Chapter 6

Restorative dentistry 2: repairing teeth

Contents

Relevant pages in other chapters Caries diagnosis ➔ p. 26; amalgam ➔ p. 630; resin composite ➔ Composite resins—constituents and properties, p. 632; the acid-etch technique ➔ Enamel and dentine bonding, p. 636; dentine-adhesive systems (dentine bonding agents) ➔ p. 638; glass ionomers ➔ p. 640; cements ➔ p. 644.

Principal sources and further reading *Operative Dentistry. Dental Update. The British Dental Journal*. B. G. N. Smith 1997 *Planning and Making Crowns and Bridges*, Dunitz. P. A. Brunton 2002 *Decision Making in Operative Dentistry*, Quintessence. A. Banerjee & T. F. Watson 2011 *Pickard's Manual of Operative Dentistry* (9e), OUP. S. J. Davies & R. J. Gray 2002 *A Clinical Guide to Occlusion*, British Dental Association.

To attempt to resolve the problem of caries by preparing and restoring teeth is comparable to trying to resolve the problem of poliomyelitis by manufacturing more attractive and better quality crutches, more quickly and more cheaply.

Repair and replacement of teeth

Dental tissue may be damaged by caries (➔ Dental caries, p. 24), trauma (➔ Dental trauma, p. 94), tooth wear/tooth surface loss (➔ Tooth wear/tooth surface loss, p. 244), or may be developmentally defective (see ➔ Abnormalities of tooth structure, p. 68). Patients may present complaining of pain/sensitivity (➔ Dental pain, p. 222), dissatisfaction with dental aesthetics, fractured teeth, or may not be aware of any problems. In order to maintain structure, function, and aesthetics, the resultant lesions may be helped to repair biologically or may be repaired technically by direct and indirect restorations within a context of careful diagnosis, prevention, control, and holistic patient care.

Increasingly, the approach is tending towards a biological concept of management rather than a mechanistic 'drill and fill' philosophy.

This is important as the population lives longer and teeth are retained longer. As soon as a restoration is placed, there is entry into a 'cycle of replacement' with ever more destructive restorations inevitable over a lifetime. A minimally invasive approach wherever possible is, therefore, important in extending the longevity of an individual tooth.

Where there is total loss of tooth/teeth then replacement with fixed or removable prosthodontics, incorporating indirect, laboratory-made prostheses e.g. fixed partial dentures (bridges)/removable partial dentures/complete dentures may be required (Chapter 7). These may be implant retained.

Notebox:
Summary points for repair and replacement (you write here)

Management planning

Management planning is dependent on a thorough information gathering process. This includes a history of the presenting complaint, medical history (➔ The medical history, p. 6), dental history (➔ The dental history, p. 4), and social history. This is followed by examination; general (e.g. pallor, disability), extra-oral (e.g. facial asymmetry, swelling ➔ Examination of the head and neck, p. 9) and intra-oral examination (➔ Examination of the mouth, p. 10). Intra-oral examination includes soft tissues, periodontal tissues, teeth, occlusion (➔ Occlusion—1, p. 226), and any existing prostheses. Mounted study models and diagnostic wax-up should be considered. Relevant special investigations, e.g. X-rays/sensibility testing, completes the process and allows a diagnosis and risk assessment to be made.

Risk/susceptibility for caries and tooth wear can be identified by gathering information from *targeted verbal history* (e.g. irregular attender/frequent sugar intake, eating disorder/clenching grinding habits) and *clinical evidence* (e.g. poor OH/new lesions, masseteric hypertrophy).

Staging of carious lesions with an index (e.g. ICDAS: International Caries Detection and Assessment System) and consideration of caries risk and X-ray examination allows the best management option to be chosen.

Under ideal circumstances an integrated management plan is formulated for each patient at the start of every course of treatment. Very often, however, the plan will need to be revised in the light of clinical findings as care progresses, e.g. patient cooperation, response to periodontal therapy, investigation of teeth of doubtful prognosis, etc. When dealing with patients with a range of problems it is therefore wise to formulate a plan which has a number of achievable goals, and then on completion of this to reassess the patient to decide on what further management is necessary. Contemporaneous accurate notes must be kept at all times and written information given to the patient.

Sequence of treatment

This list is obviously an oversimplification but should serve as a general guide to the order in which treatment should be carried out.

- Relief of pain.
- Control of active disease and achievement of stability:
  - Low caries risk: OHI, dietary modification, topical fluoride.
  - High caries risk: as for low risk with the addition of professional tooth cleaning, stabilizing restorations, high concentration toothpaste: 2800/5000ppm fluoride, fluoride mouthwash in patients ≥8yrs, professionally applied fluoride varnish, topical remineralizing agents (e.g. Recaldent®), management of hyposalivation, fissure sealants, sealant restoration. There is evidence for sealing of non-cavitated occlusal carious lesions even when there is radiolucency extending up to 1/3 of the way into dentine.[1]
  - Patients with risk of toothwear: modification of behaviour to remove aetiological factors.
  - Initial periodontal therapy.

1 C. Deery 2013 *Br Dent J* **214** 551.

  - Extraction of unsaveable teeth.
  - In patients with multiple carious lesions it may take several weeks/months to complete the permanent restorations necessary to secure oral health. In these cases it may be advisable to prevent any symptomless large lesions ↑ in size by placing temporary dressings. The cavities should be rendered caries-free at the margins, and temporarily restored with a cement, e.g. GI cement.
  - Consideration of definitive denture design.
  - Remaining simple restorations.
  - RCT(see Chapter 8).
- Reassessment of success of initial treatment, OH, periodontal condition, and prognosis of teeth.
- Definitive treatment: crowns, bridgework, dentures, implants (➔ Implantology, p. 316).
- Monitoring at intervals appropriate to level of risk.

Practical points

- *Listen* to patients and enquire as to their expectations and priorities. Discuss the management plan with them and the role they will have to play in controlling their dental disease. Success is dependent upon patient compliance, therefore time spent actively discussing their expectations, treatment options, time involved, cost implications present and future, and their role in maintenance is invaluable. Without such a discussion consent is not, by definition, informed.
- It is important to bear in mind subsequent items on a treatment plan, e.g. the design of a P/- may influence the choice of material and contour of direct/indirect restorations.
- For complex cases, several short treatment plans, each ending with a reassessment, are more logical and efficient than one long one that keeps changing.
- When formulating a treatment plan group items together into appointments to form a visit plan. Consider the time needed for each visit.
- Although it is usually advantageous to complete as much work as possible at each visit, this can be counter-productive. If in doubt about how much treatment to do at a visit, discuss this with the patient.
- Record-keeping is very important. At the end of each visit carefully note what has been done and the materials used (including sizes and shades). Cross that item off the treatment plan and adjust the patient's chart. Note what is to be done next visit: this will save time.
- It is important to recognize your own limitations, and where appropriate refer a patient for advice or treatment.

Dental pain

When a patient attends the surgery and complains of toothache, pain may be arising from a variety of different structures and may be classified as follows:

- Pulpal pain.
- Periapical/periradicular pain.
- Non-dental pain.

Dental pain can be very difficult to diagnose, and the clinician must first gather as much information as possible from the history, clinical and radiographic examinations, and other special tests (see Chapter 1).

Pulpal pain

The pulp may be subject to a wide variety of insults, e.g. bacterial, thermal, chemical, traumatic, the effects of which are cumulative and can ultimately lead to inflammation in the pulp (pulpitis) and pain. The dental pulp does not contain any proprioceptive nerve endings, therefore a characteristic of pulpal pain is that the patient is unable to localize the affected tooth but the pain does not cross the midline. The ability of the pulp to recover from injury depends upon its blood supply, not the nerve supply, which must be borne in mind when vitality (sensibility) testing is carried out (➔ Sensibility testing, p. 14).[2] It is impossible to reliably achieve an accurate Δ of the state of the pulp on clinical grounds alone; the only 100% accurate method is histological section.

Although numerous classifications of pulpal disease exist, only a limited number of clinical diagnostic situations require identification before effective treatment can be given.

Reversible pulpitis

Symptoms Fleeting sensitivity/pain to hot, cold or sweet with immediate onset. Pain is usually sharp and may be difficult to locate. Quickly subsides after removal of the stimulus.

