

# History and examination

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**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: dental charting ➞ Tooth notation, p. 762; medical conditions, Chapter 11; the child with toothache ➞ p. 62; pre-operative management of the dental patient ➞ Pre-operation, p. 554; cranial nerves ➞ p. 524; orthodontic assessment ➞ p. 124; pulpal pain ➞ p. 222.

**Principal sources** Experience.

## Listen, look, and learn

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 (see Chapter 17). 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 2–3 min 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, if it is not immediately obvious, what your role is in helping them.
- 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. Leading questions should, by and large, be avoided as they impose a preconceived idea upon the patient. This is also a problem when the question suggests the answer, e.g. 'is the pain worse when you drink hot drinks?'. To avoid this, phrase questions so that a descriptive reply rather than a straight yes or no is required. 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. 'but to come more up to date' or 'this is rather difficult—please slow down and let me understand 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 whilst establishing a mutual rapport, thus facilitating further investigations &/or treatment.

## Presenting complaint

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

**C/O** (complaining of) in the patient's own words. Use a general introductory question, e.g. 'Why did you come to see us today? What is the problem?'.

Avoid 'What brought you here today?' unless you want to give them the chance to complain about transport or car parking.

### If symptoms are present

**Onset and pattern** When did the problem start? Is it getting better, worse, or staying the same?

**Frequency** How often, 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.

**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 GDP frequently)

When did you last see a dentist and what did he do?

(this may give clues as to the diagnosis of the presenting complaint, e.g. a recent RCT)

How often do you brush your teeth and how long for?

(motivation and likely gingival condition)

Have you ever had any pain or clicking from your jaw joints?

(TMJ pathology)

Do you grind your teeth or bite your nails?

(TMPDS, personality)

How do you feel about dental treatment?

(dental anxiety)

What do you think about the appearance of your teeth?

(motivation, need for orthodontic treatment)

What is your job?

(socio-economic status, education)

Where do you live?

(fluoride intake, travelling time to surgery)

What types of dental treatment have you had previously?

(previous extractions, problems with LA or GA, orthodontics, periodontal treatment)

What are your favourite drinks/foods?

(caries rate, erosion, it is worth including specific questions as to whether or not they use tobacco, alcohol, or other recreational drugs)

**Notebox:****Summary points of the dental history  
(you write here)**

## 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
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Are you fit and well?

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?

Have you ever had asthma, eczema, hayfever?

Are you allergic to penicillin?

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?

Are you taking any drugs, medications, or pills?

If yes, please give details: (see Chapter 13)

Who is your General Medical Practitioner (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.

**NB** A complete medical history (as required when clerking in-patients) would include details of the patient's family history (for familial disease) and social history (for factors associated with disease, e.g. smoking, drinking, and for home support on discharge). It would be completed by a systematic enquiry:

**Cardiovascular** Chest pain, palpitations, breathlessness.

**Respiratory** Breathlessness, wheeze, cough—productive or not.

**Gastrointestinal** Appetite and eating, pain, distension, and bowel habit.

**Genitourinary** Pain, frequency (day and night), incontinence, straining, or dribbling.

**Central nervous system** Fits, faints, and headaches.

### 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) 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 general anaesthesia and anyone with a positive medical history undergoing extensive treatment 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 treatment if you are completely familiar with the problem). This is a summary, for more detail see Chapter 12.

**General** Look at sclera in good light for jaundice & anaemia. Cyanosis, peripheral: blue extremities; central: blue tongue. Dehydration, lift skin between thumb and forefinger.

**Cardiovascular system** Feel and time the pulse. Measure blood pressure. Listen to the heart sounds along the left sternal edge and the apex (normally 5th intercostal space mid-clavicular line on the left), murmurs are whooshing sounds between the 'lup 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** Mostly covered by 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? Examination of the cranial nerves ➡ Cranial nerves, p. 524. 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 aspect of examination that is 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 so thorough an inspection is only necessary in selected cases, e.g. suspected oral cancer, facial pain of unknown origin, trauma, etc.

**Head and facial appearance** Look for specific deformities (➡ Cleft lip and palate, p. 168), facial disharmony (➡ Orthodontics and orthognathic surgery, p. 166), syndromes (Chapter 19), traumatic defects (➡ Mandibular fractures, p. 470; ➡ Mid-face fractures, p. 472; ➡ Nasal and malar fractures, p. 474), and facial palsy (➡ Oral manifestations of neurological disease, p. 450). Assessment of the cranial nerves is covered in ➡ Cranial nerves, p. 524.

**Skin** lesions of the face should be examined for colour, scaling, bleeding, crusting, palpated for texture and consistency and whether or not they are fixed to, or arising from, surrounding tissues.

