis factor
TTP	tender to percussion
mocw U&Es	urea and electrolytes
UK	United Kingdom
ULS	upper labial segment
URA	upper removable appliance
US	United States
US(S)	ultrasound (scan)
UTI	urinary tract infection
VF	ventricular fibrillation
WHO	World Health Organization
Xbite	crossbite
X-rays	either X-ray beam or radiographs
yr	year
ZOE	zinc oxide eugenol

Chapter 1

History and examination

Relevant pages in other chapters It could, of course, be said that all pages are relevant to this section, because history and examination are the first steps in the care of any patient. However, as that is hardly helpful, the reader is referred specifically to the following: medical conditions, Chapter 13; the child with toothache, ➔ p. 64; pre-operative management of the dental patient, ➔ Pre-operation, p. 576; cranial nerves, ➔ p. 546; orthodontic assessment, ➔ p. 126; pulpal pain, ➔ p. 230.

Principal sources Experience.

First impressions

Much of what you need to know about any individual patient can be obtained by watching them enter the surgery and sit in the chair, their body language during the interview, and a few well-chosen questions (Chapter 18). One of the great secrets of healthcare is to develop the ability to actually listen to what your patients tell you and to use that information. Doctors and dentists are often concerned that if they allow patients to speak rather than answer questions, history taking will prove inefficient and prolonged. In fact, most patients will give the information necessary to make a provisional diagnosis, and further useful personal information, if allowed to speak uninterrupted. Most will lapse into silence after 2–3min of monologue. History taking should be conducted with the patient sitting comfortably; this rarely equates with supine! In order to produce an all-round history it is, however, customary and frequently necessary to resort to directed questioning. Here are a few hints:

- Always introduce yourself to the patient and any accompanying person and explain what your role is in helping them. It is useful to clarify at this stage the relationship of any chaperones with the patient (e.g. relative, friend, or support worker).
- Remember that patients are (usually) neither medically nor dentally trained, so use plain speech without speaking down to them.
- Questions are a key part of history taking and the manner in which they are asked can lead to a quick diagnosis and a trusting patient, or abject confusion with a potential litigant. Open questions should be used that require more than a simple 'Yes' or 'No' answer, to avoid leading the patient. Be careful of this when the question suggests the answer, e.g. 'Is the pain worse when you drink hot drinks?' However, with the more reticent patient it may be necessary to ask leading questions to elicit relevant information.
- Notwithstanding earlier paragraphs, you will sometimes find it necessary to interrupt patients in full flight during a detailed monologue on their grandmother's sick parrot. Try to do this tactfully, e.g. 'That is a lot of information you are telling me, can we recap how this affects the problem you have come about today?'

Specifics of a medical or dental history are described in ➲ The dental history, p. 4; ➲ The medical history, p. 6. The object is to elicit sufficient information to make a provisional diagnosis for the patient while establishing a mutual rapport, thus facilitating further investigations &/or treatment (Rx).

Presenting complaint

The aim of this part of the history is to establish provisional differential diagnoses even before examining the patient. The following is a suggested outline, which would require modifying according to the circumstances:

Complaining of (C/O) documented in the patient's own words

Use a general introductory question, e.g. 'Why did you come to see us today?' or 'What is the problem?'

If symptoms are present

Onset and pattern When did the problem start? Was it a sudden or gradual onset? Is it getting better, worse, or staying the same?

Frequency How often and how long does it last? Does it occur at any particular time of day or night?

Exacerbating and relieving factors What makes it better? What makes it worse? What started it?

If pain is the main symptom

Origin and radiation Where is the pain and does it spread?

Character and intensity How would you describe the pain: sharp, shooting, dull, aching, etc.? This can be difficult, but patients with specific 'organic' pain will often understand exactly what you mean whereas patients with symptoms with a high behavioural overlay will be vague and prevaricate.

Remember, while 'severity' of pain is subjective this may give an idea of how well a patient is coping.

Associations Is there anything, in your own mind, which you associate with the problem?

The majority of dental problems can quickly be narrowed down using a simple series of questions such as these to create a provisional diagnosis and judge the urgency of the problem.

The dental history

It is important to assess the patient's dental awareness and the likelihood of raising it. A dental history may also provide invaluable clues as to the nature of the presenting complaint and should not be ignored. This can be achieved by some simple general questions:

How often do you go to the dentist? This gives information on motivation, likely attendance patterns, and may indicate patients who change their general dental practitioner (GDP) frequently.

When did you last see a dentist and what did they do? This may give clues as to the diagnosis of the presenting complaint, e.g. a recent root canal treatment (RCT).