Signs Exaggerated response to pulp testing. Carious cavity/leaking restoration. Tooth not tender to percussion.

Rx Remove any caries present and restore or place a sedative dressing (e.g. ZOE) or permanent restoration with suitable pulp protection.

Irreversible pulpitis

Symptoms Spontaneous dull, throbbing pain which may last several minutes or hours, be worse at night, and is often pulsatile in nature. Pain exacerbated by hot and cold. In later stages, cold may actually ease symptoms. A characteristic feature is that the pain remains after the removal of the stimulus. Localization of pain may be difficult initially, but as the inflammation spreads to the periapical tissues the tooth will become more sensitive to pressure.

2 A. H. R. Rowe & T. R. Pitt Ford 1990 *Int Endo J* **23** 77.

Signs Application of heat (e.g. warm GP) elicits pain. Affected tooth may give exaggerated or reduced or no response to electric pulp tester. In later stages may become TTP.

Rx Extirpation of the pulp and RCT (Chapter 8) is the treatment of choice (assuming the tooth is to be saved). If time is short or if anaesthesia proves elusive then removal of the coronal pulp and a Ledermix® dressing can often control the symptoms until the remaining pulp can be extirpated under LA at the next appointment.[3]

Dentine hypersensitivity

This is pain arising from exposed dentine in response to a thermal, tactile, or osmotic stimulus (but not all exposed dentine gives rise to symptoms). It is thought to be due to dentinal fluid movement stimulating pulpal pain receptors. Prevalence is ~1:7 adults with a peak in young adults, then ↓ with age.[4] Δ is by elimination of other possible causes and by evoking symptoms.

Rx Involves ↓ aetiological factors (i.e. OHI, possibly including tooth- brushing technique and intrinsic and extrinsic dental erosion) and by ↓ permeability of dentinal tubules (e.g. by toothpaste containing strontium &/or fluoride; placement of varnishes, dentine desensitizers, dentine adhesive systems, or, if indicated, a restoration).

Cracked tooth syndrome

Symptoms Sharp pain on biting—short duration.

Signs Often relatively few, therefore Δ difficult. Tooth often has a large restoration. Crack may not be apparent at first but transillumination and possibly removal of the restoration may aid visualization. There is a positive response to vitality (sensibility) testing. Pain can normally be elicited by getting the patient to bite then release with the affected tooth on a cotton-wool roll or a 'Tooth Slooth®'. May be associated with bruxing habit.

Rx An adhesive resin composite restoration may be appropriate in teeth which are minimally restored, but in some cases an indirect restoration with full occlusal coverage will be needed. Occasionally RCT may be required.

Periapical/periradicular pain

Progression of irreversible pulpitis ultimately leads to death of the pulp (pulpal necrosis). At this stage the patient may experience relief from pain and thus may not seek attention. If neglected, however, the bacteria and pulpal breakdown products leave the root canal system via the apical foramen or lateral canals and lead to inflammatory changes and possibly pain. Characteristically the patient can precisely identify the affected tooth, as the periodontal ligament, which is well supplied with proprioceptive nerve endings, is inflamed.

Pulpal necrosis with periapical periodontitis

Symptoms Variable, but patients generally describe a dull ache exacerbated by biting on the tooth.

3 Scottish Dental Clinical Effectiveness Programme 2007 *Emergency Dental Care* (℔ http://www.sdcep.org.uk).

4 P. Dowell *et al.* 1985 *Br Dent J* **158** 92.

Signs Usually no response to sensibility (vitality) testing, unless one canal of a multirooted tooth is still vital. The tooth will be TTP. Radiographically there may be loss of lamina dura in the periapical region, the apical PDL may be widened or there may be a periapical radiolucency (granuloma or cyst).

Rx RCT or extraction.

Acute periapical abscess

Symptoms Severe pain which will disturb sleep. Tooth is exquisitely tender to touch.

Signs Affected tooth is usually extruded, mobile, and TTP. May be associated with intra-oral and facial swelling or with a more localized intra-oral swelling. Sensibility testing may be misleading as pus may conduct stimulus to apical tissues. Radiographic changes can range from a widening of the apical PDL space to an obvious radiolucency. It is important to differentiate this condition from a periodontal abscess.

Rx Drain pus and, if indicated, relieve occlusion. Drainage of pus can often be achieved by entering the pulp chamber with a high-speed diamond bur, steadying tooth with a finger to prevent excessive vibration. After drainage has been achieved it is preferable to prepare the canal and place a temporary dressing. Avoid 'open drainage' if possible, but if absolutely necessary for <24h, as after this time further bacterial contamination of the root canal makes subsequent RCT very difficult. If a fluctuant soft tissue swelling is present, this should be incised to achieve drainage. Antibiotics should be prescribed if there is systemic involvement or if the infection is spreading significantly along tissue planes. When the acute symptoms have subsided, RCT must be performed or the tooth extracted.

Chronic periapical periodontitis

Often symptomless. Possibly associated with persistent sinus. Presentation may be: coincidental finding or acute exacerbation. Radiographs show well demarcated periapical radiolucency. (Granuloma or cyst).

Lateral periodontal abscess

Symptoms Similar to periapical abscess with acute pain and tenderness, and often an associated bad taste.

Signs Tooth is usually mobile and TTP, with associated localized or diffuse swelling of the adjacent periodontium. A deep periodontal pocket is usually associated, which will exude pus on probing. Radiographs normally show vertical or horizontal bone loss, and vitality (sensibility) testing is usually positive, unless there is an associated endodontic problem (perio-endo lesion).

Rx Achieve drainage of pus. Irrigate with a chlorhexidine solution. If there is systemic involvement or it is a recurrent problem, prescribe antibiotics (metronidazole or amoxicillin). Debride the pocket once acute symptoms have settled.

Non-dental pain

When no signs of dental or periradicular pathology can be detected then non-dental causes must be considered. Other causes of pain that can present as toothache include:

- TMPDS (➔ Temporomandibular pain—dysfunction/facial arthromyalgia, p. 458).
- Maxillary sinusitis (➔ Maxillary sinusitis, p. 396).
- Psychological disorders (atypical odontalgia) (➔ Atypical facial pain, p. 439).
- Tumours (➔ Benign tumours of the mouth, p. 394; ➔ Oral cancer, p. 428).

Notebox:
Summary points for management of dental pain (you write here)

Occlusion—1

In a book of this size it is not possible to consider all aspects of occlusion; therefore focus will be on the practical aspects and the more esoteric considerations left to other texts. Significant occlusal adjustment is rarely indicated and should only be attempted by a specialist.

Definitions

Ideal occlusion Anatomically perfect occlusion—rare.

Functional occlusion An occlusion that is free of interferences to smooth gliding movements of the mandible, with absence of pathology.

Balanced occlusion Balancing contacts in all excursions of the mandible to provide ↑ stability of F/F dentures; not applicable to natural dentition (except rarely in full-mouth reconstruction).

Group function Multiple tooth contacts on working side during lateral excursions, but no contact on non-working side.

Canine-guided occlusion During lateral excursions there is disclusion of all the teeth on the working side except for the canine, and no contacts on non-working side.

Hinge axis The axis of rotation of the condyles during the first few millimetres of mandibular opening.

Terminal hinge axis The axis of rotation of the mandible when the condyles are in their most superior position in the glenoid fossa.

Retruded arc of closure The arc of closure of the mandible with the condyles rotating about the terminal hinge axis.

Intercuspal position (ICP) or centric occlusion Position of maximum interdigitation.

Retruded contact position (RCP) or centric relation Position of the mandible where initial tooth contact occurs on the retruded arc of closure. Occurs when condyles are fully seated in the glenoid fossa. In ~20% of patients RCP and ICP are coincident; the remainder have forward slide from RCP to ICP.

Rest position The habitual postural position of the mandible when the patient is relaxed with the condyles in a neutral position.

Freeway space The difference between the rest and intercuspal positions.

Centric stops The points on the occlusal surface which meet with the opposing tooth in ICP. Normally the cusp tips, marginal ridges and central fossae.

Supporting or functional cusps The cusps that occlude with the centric stops on the opposing tooth. Usually palatal on upper and buccal on lower.

Non-supporting cusps The cusps that do not occlude with the opposing teeth. Usually buccal on upper and lingual on lower.