**Eyes** Note obvious abnormalities such as proptosis and lid retraction (e.g. hyperthyroidism) and ptosis (drooping eyelid). Examine conjunctiva for chemosis (swelling), 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. 468).

**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. 10.

**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. OMF 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).

**TMJ** Palpate both joints simultaneously. Have the patient open and close and move joint laterally whilst feeling for clicking, locking, and crepitus. Palpate the muscles of mastication for spasm and tenderness. Auscultation is not usually used.

## Examination of the mouth

Most dental textbooks, quite rightly, include a very detailed and comprehensive description of how to examine the mouth. These are based on the premise that the examining dentist has never before seen the patient, who has presented with some exotic disease. 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. As any abnormal findings indicate that further investigation is required, the reader is referred to the page numbers in parenthesis, as necessary.

**EO examination** (➡ Examination of the head and neck, p. 9.) 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.

### IO examination

- Oral hygiene.
- 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. 456).
- Periodontal condition. This can be assessed rapidly, using a periodontal probe. Pockets >5mm indicate the need for a more thorough assessment (➡ Basic Periodontal Examination (BPE), p. 174).
- Chart the teeth present (➡ Tooth notation, p. 762).
- 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. 122), but also looking at the path of closure for any obvious prematurities and displacements (➡ Crossbites, p. 152). Check for evidence of tooth wear (➡ Tooth wear/tooth surface loss, p. 244).

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. 14).

**Notebox:**

**Summary points for history and examination  
(you write here)**

## 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** These are the nurses' stock-in-trade. You need to be able to interpret the results.

**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. An ↑ BP + ↓ pulse suggests ↑ intracranial pressure (➡ Assessing head injury, p. 468).

**Respiratory rate** (12–18 breaths/min) ↑ in chest infections, pulmonary oedema, and shock.

**Urinalysis** is 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. 556.) Reference ranges vary.

**Full blood count** (EDTA, pink tube) 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<sub>12</sub> and folate deficiency, ↓ (microcytosis) iron deficiency.

**White cell count** (4–11 × 10<sup>9</sup>/L.) ↑ in infection, leukaemia, and trauma, ↓ in certain infections, early leukaemia, and after cytotoxics.

**Platelets** (150–400 × 10<sup>9</sup>/L.) See also ➡ Platelet disorders, p. 506.

**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) ↑ 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, vitamin B<sub>12</sub>, etc.

**Glucose** (fasting 4–6mmol/L) ↑ suspect diabetes, ↓ hypoglycaemic drugs, exercise. Competently interpreted proprietary tests, e.g. 'BMs' equate well to blood glucose (🔄 Hypoglycaemia, p. 547).

**Virology** Viral serology is costly and rarely necessary. If you must, use 10mL clotted blood in a plain tube.

**Immunology** Similar to virology but more frequently indicated in complex oral medicine patients; 10mL in a plain tube.

### Bacteriology

**Sputum and pus swabs** are often helpful in dealing with hospital infections. Ensure they are taken with sterile swabs and transported immediately or put in an incubator.

**Nasal and axillary swabs** are used to screen for MRSA 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** are also useful if the patient has septicaemia. 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 lab indicates otherwise).

**Biopsy** See 🔄 Biopsy, p. 386.

**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.

## 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.

**Application of cold** This is most practically carried out using ethyl chloride on a pledget of cotton wool.

**Application of heat** Vaseline should be applied first to the tooth being tested to prevent the heated 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 prophylaxis 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. For the described methods misleading results may occur (Table 1.1).

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 dentine
Apprehensive patient	Large insulating restoration

**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.

**Percussion** 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.

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

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

**Biting on to gauze or rubber** can be used to try and elicit pain due to a cracked tooth.

**Local anaesthesia** can help localize organic pain.

**Radiographs** (🔍 Radiology and radiography, p. 16; 🔍 Advanced imaging techniques, p. 18; 🔍 X-rays—practical tips and helpful hints, p. 748.) (See Table 1.2.)

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
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. Referring to a radiologist as a radiographer ensures upset.

Radiographic images are produced by the differential attenuation of X-rays by tissues. Radiographic quality depends on the density of the tissues, the 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* shows all of 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 increased to minimize magnification; the optimum distance is 30cm. The most accurate and reproducible technique.
- *Bisecting angle technique* Older technique which can be carried out without film holders. Film 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 patient's finger. Not as geometrically accurate a technique as more coning off occurs and needlessly irradiates the patient's finger.

*Bitewing* shows crowns and crestal bone levels, 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* demonstrates larger areas. May be oblique, true, or special. Used for localization of impacted teeth, 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 film 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 extra-orals (intensifying screens are now rare earth, e.g. gadolinium and lanthanum). X-rays act on screen which fluoresces and the light interacts with emulsion. There is loss of detail but ↓ the dose to patient. Dark-room techniques and film storage are affected due to the properties of the film.