How often do you brush your teeth and how long for? Do you use mouthwash, floss, or interdental brushes? This gives information on motivation and likely gingival condition.

Have you ever had any pain or clicking from your jaw joints? This may indicate temporomandibular joint (TMJ) pathology.

Are you aware that you grind your teeth or bite your nails? This may provide information on temporomandibular disorder (TMD) and personality.

How do you feel about dental treatment? This helps in explaining any dental anxiety.

What do you think about the appearance of your teeth? This provides clues about motivation and possible need for orthodontic Rx.

What is your job? This can give indications about socio-economic status, education, availability for attending appointments, possible snacking habits, and frequently changing routines (e.g. night shifts or long-distance driving), that may affect diet (e.g. high-sugar/energy drinks if an athlete).

Where do you live? This gives information on fluoride intake and travelling time to surgery. This question may seem invasive to the patient, so the information can be obtained from their records. Confirm these are up to date and accurate.

What types of dental treatment have you had previously? For example, previous extractions, problems with local anaesthesia (LA) or general anaesthesia (GA), orthodontics, and periodontal Rx.

What are your snacking habits like? For example, types of foods/drinks and frequency. This can give indications about hidden sugars, caries rate, and erosion. It is worth including specific questions as to whether or not they use tobacco, alcohol, or other recreational drugs.

The social history

The patient's social history can give a lot of information about their lifestyle and risk factors for diseases such as periodontal disease and oral cancer. It is important not to be judgemental at this stage; however, these questions can be helpful in getting to know patients and in Rx planning.

Smoking What do they smoke? How long have they smoked for? If they have stopped smoking, when did they stop?

Alcohol The Chief Medical Officer's guidelines now advise no more than 14 units of alcohol per week for both men and women to keep health risks from alcohol to a low level. It is useful to clarify what the patient drinks (spirits, lager, or wine, for example) and often they will need help in calculating the number of units they consume.

Occupation Certain occupations may affect both routine and diet so should be considered when delivering oral health advice and motivating patients.

Diet General information can be gathered regarding a patient's diet; however, a more formal approach is to use a diet sheet. Ideally, this should be completed across a mixture of both working days and non-working days to get an idea what the patient's frequency of sugar intake is. They should include drink as well as food and record if sugar is added to these. It is tempting for patients to change their diet once they know it is being analysed, or to avoid recording things they feel they shouldn't have eaten. It is important to educate patients about hidden sugars and the impact of diet on their dental health regardless of what is recorded, in case there have been any omissions on their completed diet sheets!

Other substances It is useful to know whether patients are using other substances such as gutka, betel nut, or paan (with or without tobacco) as these can lead to staining of teeth and gingival tissues as well as an ↑ risk of oral cancer.

The medical history

There is much to be said for asking patients to complete a medical history questionnaire, as this encourages more accurate responses to sensitive questions. However, it is important to use this as a starting point and clarify the answers with the patient.

Example of a medical questionnaire

QUESTION — YES/NO

Are you fit and well?

Are you seeing a doctor for anything?

Have you ever been admitted to hospital?
- If yes, please give brief details.

Have you ever had an operation?
- If so, were there any problems?

Have you ever had any heart trouble or high blood pressure?

Have you ever had any chest trouble?

Have you ever had any problems with bleeding? Do you bruise easily?

Have you ever had asthma, eczema, or hayfever?

Do you have fits, faints, or headaches?

Do you have any known allergies such as penicillin, latex, or Elastoplast?

Are you allergic to any other drug or substance?

Do you have or ever had:
- Arthritis?
- Diabetes?
- Epilepsy?
- Tuberculosis?
- Jaundice?
- Hepatitis especially B or C?
- Other infectious disease, HIV in particular?

Are you pregnant or breastfeeding?

Are you taking any drugs, medications, or pills?
- If yes, please give details (Chapter 14):
- If a patient cannot recall their regular medications, ask them to bring their prescription to their next appointment or contact their General Medical Practitioner (GMP).

Who is your GMP?

► Check the medical history at each recall.
► If in any doubt, contact the patient's GMP, or the specialist they are attending, before proceeding.

Screening for medical problems in dental practice

Certain conditions are so commonplace and of such significance that screening (specifically looking for asymptomatic markers of disease) is justifiable. Whether or not it is appropriate to use the dental practice environment to screen for hypertension, smoking, or drug and alcohol abuse is very much a cultural, personal, and pragmatic decision for the dentist.