Deflective contacts Deflect mandible from natural path of closure.

Interferences Contacts that hinder smooth excursive movements of mandible.

Occlusal vertical dimension (OVD) Relationship between maxilla and mandible in ICP, i.e. face height.

Do occlusal factors play a role in temporomandibular disorders (TMPDS)?

TMPDS is recognized as being of multifactorial aetiology (➔ Temporomandibular pain—dysfunction/facial arthromyalgia, p. 458). The evidence would suggest that occlusal interferences usually cause either subclinical or no dysfunction because they lie within the adaptive capacity of the patient's neuromusculature. However, this may be lowered by stress and emotional problems so that in susceptible patients occlusal interferences can result in muscle hyperactivity at certain times. It is important therefore to ensure that iatrogenic interferences are not introduced during restorative procedures.

Occlusion—2

Occlusal examination

Prior to carrying out restorative treatment it is important to examine the patient's occlusion. Occlusal contacts can be identified with 8μm metal foil (Shimstock™) and marked using thin articulating paper (20μm). Important features to look for are:

- Number and distribution of occluding teeth.
- Over-eruption, tilting, rotation, etc.
- Presence or absence of centric stops.
- The RCP and any slide between RCP and ICP.
- Anterior guidance—look for disclusion of posterior teeth on protrusion.
- Lateral excursions—? group function, ? canine guidance. Check for non-working interferences.
- TMJs and muscles of mastication.

The clinical examination can only reveal a limited amount of information and in some circumstances (such as prior to crown and bridgework or in patients with TMPDS) a more detailed occlusal examination is required. This is called an *occlusal analysis* or a *diagnostic mounting*, and is done by mounting study models on a semi-adjustable articulator to facilitate the examination of the features.

Occlusal considerations for restorative procedures

In most situations restorations are made to conform to the patient's existing occlusion and the main consideration is to prevent the introduction of iatrogenic occlusal interferences. This approach to treatment is known as the *conformative approach*. In some circumstances the conformative approach is not appropriate and a new occlusal scheme must be planned. This is often the case when extensive crown and bridgework is required, such that the patient's existing occlusion will be effectively destroyed by the preparations. A new occlusion is established, free of interferences and with the patient occluding in retruded contact position, which is the only reproducible position. This approach to treatment is called the *reorganized* approach and further consideration of this line of treatment is beyond the scope of this book.

Generally for simple intracoronal restorations complex methods are not needed, but care must be taken to ensure the correct occlusal scheme is reproduced. Before preparing a tooth it is worthwhile marking the centric stops with articulating paper and trying to preserve them if possible. On completion of the restoration it must be checked in intercuspal position to ensure that it is not high, but also to ensure that it has recreated the centric stops, as if it is out of occlusion then over-eruption will occur (which may produce interferences). The restoration should then be checked in all mandibular excursions to ensure that no interferences have been introduced.

One or two units of extracoronal restorations can again be constructed in a relatively simple manner. This is usually done in the laboratory using hand-held models to reproduce the occlusion. Again, great care must be taken at the try-in stage to check the occlusion. Care also required when restoring the most distal tooth in the arch as it is very easy to introduce

errors in this situation; it may be more appropriate to use an occlusal record (transfer coping technique) and mount the models on an articulator.

More complex laboratory-made restorations need to be constructed with the models mounted on an articulator. This allows the restorations to be constructed in harmony with the patient's occlusion in all mandibular positions, which should minimize the amount of time spent adjusting the restoration at the try-in stage. Also, if any changes to the patient's occlusion are planned, then they can be made on the articulator in a controlled fashion. An articulator is a device which holds the models in a particular relationship and simulates jaw movements. Numerous types of articulators are available but only certain types are appropriate for use in crown and bridgework, e.g. the Denar® Mark II which is a semi-adjustable articulator. The articulator must accurately reproduce mandibular movements and to do this the casts must be mounted in the correct relationship to the TMJs; this is achieved by taking a facebow record. In a conformative approach casts should be related in ICP for restoration.

Occlusal records

Occlusal records are required to mount the models on an articulator in a particular position. Two positions are commonly used for the mounting, the ICP and the RCP. A wax 'squash bite' has commonly been used to record ICP; however, it is inaccurate as the mandible can be deviated as the teeth 'bite' through the wax. It is better not to use any record and to mount the models to the position of 'best fit'. After the preparations have been carried out it can be difficult to locate the working model to this position of best fit; in this situation the *transfer coping technique* can be used. In this technique DuraLay® copings are constructed on the working dies, which are taken to the clinic and seated in place on the preparations; they are then adjusted to ensure they are clear of the occlusion. A further mix of DuraLay® is applied to the occlusal surface of the coping and the patient asked to close together; this produces an indent of the opposing tooth in the resin and provides a very accurate occlusal registration.

When the models are to be mounted in RCP, this is achieved by recording the position of the mandible on the retruded arc of closure just before tooth contact occurs. This is termed *pre-centric record* and is generally registered with a relatively hard wax (Moyco® Dental Wax). The record is constructed on the maxillary model and trimmed flush with the buccal surfaces of the teeth. It is then softened and seated on the maxillary teeth and the mandible manipulated onto the retruded arc of closure to indent the wax, without allowing tooth contact to take place. The registration can be refined by using a low viscosity material (e.g. TempBond®) in the wax record.

Alternatively, a proprietary inter-occlusal registration material (e.g. Jet Bite™, Blu-Mousse®) may be used to record the space between prepared teeth and their opponents.

Teamworking

It is essential for the whole dental team (dentist, dental nurse, hygienist/therapist, dental technician, and receptionist) to work together and communicate well for optimum outcomes for the patient and optimum use of individual skills. Referral to a specialist may sometimes be required.

Four-handed dentistry

Working in a seated position is now the norm for all dentists. This has resulted in the dental nurse taking a more active role by working closely with the dentist.

Advantages and disadvantages

- ↑ comfort for dentist and nurse.
- ↑ efficiency.
- ↑ patient comfort.
- ↑ operator visibility.
- ↓ backache.
- ↑ professional satisfaction for the dentist and dental nurse.

Seating the patient Except for the old, infirm or pregnant patient, a totally supine position is preferable. Remember to warn the patient before reclining the chair.

Seating the dentist The aim is a relaxed, undistorted, and comfortable posture, with good vision of the teeth to be treated. Adjust the dentist's stool so that the top of their thighs slope at 15° to the floor. Position the dental chair so that, with the operator's back straight, the patient's mouth is at the dentist's focal distance (mid-sternal level). Forearms should slope upwards to this point. The operator's location is between 10 and 11 o'clock relative to the patient's head. Ensure the patient's head is at the top of the headrest.

Seating the dental nurse The dental nurse must also be seated comfortably with a straight back, with their eye level 10cm higher than the dentist's for maximum vision. The dental nurse's normal working environment is at between 2 and 3 o'clock, within easy reach of the instruments and equipment to be used.

Instrument transfer The transfer zone is just in front of, and slightly below the patient's mouth, not over their eyes. There are several techniques which enable the dental nurse to pass and receive instruments effectively from the dentist. Each dental team needs to choose, adapt, practise, and perfect a system that safely achieves instrument transfer.

Role of the dental nurse

- Assisting the dentist by preparing and maintaining the clinical environment, carrying out infection control procedures, handling dental materials, recording notes, processing X-rays.
- Supporting the patent by monitoring, providing support, advice and reassurance. Providing support if a medical emergency occurs.

Dental nurses can develop additional skills such as oral health promotion and taking radiographs at the prescription of a dentist.

Notebox:
Summary points for four-handed dentistry (you write here)

Isolation and moisture control

Isolation and moisture control is required to protect the patient from caustic materials or aspiration of foreign material, aid visibility, prevent contamination during moisture-sensitive techniques and maintain a relatively aseptic environment.

Aspiration

High-volume suction, e.g. an aspirator.

Low-volume suction, e.g. a saliva ejector.

Compressed air This tends to redistribute the moisture to somewhere else (e.g. your eye) rather than remove it. Should be used with care in deep preparations as prolonged use can cause pulpal damage, let alone displace adhesive materials when the solvent is being evaporated prior to curing.