**Lateral oblique** Largely superseded by panoramic but can use dental X-ray set.

**PA mandible** Patient has nose to forehead touching film. Beam perpendicular to film. Used for diagnosing/assessing # mandible.

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

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

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

**Cephalometry** (🔍) Cephalometrics, p. 128; (🔍) More cephalometrics, p. 130) uses cephalostat for reproducible position. Use Frankfort plane or natural head position. Wedge (aluminium or copper and rare earth) to show soft tissues. Lead collimation to reduce unnecessary dose to patient and scatter leading to ↓ contrast. Barium paste can be used to outline soft tissues.

**Panoramic** Generically referred to as 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 5–8° tilt of beam). Relatively low-dose technique and sectional images can be obtained. Useful for gross pathology but less so for subtle changes such as early caries.

**Lead aprons** (0.25mm lead equivalent)

The 10-day rule is now defunct for dental radiology. 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 lead apron if primary beam is directed at 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 (🔍) X-rays—the statutory regulations, p. 746.

**Parallax technique** involves 2 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 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) 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 CT (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).

### 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 radio-frequency 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 re-align 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** 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 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. 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 treatment or the detection of occult cancers.

## Differential diagnosis and treatment plan

Arriving at this stage is the whole point of taking a history and performing an examination, because by narrowing down your patient's symptoms into possible diagnoses you can, in most instances, formulate a series of investigations &/or treatment that will benefit them.

### Suggested approach

- History and examination (as shown in ➡ The dental history, p. 4; ➡ The medical history, p. 6; ➡ Medical examination, p. 8; ➡ Examination of the head and neck, p. 9; ➡ Examination of the mouth, p. 10).
- Preliminary investigations.
- Differential diagnosis.
- Specific investigations which will confirm or refute the differential diagnoses.
- Ideally, arrive at the definitive diagnosis(es).
- List in a logical progression the steps which can be undertaken to take the patient to oral health.
- Then carry them out.

Simple really!

This is the ideal, but life, as you are no doubt well aware, is far from ideal, and it is not always possible to follow this approach from beginning to end. The principles, however, remain valid and this general approach, even if much abbreviated, will help you deal with every new patient safely and sensibly.

### An example

#### Presentation

Mr Ivor Pain, 25, an otherwise healthy young man has 'toothache'.

C/O Pain, left side of mouth.

*HPC* Lost large amalgam [5 3 weeks ago. Had twinges since then which seemed to go away, then 2 days ago tooth began to throb. Now whole jaw aches and he can't eat on that side. The pain radiates to his ear and is worse if he drinks tea. He has a foul taste in his mouth. Little relief from analgesics.

*PMH* Well. Medical history NAD, i.e. no 'alarm bells' on questionnaire.

*PDH* Means well, but is an irregular attendee, 'had some bad experiences', 'don't like needles'.

#### O/E

*EO* Medical examination inappropriate in view of *PMH*. Some swelling left side of face due to left submandibular lymphadenopathy. Looks distressed and anxious.

*IO* Moderate OH, generalized chronic gingivitis, no mucosal lesions, caries partially erupted [8 with pus exuding, [5 large cavity, but seems periodontally sound, no fluctuant soft tissue swelling. Otherwise complete dentition with Class I occlusion (Fig. 1.1).

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Fig. 1.1 IO.

*General investigations* Temperature 38°C.

*Differential diagnoses*

- Acute apical abscess [5.
- Acute pericoronitis [8.
- Chronic gingivitis? Periodontitis.
- Caries as charted.

*Specific investigations*

- Vitality test [5 (non-vital).
- Periapical X-ray [5 (patent canal, apical area).

*Rx plan*

- Drain [5 via root canal (does not require LA as pulp is necrotic, hence won't unduly distress anxious patient, but will relieve pain and infection).
- Irrigate operculum of [8.
- Antibiotics (as patient is pyrexia with two sources of infection: usually due to mixed anaerobic/aerobic organisms therefore use amoxicillin and metronidazole) and analgesics (NSAID for 24–48h).
- Explain the problems and arrange a review appointment for OHI, periodontal charting, and a DPT.

*Future plan*

- OHI, scaling.
- RCT [5.
- Plastic restorations as indicated.
- Post/core crown [5.
- Remove third molars as indicated (clinically and from DPT).

Treatment at the first visit is kept at a minimum to relieve patient's pain and thereby gain his trust and future attendance.

**Notebox:**  
**Summary points of advanced imaging techniques and treatment planning**  
**(you write here)**