What is crucial is that if you choose to initiate, say, a screening policy for hypertension in practice (i.e. you measure every adult's blood pressure (BP)), you must ensure you are adequately trained in the technique, are aware of and avoid the risk of inducing disease (people get anxious at the dentist and may have 'white coat hypertension' which is of no significance), and act on significant results in a meaningful way. Generating a cohort of 'worried well' who then overload their GMP is hardly helpful whereas detecting significant hypertension in an unsuspecting middle-aged man who then has this corrected could be.

Medical examination

For the vast majority of dental patients attending as out-patients to a practice, community centre, or hospital, simply recording a medical history should suffice to screen for any potential problems. The exceptions are patients who are to undergo GA and anyone with a positive medical history undergoing extensive Rx under LA or sedation. The aim in these cases is to detect any gross abnormality so that it can be dealt with (by investigation, by getting a more experienced or specialist opinion, or by simple Rx if you are completely familiar with the problem). This is a summary, for more detail see Chapter 13.

General Look at sclera in good light for jaundice and anaemia. Check for cyanosis (peripheral: blue extremities; central: blue tongue) and dehydration (lift skin between thumb and forefinger).

Cardiovascular system Feel and time the pulse. Measure BP. Listen to the heart sounds along the left sternal edge and the apex (normally fifth intercostal space mid-clavicular line on the left), murmurs are whooshing sounds between the 'lub dub' of the normal heart sounds. Palpate peripheral pulses and look at the neck for a prominent jugular venous pulse (this is difficult and takes much practice).

Respiratory system Look at the respiratory rate (12–18/min)—is expansion equal on both sides? Listen to the chest—is air entry equal on both sides? Are there any crackles or wheezes indicating infection, fluid, or asthma? Percuss the back, comparing resonance.

Gastrointestinal system With the patient lying supine and relaxed with hands by their sides, palpate with the edge of your hand for liver (upper right quadrant) and spleen (upper left quadrant). These should be just palpable on inspiration. Also palpate bimanually for both kidneys in the right and left flanks (healthy kidneys are not palpable) and note any masses, scars, or hernia. Listen for bowel sounds and palpate for a full bladder.

Genitourinary system This is mostly covered by the abdominal examination. Patients with genitourinary symptoms are more likely to go into post-operative urinary retention. Pelvic and rectal examinations are neither appropriate nor indicated and should not be conducted by the non-medically qualified.

Central nervous system Is the patient alert and orientated in time, place, and person? For examination of the cranial nerves see ➔ Cranial nerves, p. 546. Ask the patient to move their limbs through a range of movements, then repeat passively and against resistance to assess tone, power, and mobility. Reflexes—brachioradialis, biceps, triceps, knee, ankle, and plantar—are commonly elicited (stimulation of the sole normally causes plantar flexion of the great toe).

Musculoskeletal system Note limitations in movement and arthritis, especially affecting the cervical spine, which may need to be hyperextended in order to intubate for anaesthesia.

Examination of the head and neck

This is an important aspect of examination that is often undertaught and overlooked in both medical and dental training. In the former, the tendency is to approach the area in a rather cursory manner, partly because it is not well understood. In the latter, it is often forgotten, despite otherwise extensive knowledge of the head and neck, to look beyond the mouth. For this reason, the examination described here is given in some detail, but the depth of examination will vary, dependent on the patient's complaint, risk factors, and clinical suspicion.

Head and facial appearance Look for specific deformities (➔ Cleft lip and palate, p. 170), facial disharmony (➔ Orthodontics and orthognathic surgery, p. 168), syndromes (Chapter 20), traumatic defects (➔ Mandibular fractures, p. 494; ➔ Mid-face fractures, p. 496; ➔ Nasal and malar fractures, p. 498), and facial palsy (➔ Oral manifestations of neurological disease, p. 476).

Assessment of the cranial nerves is covered in ➔ Cranial nerves, p. 546.

Skin Lesions of the face should be examined for colour, scaling, bleeding, and crusting, and palpated for texture and consistency and whether or not they are fixed to, or arising from, surrounding tissues. Those with facial hair who have had radiotherapy may have hairless patches indicating the area which was irradiated.

Eyes Note obvious abnormalities such as proptosis and lid retraction (e.g. hyperthyroidism) and ptosis (drooping eyelid). Examine conjunctiva for chemosis (swelling) and pallor (e.g. anaemia or jaundice). Look at the iris and pupil. Ophthalmoscopy is the examination of the disc and retina via the pupil. It is a specialized skill requiring an adequate ophthalmoscope and is acquired by watching and practising with a skilled supervisor. However, direct and consensual (contralateral eye) light responses of the pupils are straightforward and should always be assessed in suspected head injury (➔ Pupils, p. 492).