Absorbents

- Cotton-wool rolls. Insert with a rolling action away from the alveolus. Moisten before removal to prevent tearing mucosa.
- Paper pads.
- Carboxymethylcellulose pads (Dry Tips®). Very effective if inserted the correct way round with the impermeable plastic against the tooth.

Rubber dam

This provides effective isolation and also improves access to operating site. It is indicated where airway protection and moisture control are essential, e.g. RCT (RCT without rubber dam is considered negligent), bonding. With practice, rubber dam can be applied quickly and often saves time in the long run. The dam must be secured to the teeth; several methods are available:

- Rubber dam clamps. These consist of two metal jaws linked by one or more bows. Commonly used for posterior teeth.
- Floss ligatures.
- Wedges.
- Proprietary rubber bands (Wedjets®) or pieces of dam, worked through contact points.
- By pinching dam between a tight contact point.

Types of dam

- Sheet grade, 6-inch square (15cm), which is supported with a frame. Moderate to thicker gauges are preferable.
- Mask type, which is supported by a paper margin and looped over ears with elastic. Increasingly, latex-free rubber dam is available and arguably should be used routinely.

Placement Several regimens have been described; the following is popular:

- Place cotton-wool roll in sulcus beside tooth for treatment.
- Punch holes, which correspond to tooth size, cleanly in the rubber dam at the centre of each tooth to be included.
- Try in clamp (with floss tied to it).

- Fit clamp into appropriate hole, with bridge distally, and using forceps place clamp and dam on to tooth (winged technique). Alternatively, the clamp may be placed first and the dam pulled over (wingless). The latter is especially useful for broken down teeth or poor access.
- Position dam on other teeth, using floss to ease through contact points.
- Secure dam anteriorly using one of the methods described earlier in this section.
- If frame required, position.
- Put napkin on patient's chin under dam. A saliva ejector will add to the patient's comfort.

If using caustic materials, a rubber dam sealer (e.g. OraSeal®) should be used.

Removal

- Take away clamps/ligatures, etc.
- Stretch dam, carefully cut interdental septa with scissors, and remove.

Protection of the airway

Mandatory when fitting crowns, bridges, inlays, and carrying out RCT. Best provided by rubber dam, but if this is not possible a butterfly sponge or gauze can be used.

Gingival retraction

↓ gingival exudate and exposes subgingival preparations prior to impression-taking. Some retraction cords are impregnated with substances such as adrenaline to ↓ bleeding. The cord should be gently placed into the gingival crevice with a cord packing instrument (leaving no tag hanging out) prior to impression-taking and temporization. Braided cords are better than twisted. Bleeding from the gingival margin can be ↓ by applying an astringent. A paste (Expasyl™) which contains aluminium chloride provides for retraction and haemorrhage control. Expasyl™ is useful for preparations finished within or just below the level of the gingival crevice, otherwise retraction cord is more appropriate.

Electrosurgery

May be indicated where a margin extends subgingivally and gingival overgrowth is hampering restoration placement or impression-taking. Also for crown-lengthening procedures, although bone removal is required too.

(See ➔ Coronal 1⁄3, p. 102 on crown lengthening.)

Principles of operative procedures

Why restore?

- For pain relief in reversible pulpitis.
- To allow the pulpodentinal complex to respond and heal.
- To restore function, form, and aesthetics.
- To prevent further spread of an active lesion which is not amenable to preventive measures or where preventive measures have failed.

However, these reasons need to be evaluated with regard to the patient and the rest of the dentition (➔ Management planning, p. 220).

Minimally invasive dentistry

Tooth preparation should be minimally invasive. It should be based on:

- *The morphology of the carious lesion.* Cavities should be kept as small as possible by excavation of only diseased enamel and dentine.
- *The requirements of the restorative material being used.* The remaining cavity walls are prepared chemically and physically in a manner appropriate to the material.

The final restoration should support and strengthen the remaining tooth tissue, promote remineralization, seal any remaining bacteria and deprive them of their nutritional supply and predictably restore form, function, and aesthetics.

General principles of tooth preparation

- Gain or widen access to caries through enamel using rotary instruments or hand chisels.
- Cut away all significantly unsupported enamel and demineralized enamel margins creating a sound enamel margin.
- Caries infected (dark brown, soft, wet) dentine should be removed using low-speed rose head burs or hand excavators or chemo-mechanical gels
- In smaller lesions with optimal moisture control, some peripheral caries affected (light brown, sticky, scratchy) dentine can be left at the ADJ provided there are no aesthetic concerns.
- In larger lesions or where moisture control is not optimal, then sound dentine at the ADJ is essential to maximize bond.
- A small amount of caries affected dentine can be left overlying the pulp in a symptomless tooth with achievable peripheral seal if there is a risk of pulpal exposure (➔ Management of the deep carious lesion, p. 241).
- Where endodontics is planned, all carious dentine should be removed.
- Once caries has been removed, further modifications should be made according to the restorative material chosen.
- For all materials all internal line angles should be rounded to ↓ internal stresses.
- Removing caries with a large diameter round bur automatically produces the desired shape internally.

Resin composite

(See also ➔ Composite resins—constituents and properties, p. 632.)

- Bevel enamel margin; increases surface area for bond.
- Need to acid etch with 37% orthophosphoric acid.

Amalgam[5]

(See also ➔ Amalgam, p. 630.)

- Amalgam is brittle, therefore an amalgam cavo-surface margin of at least 70°, preferably 90°, is required to prevent ditching. Also avoid leaving amalgam overlying cavity margins and overcarving.
- Accepted minimal dimensions for amalgam are 2mm occlusally and 1mm elsewhere.
- Undercuts are required for retention.
- In deep preparations, sealers &/or liners are required to seal the dentine and prevent ingress of bacteria.

Glass ionomer

(See also ➔ Glass ionomers, p. 640.)

- Wear precludes their use in load-bearing situations except for 1° teeth.
- Management of root caries, temporary restorations, and the atraumatic restorative technique.
- Use 10% polyacrylic/citric acids to condition dentine and prepare the surface for chemical adhesion.

Helpful hints

- Mark centric stops with articulating paper prior to tooth preparation and try to preserve if possible, or place the preparation margins past the occlusal contact areas.
- Avoid crossing marginal ridges if possible.
- In removing caries mechanically a tactile appreciation of the hardness of dentine is important, therefore use slow-speed instruments or excavators.
- Margins should be supragingival where possible.

Nomenclature

Black's classification of cavities is now not widely used. It has been replaced by Table 6.1:

Table 6.1 Classification of cavities

Class	Black's class	Site
Occlusal	Class I	Pits and fissures
Proximal	Class II	Proximal surface(s) of posterior tooth
Proximal	Class III	Proximal surface(s) of anterior tooth
Incisal	Class IV	Anterior incisal edge
Cervical	Class V	Cervical 1/3 of buccal or lingual surface of any tooth.

Cavities should not be cut to a predetermined design dictated by a classification but by the biological extent of the caries, the material chosen, and the remaining tooth structure. Experience in tooth preparation cannot possibly be adequately assimilated from the written text. The purpose of the following pages is to give the reader some practical tips on how to do the procedures considered, as well as to describe recent innovations and techniques.

5 P. B. Robinson 1985 *Dental Update* **12** 357.

Posterior composite restorations

Although amalgam is inexpensive, durable, easy to handle, and is still widely used, there is ongoing debate regarding its use in patients and the environmental issues around production/disposal. It is likely that a phasing down will occur over the years worldwide. Additionally, patient expectations increasingly include tooth-coloured restorations. Posterior composite restorations are an established feature of contemporary dental practice. Many dental educators no longer consider amalgam the 'material of choice' for restoring posterior teeth. There is increasing evidence to justify the use of composite in the restoration of posterior teeth.[6] National remuneration systems, however, do not always support best practice. All new dental graduates should be competent in providing posterior composite restorations but there is still some inconsistency in how they are taught.[7]

Indications for posterior composite restorations

- 1° carious lesions in occlusal or proximal surfaces.
- Core build-ups.
- Restoration of endodontically treated teeth.
- Restoration of worn teeth.
- Repair/replacement of failed restorations.
- Restorations extending onto root surface (may require RMGIC layer in 'open sandwich' technique).