Ears Gross abnormalities of the external ear are usually obvious. Further examination requires an auroscope. The secret is to have a good auroscope and straighten the external auditory meatus by pulling upwards, backwards, and outwards using the largest applicable speculum. Look for the pearly grey tympanic membrane; a plug of wax often intervenes.

Mouth See ➔ Examination of the mouth, p. 12.

Oropharynx and tonsils These can easily be seen by depressing the tongue with a spatula, the *hypopharynx* and *larynx* are seen by indirect laryngoscopy, using a head-light and mirror, and the *post-nasal space* is similarly viewed. Skill with a flexible nasendoscope is essential for those (e.g. oral and maxillofacial surgery trainees) who examine this area in detail regularly.

The neck Inspect from in front and palpate from behind. Look for skin changes, scars, swellings, and arterial and venous pulsations. Palpate the neck systematically, starting at a fixed standard point, e.g. beneath the chin, working back to the angle of the mandible and then down the cervical chain, remembering the scalene and supraclavicular nodes. Swellings of the thyroid move with swallowing. Auscultation may reveal bruits over the carotids (usually due to atheroma).

Temporomandibular joint Palpate both joints simultaneously. Have the patient open and close and move joint laterally while feeling for clicking, locking, and crepitus. Palpate the muscles of mastication for spasm and tenderness. Auscultation is not usually used. Clicking can be physiological rather than pathological and in these cases simple reassurance may be required. Examine for diversion of the mandible.

Examination of the mouth

Most dental textbooks, quite rightly, include a very detailed and comprehensive description of how to examine the mouth. Given the constraints imposed by routine clinical practice, this approach needs to be modified to give a somewhat briefer format that is as equally applicable to the routine dental attendee who is symptomless as to the new patient attending with pain of unknown origin.

The key to this is to develop a systematic approach, which becomes almost automatic, so that when you are under pressure there is less likelihood of missing any pathology.

Extra-oral (EO) examination

(➔ Examination of the head and neck, p. 10.) For routine clinical practice this can usually be limited to a visual appraisal, e.g. swellings, asymmetry, patient's colour, etc. More detailed examination can be carried out if indicated by the patient's symptoms. Lymph nodes may be palpated.

Intra-oral (IO) examination

- Oral hygiene. Avoid subjective scores. A validated plaque score is advised, preferably using scores where a higher number is better, to motivate the patient with an objective measurement.
- Soft tissues. The entire oral mucosa should be carefully inspected. Any ulcer of >3 weeks' duration requires further investigation (➔ An approach to oral ulcers, p. 482). Examination should include the tongue, floor of mouth, lips, oropharynx, tonsillar crypt and tonsils, and hard palate. It is important to recognize normal anatomy.
- Periodontal condition. This can be assessed rapidly, using a periodontal probe (➔ Basic Periodontal Examination, p. 178).
- Chart the teeth present (➔ Tooth notation, p. 790).
- Examine each tooth in turn for caries (➔ Caries diagnosis, p. 26) and examine the integrity of any restorations present.
- Occlusion. This should involve not only getting the patient to close together and examining the relationship between the arches (➔ Definitions, p. 124), but also looking at the path of closure for any obvious prematurities and displacements (➔ Crossbites, p. 154). Check for evidence of tooth wear (➔ Tooth wear/tooth surface loss, p. 252).

For those patients complaining of pain, a more thorough examination of the area related to their symptoms should then be carried out, followed by any special investigations (➔ Investigations—specific, p. 16).

Tooth notation

Because of the difficulties of putting the grid notation (Fig. 1.1 and Fig. 1.2) in word processed documents, it is common practice to indicate the quadrant by abbreviating the arch and side. Thus the upper right second premolar is UR5 and the lower left second deciduous molar is LLE.

FDI

Permanent teeth

R	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28	L
	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38	

Deciduous teeth

R	55	54	53	52	51	61	62	63	64	65	L
	85	84	83	82	81	71	72	73	74	75	

Zsigmondy–Palmer, Chevron, or Set Square system

Permanent teeth

R	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	L
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	

Deciduous teeth

R	e	d	c	b	a	a	b	c	d	e	L
	e	d	c	b	a	a	b	c	d	e	

Fig. 1.1 Tooth notation systems.

European

Permanent teeth

R	8+	7+	6+	5+	4+	3+	2+	1+	+1	+2	+3	+4	+5	+6	+7	+8	L
	8–	7–	6–	5–	4–	3–	2–	1–	–1	–2	–3	–4	–5	–6	–7	–8	

Deciduous teeth

R	05+	04+	03+	02+	01+	+01	+02	+03	+04	+05	L
	05–	04–	03–	02–	01–	–01	–02	–03	–04	–05	

American

Permanent teeth

R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	L
	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	

Deciduous teeth

R	A	B	C	D	E	F	G	H	I	J	L
	T	S	R	Q	P	O	N	M	L	K	

Fig. 1.2 European and US tooth notation.

Investigations—general

▶ Do not perform or request an investigation you cannot interpret.
▶ Similarly, always look at, interpret, and act on any investigations you have performed.

Temperature, pulse, blood pressure, and respiratory rate You need to be able to interpret the results of these investigations.

- *Temperature* (35.5–37.5°C or 95.9–99.5°F). ↑ physiologically post-operatively for 24h, otherwise may indicate infection or a transfusion reaction. ↓ in hypothermia or shock.
- *Pulse*. Adult (60–80 beats/min); child is higher (up to 140 beats/min in infants). Should be regular.
- *Blood pressure* (120–140/60–90mmHg). ↑ with age. Falling BP may indicate a faint, hypovolaemia, or other form of shock. High BP may place the patient at risk from a GA.
- *Respiratory rate* (12–18 breaths/min). ↑ in chest infections, pulmonary oedema, shock, anxiety, panic attacks, and asthma attacks.

Urinalysis Routinely performed on all patients admitted to hospital. A positive result for:

- *Glucose or ketones* may indicate diabetes.
- *Protein* suggests renal disease especially infection.
- *Blood* suggests infection or tumour.
- *Bilirubin* indicates hepatocellular &/or obstructive jaundice.
- *Urobilinogen* indicates jaundice of any type.

Blood tests (Sampling techniques, ➲ For sampling, p. 578.) Reference ranges vary.

Full blood count Measures:

- *Haemoglobin* (M 13–18g/dL, F 11.5–16.5g/dL). ↓ in anaemia, ↑ in polycythaemia and myeloproliferative disorders.
- *Haematocrit* (packed cell volume) (M 40–54%, F 37–47%). ↓ in anaemia, ↑ in polycythaemia and dehydration.
- *Mean cell volume* (76–96fL). ↑ in size (macrocytosis) in vitamin B_{12} and folate deficiency, ↓ (microcytosis) iron deficiency.
- *White cell count* (4–11 × 10^9/L). ↑ in infection, leukaemia, and trauma, ↓ in certain infections, early leukaemia, and after cytotoxics.
- *Platelets* (150–400 × 10^9/L). See also ➲ Platelet disorders, p. 530.

Biochemistry Urea and electrolytes are the most important:

- *Sodium* (135–145mmol/L). Large fall causes fits.
- *Potassium* (3.5–5mmol/L). Must be kept within this narrow range to avoid serious cardiac disturbance. Watch carefully in diabetics, those in IV therapy, and the shocked or dehydrated patient. Suxamethonium (muscle relaxant, used during GA procedures) ↑ potassium.
- *Urea* (2.5–7mmol/L). Rising urea suggests dehydration, renal failure, or blood in the gut.
- *Creatinine* (70–150micromol/L). Rises in renal failure. Various other biochemical tests are available to aid specific diagnoses, e.g. bone, liver function, thyroid function, cardiac enzymes, folic acid, and vitamin B_{12}.

- *Glucose* (fasting 4–6mmol/L). ↑ suspect diabetes, ↓ hypoglycaemic drugs, exercise. Competently interpreted proprietary tests, e.g. 'BMs' equate well to blood glucose (➲ Hypoglycaemia, p. 570).

Virology Viral serology is costly and rarely necessary.

Immunology Similar to virology but more frequently indicated in complex oral medicine patients.

Bacteriology

Sputum and pus swabs Often helpful in dealing with hospital infections. Ensure they are taken with sterile swabs and transported immediately or put in an incubator. May also help to identify appropriate antibiotics for use in persistent infections.

Nasal and axillary swabs Used to screen for methicillin-resistant *Staphylococcus aureus* in all in patients undergoing hospital-based procedures. Stool samples are still generally used to detect *Clostridium difficile* although toxin can be detected in blood.

Blood cultures Useful if the patient has septicaemia.[1] Taken when there is sudden pyrexia and incubated with results available 24–48h later. Take two samples from separate sites and put in paired bottles for aerobic and anaerobic culture (i.e. four bottles, unless your laboratory indicates otherwise). In patients with sepsis there may be an associated tachycardia and hypotension.

Biopsy See ➲ Biopsy, p. 412.

Cytology With the exception of smears for candida and fine-needle aspiration, cytology is little used and not widely applicable in the dental specialties. The diagnosis of premalignant or malignant lesions using cytology only is not widely accepted.