Manipulation

- Success depends on effective isolation, preferably with rubber dam.
- Outline form is determined by the extent of the caries and undercuts are not necessary for retention.
- Bevelling of occlusal surface is C/I as it would result in a thin composite layer in a load-bearing area which would be prone to fracture.
- Bevelling of margin of proximal box is indicated except when little enamel bulk remains or if restoration finishes on dentine or cementum.
- Linings/bonding: there is a wide range of commercially available techniques for bonding or basing deeper cavities and a lack of consensus as to the most suitable technique.
- Can use 3-step total etch or 2-step or self-etching.
- Use of metal matrix bands with a 'layering' curing technique and wooden or plastic wedges are associated with better outcomes than transparent matrix bands and light-transmitting wedges.
- Finishing with discs, polishing burs, and interproximal finishing strips is necessary to achieve excellent marginal adaptation especially proximally and cervically.

Occlusal (Class I)

Resin composite.

6 N. J. Opdam *et al.* 2010 *J Dent Res* **89** 1063.

7 Consensus view on guidelines for teaching posterior composites restorations 2007 *Br Dent J* **203** 183.

Technique for small cavitated lesions

Known as *preventive resin restoration*. Preparation is limited to caries removal and the resultant preparation restored using fissure sealant alone if small, or resin composite followed by sealant if larger. Alternatively, GI can be used instead of resin composite. The rationale of this approach is that adjacent fissures are sealed for prevention. If the preparation extends significantly into load-bearing areas, conventional tooth preparation should be carried out and the tooth restored with resin composite or other suitable material.

Technique for medium-sized lesions

Following tooth preparation:

- Etch enamel margins and occlusal surface for 15s. Wash and dry.
- Apply a dentine adhesive system.
- Restore preparation with resin composite placed and cured in increments, but don't overfill.
- Polish with discs/points/cups/strips.
- Remove rubber dam and check occlusion.
- Remove any high spots.

Proximal (Class II)

Following tooth preparation:

- Place pre-curved metal matrix band and wooden or plastic wedge.
- Etch enamel margins and occlusal surface for 15s. Wash and dry.
- Apply a dentine adhesive system.
- Restore preparation with resin composite placed and cured in increments.
- Polish with discs/points/cups/strips.
- Remove rubber dam and check occlusion.
- Remove any high spots.

Hints for resin composite restorations

- Use etchant gel in a syringe to aid placement. Many newer adhesive systems do not have a separate etch stage, however, and rely on the use of acidic primers often used in conjunction with bonding resins or as a separate stage ➔ Dentine-adhesive systems (dentine bonding agents), p. 638.
- Additions are generally easy as new resin composite will bond to old.
- Avoid eugenol-containing cements with resin composite restorations.
- Resin composite must be cured incrementally, with increments being no deeper than 2mm.
- Pre-wedging one but not both proximal contacts aids creation of a contact point.
- If possible, centric stops should be preserved on sound tooth tissue or the restorative material, but never on the marginal interface of the restoration.

Direct posterior resin composites may not perform so well in the following situations:

- Cusp replacements.
- Poor moisture control.
- Restorations with deep gingival extensions, although a bonded base approach can be adopted.
- Bruxism or heavy occlusion.

Use of indirect composite or porcelain inlays/onlays may combat some of these problems (➔ Indirect resin composite or porcelain inlays/onlays, p. 238).

Indirect resin composite or porcelain inlays/onlays

These inlay techniques appear to overcome some of the problems associated with direct resin composite restorations. When used in conjunction with an acid-etch technique existing tooth tissue can be reinforced. Curing resin composite outside the mouth with the addition of heat (110° for 5min) or pressure overcomes polymerization shrinkage and possibly ↑ strength. As the inlays are bonded to the tooth with an adhesive, parallel walls are less important, but undercuts must be removed or blocked out with an RMGI cement (not in the proximal box). In general porcelain inlays offer improved aesthetics, surface finish, and bond in comparison to resin composite inlays; however, placement and adjustment can be more difficult. Ceromers (e.g. belleGlass™) may also be used in similar situations.

Technique: preparation

- The preparation should have slightly divergent walls, rounded line angles, and a slight bevel of the enamel margins, but not occlusally. For onlays, a minimum 1.5mm reduction of cusps is necessary.
- Block out any undercuts with RMGIC.
- Take an impression of the preparation and opposing arch, and if necessary make an inter-occlusal record.
- Choose shade.
- Make and place temporary with a proprietary resin-based temporary material (e.g. Fermit™, Clip™).

Technique: cementation

- Place rubber dam.
- Remove temporary and clean tooth.
- Try-in inlay/onlay, and carefully check marginal fit and adjust as necessary.
- Polish any adjusted areas.
- Remove inlay/onlay and clean with alcohol. For porcelain only, place layer of silane coupling agent on fitting surface.
- Etch enamel and dentine (total etch concept). Wash and remove excess moisture, but do not dry.
- Place dentine-adhesive system to moist surface.
- Apply dual-cure resin composite luting cement to prep and inlay and carefully seat.
- Cure for 10sec and then remove any excess resin composite.
- Complete light-curing (dual-cure resin composite will finish setting chemically under inlay in ~6min).
- Trim any excess cement (especially interdentally) and polish.
- Remove rubber dam, check occlusion, and adjust.

Posterior amalgam restorations

In practice, preparation size is determined by the size of the carious lesion and extension beyond this should be minimal. If enamel margins are cut to an angle of 90° (or, if cusps steeply inclined, >70°) the resultant preparation will be adequately retentive. Proximal preparations comprise a proximal box with vertical grooves. The preparation should only extend occlusally if there is evidence of caries in the occlusal fissures. Retention from occlusal forces is derived from a 2–5° divergence of the walls towards the floor in both parts of the preparation. Amalgam restorations are prone to # at the isthmus in restorations extended occlusally, therefore sufficient depth must be provided in this area. The width of the isthmus should not be overcut (ideally 1⁄4 to 1⁄5 intercuspal width). If the cusps are extensively undermined or missing they should be replaced with a bonded restoration (➔ Indirect resin composite or porcelain inlays/onlays, p. 238). A chisel can be used to plane away unsupported enamel from the margins of the completed preparation to produce a 90° butt joint. In molar teeth with mesial and distal caries it is preferable to try and cut two separate cavities, but often a confluent mesio-occlusal-distal preparation is unavoidable. Increasingly the use of resin composite placed in conjunction with a dentine adhesive system is advocated for the restoration of premolar and molar teeth.

Lining

Recently, emphasis has changed, with linings being used to seal the underlying dentine for moderate to deep cavities. Light-cured RMGIs (e.g. Vitrebond™) are now recommended. A preparation sealer (Gluma® Desensitizer) can be used in minimal preparations.

► Avoid the creation of an overhang at the cervical margin and ensure a good contact point with adjacent tooth with a well-contoured matrix band and wedges.

Anterior proximal (Class III), incisal (Class IV), cervical (Class V), and root surface caries

Anterior proximal

Resin composite is the most widely used material for anterior proximal restorations.

Access should be gained from either the buccal or lingual aspect, depending on the position of the lesion. As resin composite is adhesive the preparation is just extended sufficiently to remove all peripheral caries. Some unsupported enamel can be retained labially, but the margins should be planed with chisels to remove any grossly weakened tooth structure. Tooth preparation can be almost entirely completed with slow-speed burs and hand instruments. Ideally the margins are bevelled. A slight excess of material should be moulded into the preparation with a mylar strip, wedged cervically. Once the material is set, the excess can be removed. After checking the occlusion the restoration can be polished using one of the proprietary products (e.g. Sof-Lex™ discs, Enhance®) if necessary.

Incisal

The restoration of choice is resin composite, the so-called 'acid-etch tip' (➔ Acid-etch composite tip technique, p. 100); however, for very large incisal/proximal cavities in the adult patient, a dentine-bonded crown or porcelain veneer may give better retention and aesthetics.

Cervical

Although cervical cavities are seen less frequently in younger patients, they are an ↑ problem in older age-groups with gingival recession. Resin composite e.g. flowable, compomer, or RMGIC are the preferred materials in this situation.

Once caries has been removed the occlusal margin should be bevelled. The cervical margin should not be bevelled as it has been shown to ↑ microleakage. The materials are ideally placed incrementally under rubber dam isolation.