1 https://www.nice.org.uk/guidance/ng51

Investigations—specific

Sensibility testing It must be borne in mind when vitality testing that it is the integrity of the nerve supply that is being investigated. However, it is the blood supply which is of more relevance to the continued vitality of a pulp. Test the suspect tooth and its neighbours for comparison.

Application of cold This is most practically carried out using Endo-Frost or ethyl chloride on a pledget of cotton wool, held against a dry tooth.

Application of heat Petroleum jelly should be applied first to the tooth being tested to prevent the heated gutta-percha (GP) sticking. No response suggests that the tooth is non-vital, but an ↑ response indicates that the pulp is hyperaemic.

Electric pulp tester The tooth to be tested should be dry, and prophy paste or a proprietary lubricant used as a conductive medium. Most machines ascribe numbers to the patient's reaction, but these should be interpreted with caution as the response can also vary with battery strength or the position of the electrode on the tooth. Table 1.1 lists the misleading results that may occur with the described methods.

Test cavity Drilling into dentine without LA is an accurate diagnostic test, but as tooth tissue is destroyed it should only be used as a last resort. Can be helpful for crowned teeth but should be used with caution.

Percussion This is carried out by gently tapping adjacent and suspect teeth with the end of a mirror handle. A positive response indicates that a tooth is extruded due to exudate in apical or lateral periodontal tissues.

Tooth mobility Tooth mobility is ↑ by ↓ in the bony support (e.g. due to periodontal disease or an apical abscess) and also by a fracture (#) of the root or supporting bone.

Palpation Palpation of the buccal sulcus next to a painful tooth can help to determine if there is an associated apical abscess.

Biting on to a Tooth Slooth, gauze, or rubber This can be used to try and elicit pain due to a cracked tooth.

Local anaesthesia LA can help localize organic pain.

Radiographs (➲ Radiology and radiography, p. 18; ➲ Advanced imaging techniques, p. 20; ➲ Radiographs—practical tips and helpful hints, p. 756.) See Table 1.2.

Table 1.1 Misleading results

False-positive	False-negative
Multi-rooted tooth with vital + non-vital pulp	Nerve supply damaged, blood supply intact
Canal full of pus	Secondary (s) dentine
Apprehensive patient	Large insulating restoration

Table 1.2 Radiographic choice for different areas

Area under investigation	Radiographic view
General scan of teeth and jaws (retained roots, unerupted teeth)	DPT
Localization of unerupted teeth	Parallax periapicals
Crown of tooth and interdental bone (caries, restorations)	Bitewing, periapicals
Root and periapical area	Periapical
Submandibular gland	Lower occlusal view
Sinuses	Occipito-mental, DPT
TMJ	DPT, MRI
Skull and facial bones	Occipito-mental
	PA and lateral skull
	Submento-vertex

Radiology and radiography

Radiography is the taking of radiographs, *radiology* is their interpretation.

Radiographic images are produced by the differential attenuation of X-rays by tissues. Radiographic quality depends on the density of the tissues, intensity of the beam, sensitivity of the emulsion, processing techniques, and viewing conditions.

Intra-oral views

Use a stationary anode (tungsten), direct current ↓ dose of self-rectifying machines. Direct action film (↑ detail) using D or E speed. E speed is double the speed of D hence ↓ dose to patient. Rectangular collimation ↓ unnecessary irradiation of tissues.

Periapical This shows all of the tooth, root, and surrounding periapical tissues. Performed by:

- *Paralleling technique*: film is held in a film holder parallel to the tooth and the beam is directed (using a beam-aligning device) at right angles to the tooth and film. Focus-to-film distance is ↑ to minimize magnification; the optimum distance is 30cm. This is the most accurate and reproducible technique.
- *Bisecting angle technique*: an older technique which can be carried out without film holders. Film is placed close to the tooth and the beam is directed at right angles to the plane bisecting the angle between the tooth and film. Normally held in place by the patient's finger. Not as geometrically accurate a technique as more coning off occurs and needlessly irradiates the patient's finger.

Bitewing This shows crowns and crestal bone levels, and is used to diagnose caries, overhangs, calculus, and bone loss <4mm. Patient bites on wing holding film against the upper and lower teeth and beam is directed between contact points perpendicular to the film in the horizontal plane. A 5° tilt to vertical accommodates the curve of Monson.

Occlusal This demonstrates larger areas. May be oblique, true, or special. Used for localization of impacted teeth and salivary calculi. Film is held parallel to the occlusal plane. Oblique occlusal is similar to a large bisecting angle periapical. True occlusal of the mandible gives a good cross-sectional view.

Key points

- Use paralleling technique.
- Use file holders.
- Rectangular collimation.
- E-speed film.

Extra-oral views

Skull and general facial views use a rotating anode and grid which ↓ scattered radiation reaching the film but ↑ dose to patient. Screen film is used for all EOs (intensifying screens are now rare earth, e.g. gadolinium and lanthanum). X-rays act on the screen which fluoresces and the light interacts with the emulsion. There is loss of detail but a ↓ dose to the patient. Dark-room techniques and film storage are affected due to the properties of the film.

Lateral oblique This has been largely superseded by panoramic views but can use a dental X-ray set.

Posteroanterior (PA) mandible Patient has nose to forehead touching film. Beam is perpendicular to film. Used for diagnosing/assessing # mandible.

Reverse Townes The position is as for PA mandible, but the beam is 30° up to horizontal. Used for condyles.

Occipito-mental Nose/chin touching the film beam parallel to horizontal unless occipito-mental prefixed by, e.g. 10°, 30°, which indicates angle of beam to horizontal.

Submento-vertex Patient flexes neck vertex touching film, and beam is projected menton to vertex. ↓ use due to ↑ radiation and risk to cervical spine.

Cephalometry (➲ Cephalometrics, p. 130; ➲ More cephalometrics, p. 132.) This uses a cephalostat for a reproducible position. Use Frankfort plane or natural head position. Wedge (aluminium or copper and rare earth) to show soft tissues. Lead collimation is used to reduce an unnecessary dose to patient and scatter leading to ↓ contrast. Barium paste can be used to outline soft tissues.

Panoramic Generically referred to as a DPT (dental panoramic tomograph), sometimes by make, e.g. OPT/OPG. The technique is based on tomography (i.e. objects in focal trough are in focus, the rest is blurred). The state-of-the-art machine is a moving centre of rotation (previously two or three centres) which accommodates the horseshoe shape of the jaws. Correct patient positioning is vital. Blurring and ghost shadows can be a problem (ghost shadows appear opposite to and above the real image due to a 5–8° tilt of the beam). This is a relatively low-dose technique and sectional images can be obtained. It is useful for gross pathology but less so for subtle changes such as early caries.

Lead aprons (0.25mm lead equivalent) In well-maintained, well-collimated equipment where the beam does not point to the gonads, the risk of damage is minimal. Apply all normal principles to pregnant women (use a lead apron if the primary (p) beam is directed at the fetus), but otherwise do not treat any differently.

There is no risk in dentistry of deterministic/certainty effects (e.g. radiation burns). Stochastic/change effects are more important (e.g. tumour induction). The thyroid is the principal organ at risk. Follow principles of 'ALARP' (as low as reasonably practicable) (➲ Radiographs—the statutory regulations, p. 754).

Parallax technique This involves two radiographs with a change in position of X-ray tube between them (e.g. DPT and periapical). The object furthest from the X-ray beam will appear to move in the same direction as the tube shift.

Advanced imaging techniques

Computed tomography (CT) Images are formed by scanning a thin cross-section of the body with a narrow X-ray beam (120kV), measuring the transmitted radiation with detectors and obtaining multiple projections, which a computer then processes to reconstruct a cross-sectional image ('slice'). Three-dimensional (3-D) reconstruction is also possible on some machines. Modern scanners consist of either a fan beam with multiple detectors aligned in a circle, both rotating around the patient, or a stationary ring of detectors with the X-ray beam rotating within it. The image is divided into pixels which represent the average attenuation of blocks of tissue (voxels). The CT number (measured in Hounsfield units (HU)) compares the attenuation of the tissue with that of water. Typical values range from air at –1000 to bone at +400 to +1000 units. As the eye can only perceive a limited greyscale, the settings can be adjusted depending on the main tissue of interest (i.e. bone or soft tissues). These 'window levels' are set at the average CT number of the tissue being imaged and the 'window width' is the range selected. The images obtained are very useful for assessing extensive trauma or pathology and planning surgery. The dose is, however, higher compared with conventional films and the National Radiological Protection Board recommends that all radiologists be made aware of the high-dose implications.

Cone beam computed tomography (CBCT) This is a CT technique where the beams are divergent, forming a cone. The scanner rotates around the patient's head creating multiple images (up to 600) which can be reformatted using software into 3-D image reconstructions. The data can also be used to create 3-D models. There are issues around comparability between different machines, distortion due to movement artefact, and bone density determination (as the HU in standard CT and CBCT are not directly comparable). CBCT is helpful for planning implant placement and for assessing teeth undergoing endodontic Rx, in particular if complex root or pulpal anatomy is suspected.