Root surface caries

As gingival recession is a prerequisite to root caries, it occurs predominantly in the >40yrs age group. Dentine, which has a critical pH below that of enamel, is thus directly exposed to carious attack. It is sometimes seen secondary to ↓ saliva flow (which reduces buffering capacity and may alter dietary habits) caused by salivary gland disease, drugs, or radiotherapy. Long-term sugar-based medication may also be a factor. Rx requires, first, control of the aetiological factor, and for most patients this involves dietary advice and OHI. Topical fluoride varnishes, high fluoride toothpastes, and mouthrinses may aid remineralization and prevent new lesions developing. However, active lesions require restoration, typically with a traditional or RMGIC. See also ➔ Severe early childhood caries, p. 90.

Management of extensive/deep restorations

Extensive loss of coronal tooth tissue leads to problems with retention of subsequent restorations, weakening of tooth structure, and challenges of obtaining a coronal seal. In the past, dentine pins were used to improve retention but now their use is ↓. Where amalgam is used, pins have largely been replaced by bonding techniques coupled with the use of auxiliary forms of retention such as boxes and slots, circumferential grooves, and the use of amalgam cores in the treatment of non-vital teeth. Dentine pins can produce stresses within the teeth while weakening restorative materials and there is no indication for their continued use. Where composite is used, a good seal can be achieved where enamel is present but if restorations cover a large surface area, bonded, indirect restorations in composite, ceramic, or gold should be considered.

Management of the deep carious lesion

Assessment

- Is the tooth restorable and is restoration preferable to extraction?
- Is the tooth symptomless? If not what is the character and duration of the pain?
- Sensibility test and percuss the tooth (before LA!).
- Take X-rays to check extent of lesion and if apical pathology.

Management

Depends upon an assessment of pulpal condition (➔ Pulpal pain, p. 222).

Irreversible pulpitis/necrotic pulp—Rx: RCT (➔ Root canal treatment—rationale, p. 330) or extraction.

Reversible pulpitis/healthy pulp—aim to maintain pulp vitality by selective removal of carious dentine without pulp exposure. See ➔ Pulp-preserving therapies, p. 326.

If in doubt Rx as reversible pulpitis. Can always institute RCT later.

Rationale Bacteria sealed under a restoration that provides a good peripheral seal are denied substrate, therefore lesion arrests. This allows the pulpodentinal complex to lay down reparative dentine.[8]

8 D. Rickets *et al*. 2013 *Cochrane Database Syst Rev* **3** CD003808.

Survival and failure of restorations

Survival of restorations

The results of Elderton's study into the durability of routine restorations placed in the General Dental Services in Scotland provided both a shock and a stimulus to the profession, as he found that 50% lasted for <5yrs.[9] This led to debate over both clinical technique and the profession's readiness to replace restorations. It has been reported that 60% of practitioners' time is spent replacing restorations. It is also interesting to note that those patients who change dentists frequently are more at risk of replacement restorations than those who are loyal to the same GDP.[10] In order to ↑ longevity we need to consider the reasons and types of failure of restorations.

Reasons for failure of restorations

- Poor understanding of the occlusion.
- Incorrect preparation, e.g. caries left at ADJ; incorrect margin preparation; inadequate retention; preparation too shallow; weakened tooth tissue left unprotected.
- Incorrect choice of restorative material, e.g. inadequate strength or resistance to wear for situation.
- Incorrect manipulation of material, e.g. inadequate moisture control; over- or under-contouring.

Before replacing a failed restoration it is important to identify the cause of failure and decide whether this can be dealt with by repair rather than replacement.[11] When making this decision bear in mind that cavity size is ↑ on average by 0.6mm each time a restoration is removed.

Types of failure

Failed aesthetics This may be due to underlying discolouration from stained dentine or corrosion products or superficial from surface staining. Patients may not be concerned so it is worth checking before replacing.

Failed marginal integrity can be due to creep/corrosion and ditching of amalgams or shrinkage of composites/GIC or marginal chipping.

If the patient can keep the margin plaque free and there is no recurrent caries then it may not be necessary to replace the restoration. If not, 2° or recurrent caries may be a risk. 2° caries is difficult to diagnose, but careful observation (clinically and radiographically) rather than intervention, is now advocated. Intervention is only indicated when the lesion is in dentine, and there is evidence of progression &/or cavitation is present. To prevent 2° caries it is important not only to educate the patient to reduce their caries rate but also to use excellent restorative technique to ensure good long term-restorations.

Bulk fracture can be due to heavy occlusal loading, poor cavity design, or poor bonding.

9 R. J. Elderton 1983 *Br Dent J* **155** 91.
10 J. A. Davies 1984 *Br Dent J* **157** 322.
11 R. Hickel *et al*. 2013 *Dent Mater* **29** 28.

Notebox:
Summary points for topics covered so far (you write here)

Tooth wear/tooth surface loss

Definition

The irreversible loss of tooth substance by factors other than trauma or caries. Usually caused by combinations of erosion, attrition, abrasion and possibly abfraction.

Some toothwear during life is inevitable (physiological), but where it has resulted in an unsatisfactory appearance, sensitivity, loss of vitality, or mechanical problems (pathological), the condition warrants investigation and Rx. Differentiating between these can be difficult. Wear that might be considered normal in a 70yr-old would not be normal in a 20yr-old.

Epidemiology

The Adult Dental Health Survey 2009 showed that 77% of people in the UK have at least one tooth worn to dentine. By the age of 75 about 40% of people have moderate tooth wear but severe wear only affects a small proportion of the population. Identifying what proportion of the population have problematic wear and what treatment they might need is very difficult.

Erosion is loss of tooth substance from non-bacterial chemical attack. Enamel initially becomes smooth and shiny then eventually dentine is exposed. This leads to cup-shaped lesions on the occlusal and incisal surfaces and proud amalgams. Once erosion is through to dentine it can accelerate. Sources of acid may be intrinsic or extrinsic.

Intrinsic Acid from stomach due to gastro-oesophageal reflux, vomiting in relation to eating disorder (➔ Anorexia nervosa/bulimia nervosa, p. 533), pregnancy, stress or rumination. Such conditions warrant referral. Affects palatal surfaces of ULS and occlusal/buccal of lower molars.

Extrinsic

- *Dietary* (e.g. citric, phosphoric, acetic acid)—found in carbonated drinks, fruit/citrus juices, pickles. Labial surfaces of ULS teeth classically affected.
- *Environmental*—occurred historically in industrial areas (e.g. battery manufacture). Rare now due to health and safety law. Pitting on labial surfaces of ULS. Competitive swimmers and professional wine tasters ↑ risk.
- *Medication*—iron tonics, vitamin C, acidic salivary flow stimulants and substitutes, nutritional supplements.

Attrition is physical wear caused by tooth to tooth contact. It affects interproximal and occlusal surfaces. ↑ in more abrasive diets and in bruxism. Occlusal wear facets match with opposing teeth. Usually occurs in combination with erosion.

Abrasion is physical wear of a tooth caused by objects other than teeth. Hard toothbrushing and abrasive toothpastes can result in dished or v-shaped cervical lesions. Habits such as pipe smoking or nail-biting may also produce incisal wear/grooves.

Abfraction stresses produced by clenching may concentrate at cervical margins and result in v-shaped cervical lesions. This is still controversial.

Diagnosis

From the history, clinical picture,[12] and special investigations. As toothwear may be due to a factor which no longer operates, it may be necessary (tactfully) to delve into the patient's past.[13] Targeted questions (e.g. diet, digestion disorders, eating disorders, pregnancy sickness, alcohol intake, stress, habits) help to assess the aetiology. In a proportion of cases, the aetiology will remain obscure and this will complicate prevention. It is important to establish whether the toothwear is ongoing. Monitoring is essential before operative intervention.

Management

- Prevention requires an understanding of the aetiology. However, an explanation of possible exacerbating factors to the patient may help to limit loss even if the exact aetiology is unknown.
- For patients where parafunction is thought to be a factor, a splint may be provided for night wear. Hypnotherapy may also be useful.
- Referral to a physician (gastrointestinal problems), psychiatrist (bulimic patient), or restorative specialist (complicated restorative problem).
- Monitoring. Take study models, silicone indices, and photos to allow rate of wear to be monitored. Intervention is indicated in cases with an unsatisfactory appearance, sensitivity, or functional problems.
- If Rx is required, GI or resin composite restorations may help improve appearance and ↓ sensitivity.
- If there has been compensatory over-eruption it may not be possible to provide an aesthetic result without ↑ OVD or carrying out surgical crown lengthening. Generally, if ULS teeth not seen when the patient is smiling then an ↑ in incisal length is required. If excessive gingiva shows when smiling then surgical crown lengthening is required. Use of the 'Dahl' approach can create space by a combination of anterior tooth intrusion and posterior tooth eruption.[14] Composite is added to the palatal surfaces of the anteriors (minimum thickness 1.5mm palatally). Warn patient that the posterior teeth will be out of contact but will come together again in 3–6 months. The predictability of this method ↓ with ↑ age.
- Restoration can be achieved by direct composite restorations or by indirect restorations. These may be full coverage crowns or bonded onlays. If there is sufficient freeway space direct composite resin or dentine bonded crowns may be used to restore the dentition.
- Overdentures may be indicated in cases of excessive toothwear, but are aesthetically less satisfactory.
- Sensitivity is a frequent problem in tooth wear. There may be pulpal involvement in 9–12% of cases, particularly inc.[15,16] If pulps are exposed, pulpotomy may be indicated.

12 B. E. Wazani *et al.* 2012 *Br Dent J* **213** E10.
13 E. A. M. Kidd & B. G. Smith 1993 *Dent Update* **20** 174.
14 A. B. Gulamali *et al.* 2011 *Br Dent J* **211** E9.
15 J. S. Rees *et al*. 2011 *Dent Update* **38** 24.
16 K. Simvasithamparan *et al.* 2003 *Aus Dent J* **48** 97.

'Cosmetic' dentistry

All procedures carried out in the anterior region have an integral aesthetic element as treatment is intended to restore appearance as well as function. 'Cosmetic' treatment is treatment intended to 'improve' a person's appearance. There is a huge market in procedures aimed at 'enhancing' or 'improving' natural aesthetics. Some of these procedures are relatively non-invasive: tooth whitening/bonding procedures/orthodontics. Some, however, can be highly destructive and risk doing harm.

While there may undoubtedly be psychological benefit to enhancing personal appearance, all patients need to be fully informed of the risks involved in destroying sound, healthy tooth tissue, the irreversible nature of the procedure, the risks of sensitivity and marginal failure and the inevitable need for replacement over a lifetime. Management of expectations is essential and can be challenging.

Notebox:
Summary points for 'cosmetic' dentistry
(you write here)

Tooth whitening

Tooth whitening (bleaching) provides a non-invasive solution for mild to moderately discoloured vital or root-filled teeth. It is safe and effective provided it is used properly. Potential local adverse effects include gingival irritation and tooth sensitivity. Some shade rebound may occur shortly after treatment.

Following amendment in 2012, the current European Directive position is:

- Whitening is the practice of dentistry and that it should only be undertaken by regulated dental professionals.
- Products containing or releasing between 0.1% and 6% hydrogen peroxide cannot be used on any person under 18yrs of age
- Products containing between 0.1% and 6% hydrogen peroxide should only be used after appropriate clinical examination to ensure there are no risk factors or oral pathology concerns.
- Products should be available only via a dentist/hygienist or dental therapist.
- For each cycle of use, the first use must be carried out by dental practitioners or under their direct supervision.
- After that, the product may be provided by the dental practitioner to the consumer to complete the cycle of use.

Vital bleaching

Two methods have been described. Take photos as a pre-operative record or alternatively note shade of tooth using a porcelain shade-guide.

Home bleaching technique

A gel of 10–15% carbamide peroxide in a soft splint has also been advocated for 'home bleaching'. 10% carbamide peroxide provides around 3% hydrogen peroxide. This is worn for a few hours, up to 8h each day for several weeks, usually 2, and is the preferred technique.

- Take an alginate impression.
- Ask the laboratory to make a bleaching splint.
- Fit the splint, dispense the carbamide peroxide (10%), and give instructions.
- Advise 6–8h treatment per day.
- Review weekly.

'In-office' bleaching technique

This uses gels of high concentration which can cause tissue burns (hydrogen peroxide 25–40%). Gingival barrier protection must be used and checked for signs of leakage. Dental curing lights are commonly used to activate the bleaching agent.[17] However, usually no activation is necessary.

- Apply Orabase® to gingivae prior to placing rubber dam over teeth to be treated.
- Polish teeth with pumice.
- Apply the bleaching agent according to the manufacturer's instructions.
- Wash teeth with copious amounts of water.
- Remove rubber dam and polish teeth.
- Advise patient to avoid tea, coffee, red wine, cigarettes, etc., for 1 week and that some sensitivity may occur.
- Can repeat as required.

Non-vital bleaching

This provides a conservative alternative to a post-retained crown for the discoloured root-filled tooth. However, it usually only achieves an improvement in shade. There is a tendency for the discoloration to recur over time, therefore warn the patient and over-bleach. Interestingly, it has been shown that the degree and duration of discoloration and the age of the patient do not affect the prognosis for a successful result.[17]

Walking bleach technique

- Place Orabase® around gingivae of tooth to be treated and isolate with rubber dam.
- Open access cavity and remove root filling to 2mm below gingival margin (a perio probe is a useful guide).
- Place thin layer of GI over root filling to prevent root resorption.
- Remove any stained dentine within pulp chamber.
- Clean access cavity with etchant on a pledget of cotton wool and then repeat with alcohol. Wash and dry.
- Place 35% carbamide peroxide.
- Seal with a pledget of cotton wool and GI.
- Review after 1–2 weeks and repeat (up to 2x) if necessary.
- Seal access cavity permanently with a light shade of resin composite.
- Alternatively, after sealing and cleaning access cavity, place 10% carbamide peroxide into pulp chamber and ask patient to change the material regularly through the open access cavity over a 24h period combined with wearing a tray for simultaneous external bleaching of the tooth (inside/outside bleaching). The tooth is sealed coronally when the patient returns.

Thermocatalytic techniques, where the hydrogen peroxide is heated within the pulp chamber, should no longer be used, as they are associated with the development of cervical resorption lesions.

17 R. A. Howell 1980 *Br Dent J* **148** 159.

Veneers

Indications

Where teeth are fundamentally sound but discoloured. Mild discoloration (can ↑ success by bleaching first), hypoplasia, fractured teeth, toothwear lesions, closing space, or modifying shape (within limits). Veneers are particularly useful in adolescents, where more extensive tooth preparation may risk exposure.

Contraindications

Large existing restorations, severe discoloration, insufficient tooth substance to bond restoration to, and parafunction. Overlapping teeth, pencil-chewing, or nail-biting are relative C/I.

As whitening becomes more common the need for veneers is less but they still provide the least destructive restoration for anterior teeth. On the other hand, survival rate at 10yrs is 20% lower than crowns.[18]

Types

Resin composite Useful for the treatment of adolescent patients. Can be made directly (less destructive) or, more commonly, indirectly. Problems are shrinkage, staining, and wear. Average lifespan ~4yrs.[19]

Porcelain Better performance and aesthetics than resin composite and long-term follow-up now available.[20] In addition, porcelain is less plaque retentive. They are made indirectly in the laboratory and roughened on their fitting surface by etching or sandblasting. This surface is treated with a silane coupling agent prior to bonding to the etched tooth enamel with resin composite luting cement.

Technique for porcelain veneers

Tooth preparation Veneers are usually 0.5–0.7mm thick, therefore unless deliberate overbuilding is required, the tooth needs to be reduced labially. To guide reduction depth cuts of 0.5mm are advisable. A definite chamfered finishing line will make the technician's job considerably easier and this should be established first. If the tooth is discoloured the margin should be sub-gingival (but still in enamel), otherwise keep slightly supragingival. The finishing line is extended into the embrasures, but kept short of the contact points. Incisally, the veneer can be finished to a chamfer at the incisal edge or wrapped over onto the palatal surface (see Fig. 6.1).

An impression of the preparation is taken using an elastomeric impression material in a stock tray and the shade taken with a porcelain shade-guide. Temporary coverage is not usually required (see ➔ Temporary restorations, p. 260).