Magnetic resonance imaging (MRI) The patient is placed in a machine which is basically a large magnet. Protons then act like small bar magnets and point 'up' or 'down', with a slightly greater number pointing 'up'. When a radiofrequency pulse is directed across the main magnetic field, the protons 'flip' and align themselves along it. When the pulse ceases, the protons 'relax' and as they realign with the main field they emit a signal. The hydrogen atom is used because of its high natural abundance in the body. The time taken for the protons to 'relax' is measured by values known as T1 and T2. A variety of pulse sequences can be used to give different information. T1 is longer than T2 and times may vary depending on the fluidity of the tissues (e.g. if inflamed). MRI is not good for imaging cortical bone as the protons are held firmly within the bony structure and give a 'signal void', i.e. black, although bone margins are visible. It is useful, however, for the TMJ and facial soft tissues.

Problems These include patient movement, expense, the claustrophobic nature of the machine, noise, magnetizing, and movement of instruments or metal implants and foreign bodies. Cards with magnetic strips (e.g. credit cards) near the machine may also be affected.

Digital imaging This technique has been used extensively in general radiology, where it has great advantages over conventional methods in that there is a marked dose reduction and less concentrated contrast media may be used. The normal X-ray source is used but the receptor is a charged coupled device linked to a computer or a photo-stimulable phosphor plate which is scanned by a laser. The image is practically instantaneous and eliminates the problems of processing. However, the sensor is difficult to position and smaller than normal film, which means the dose reduction is not always obtained. Gives ↓ resolution. Now widely used in the UK and European countries.

Ultrasound (US) Ultra-high-frequency sound waves (1–20MHz) are transmitted through the body using a piezoelectric material (i.e. the material distorts if an electric field is placed across it and vice versa). Good probe/skin contact is required (gel) as waves can be absorbed, reflected, or refracted. High-frequency (short wavelength) waves are absorbed more quickly whereas low-frequency waves penetrate further. US is used to image the major salivary glands and soft tissue pathology (cysts/abscesses).

Doppler US is used to assess blood flow as the difference between the transmitted and returning frequency reflects the speed of travel of red cells. Doppler US has also been used to assess the vascularity of lesions and the patency of vessels prior to reconstruction.

Sialography This is the imaging of the major salivary glands after infusion of contrast media under a controlled rate and pressure using either conventional radiographic films or CT scanning. The use of contrast media will reveal the internal architecture of the salivary glands and show up radiolucent obstructions, e.g. calculi within the ducts of the imaged glands. It is particularly useful for inflammatory or obstructive conditions of the salivary glands. Patients allergic to iodine are at risk of anaphylactic reaction if an iodine-based contrast medium is used. Interventional sialography can be used for stone retrieval.

Arthrography Just as the spaces within salivary glands can be outlined using contrast media, so can the upper and lower joint spaces of the TMJ. Although technically difficult, both joint compartments (usually the lower) can be injected with contrast media under fluoroscopic control and the movement of the meniscus can be visualized on video. Stills of the real-time images can be made although interpretation is often unsatisfactory.

Positron emission tomography (PET) This relies on the detection of emitted beta particles. Applications in the head and neck are in tumour detection, particularly when coupled with a metabolite—fluorodeoxyglucose (FDG-PET). Software can allow superimposition of a CT scan onto the FDG-PET image which has a major potential role in the detection of active malignancy after non-surgical Rx or the detection of occult cancers.

Chapter 2

Preventive and community dentistry

Relevant pages in other chapters Plaque control, ➔ Non-surgical treatment—plaque control, p. 204; prevention of secondary caries, ➔ Principles of operative procedures, p. 242; prevention of trauma to anterior teeth, ➔ Prevention, p. 99.

Principal sources and further reading British Society for Disability and Oral Health guidelines and policy documents 🖉 http://www.bsdh.org.uk. British Society of Paediatric Dentistry guidelines and policy documents 🖉 http://www.bspd.co.uk. DOH 2017 *Delivering Better Oral Health—An Evidence-based Toolkit for Prevention* 🖉 http://www.dh.gov.uk. J. J. Murray et al. 2003 *Prevention of Oral Disease* (4e), OUP. Scottish Dental Clinical Effectiveness Programme (SCDEP) 2018 *Prevention and Management of Dental Caries in Children* 🖉 http://www.sdcep.org.uk. Scottish Intercollegiate Guideline Network (SIGN) guideline 138 (preventing dental caries) 🖉 http://www.sign.ac.uk. R. R. Welbury et al. 2018 *Paediatric Dentistry* (5e), OUP.