18 T. Burke & P. S. Lucarotti 2009 *J Dent* **37** 12.
19 J. S. Clyde & A. Gilmour 1988 *Br Dent J* **164** 9.
20 F. J. Shaini *et al.* 1997 *J Oral Rehabil* **24** 553.

Try-in Careful handling is necessary so as not to contaminate the fitting surface of the veneer. Do not check the fit of the veneer on the stone cast. The prepared tooth should be cleaned and isolated and then the veneer tried in wet (to ↑ translucency). Minor adjustments are best deferred until after cementation to ↓ risk of #. The effect of different shades of resin composite &/or opaquers and tints can be tried prior to etching to get the best colour match. If several veneers are to be fitted, check them individually and then together to work out the order of placement.

Placement The fitting surface of the veneer is cleaned with alcohol, dried, and then coated with a thin layer of silane coupling agent followed by bonding resin. The tooth is re-isolated and cellulose acetate strips used to separate from adjacent teeth. After etching, washing, and flash drying, a dentine adhesive system is used. Numerous cementation systems are available, e.g. Calibra®, Nexus™, Variolink®. The resin composite luting cement is placed thinly on the fitting surface of the veneer and the veneer carefully positioned. Excess luting cement should be removed with a brush dipped in bonding resin before curing. Adjustments are made with flame-shaped diamond or multi-blade tungsten carbide bur before polishing. The patient should be instructed in the use of floss.

Porcelain slips are veneered corners or edges used to restore # incisors or close spaces by building out the tooth mesially or distally. Now rarely used as direct placement of resin composite is preferred.

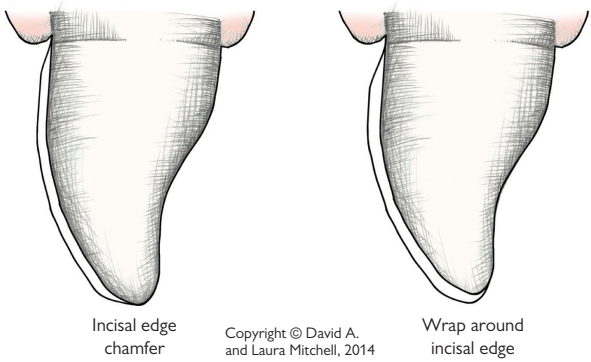

Fig. 6.1 Porcelain veneer preparations.

Anterior crowns for vital teeth

▶ Defer preparation of any crowns until the patient can attain good OH. Not only will this help to ↑ their motivation, but also healthy gingivae are necessary for correct placement of preparation margins and accurate impressions.

Preliminary treatment

- Check vitality; if non-vital, institute RCT first.
- Take a periapical radiograph to check for apical pathology, health of supporting tissues, and anatomy of pulp.
- Get study models. A trial preparation and diagnostic wax-up on a duplicate model can be helpful (especially for the less confident operator). This helps to anticipate any complications and can also be used for fabrication of a temporary crown.
- Record the shade, so that it can be checked at subsequent visits.
- Examine the occlusion.

All-ceramic crowns becoming more popular than porcelain fused to metal but there is little evidence as to which material to use in which situation.

Porcelain fused to metal (PFM) crown

↑ strength, but ↑ labial reduction (*NB* some ceramic crowns can be more destructive than PFMs). ↑ aesthetics compared with all-ceramic but proven clinical track record. Preparation requires 0.5mm reduction of lingual surface with chamfered margin and labial reduction of 1.2–1.5mm, with shoulder. Transition from shoulder to chamfer is on proximal surface. The junction between porcelain and metal must not be in an area of contact with the opposing teeth. Ideally, all occlusal surfaces in contact with opposing teeth should be finished in metal.

Porcelain jacket crown (PJC)

This was previously the first choice for aesthetics in cases where occlusal loading was not a problem. Now being superseded by newer ceramic systems.

Dentine bonded crowns

These are full coverage ceramic restorations which are bonded to the underlying dentine. These are the least destructive of the all-ceramic crowns. The bond is formed between a dentine bonding agent, composite resin luting material and a ceramic fitting surface which has been made micromechanically retentive by etching. The labial preparation is minimal, but incisal reduction is the same as for other porcelain crowns. They are useful for tooth wear cases or where preparation taper is large or crown height poor. Chair-side fitting is more time consuming than for conventional crowns.

All-ceramic crown

Where there is a large restoration in place or there is a pre-existing crown it may not be possible to use a dentine-bonded crown. In this case an all-ceramic crown provides better aesthetics and ↑ strength compared with PJC (e.g. In-Ceram®, Empress II®, Procera®, Lava™).

Which system to use depends on clinical situation. Glass-based, etchable ceramics provide superior aesthetics but won't mask out an underlying dark substrate and are relatively low strength (e.g. IPS Empress® IPS emax®). Must be bonded with resin cement to achieve clinically acceptable strength. Crystalline alumina- or zirconia-based ceramics are relatively opaque so can mask underlying darker substrate and have high strength (e.g. Procera®,

Lava™, In-ceram®, Zircon). They are not etchable. Can be cemented with RMGI or resin cement.

Principles

- Sufficient tooth reduction to permit adequate thickness of crown for strength and aesthetics.
- Reduction should follow tooth contours. *NB* Two-plane reduction on labial face of incisor teeth.
- Chamfer preparation: 1.0mm labial (just into gingival crevice) and palatal (supragingival).
- 5° taper of opposing walls for retention.

Preparation

- Check shade in natural and artificial light with dental nurse and patient.
- *Interproximal.* Use a long, tapered chamfer bur. Walls should have 5° taper and converge lingually.
- *Labial.* With the same bur, first place three depth grooves and remove intervening tooth tissue. Extend a maximum of 0.5mm subgingivally.
- *Lingual.* If possible carry out under direct vision. Continue interproximal shoulder round to form cingulum wall, supra-gingivally. Remainder of palatal surface should be prepared with a flame-shaped bur to give 0.8–1.0mm clearance from opposing teeth.
- *Incisal.* A reduction of 1.5–2mm is required.
- *Finishing.* Finishing burs should be used to round off line angles.
- *Fabricate temporary crown* (➔ Temporary crowns, p. 260) next, as if time runs out impressions can be deferred, but a temporary crown cannot.
- *Impressions.* (➔ Impression techniques, p. 648.) Record preparation in elastomeric material. Opposing arch can be recorded in alginate (cheaper), inter-occlusal record, and facebow if required. Fit temporary and arrange next appointment. CAD CAM may also be used.
- *Fitting crown.* Isolate with rubber dam. Remove temporary crown. Check marginal fit, contact points. Cement with resin cement or RMGIC. Check occlusion. If any adjustments are required polish with porcelain polishing wheels. Make sure patient is happy before you cement crown.

Common problems with anterior crowns

- *Preparation likely to expose pulp.* Consider veneer as interim measure.
- *Completed crown does not seat.* Check: (i) no temporary cement left on preparation; (ii) approximal contacts with floss, and if too tight, adjust; (iii) ? distorted impression. Check no undercuts on preparation and repeat impressions; (iv) die over-trimmed leading to over-extension of margin—cut-back crown margin.
- *Core material showing through crown.* Need to ↓ preparation so that sufficient bulk of enamel and dentine porcelain can be built up over core, and remake.
- *Colour not right.* If technician handy can see if surface stains will give sufficient improvement. If not, re-choose shade and remake.

Removing old crowns

- Protect airway.
- A crown-removing instrument can be used to try and remove a crown without destroying it.
- If crown is to be replaced: cut a longitudinal groove in labial surface of crown. Insert a flat plastic and twist.

Anterior post and core crowns

In root-filled anterior teeth it may be necessary to insert a post and core prior to the placement of a crown if there is insufficient remaining tooth tissue to support a core. Post and cores provide support and retention for a crown but they do *not* reinforce teeth. They transfer forces to the root of the tooth. A ferrule effect will protect the root from this to an extent. The placement of a post makes further orthograde endodontics difficult, so it is important to check first that the root-filling and apical condition are satisfactory. If in doubt, repeat RCT.

Preliminary preparation

The first step is to prepare the crown of the tooth to receive the appropriate coronal restoration. The appropriate reductions and margin preparations are carried out with the intention of retaining as much coronal dentine as possible. Grossly weakened tooth substance is removed, but the root face should *not* be flattened off. The retention of a core of tooth substance is important as it effectively ↑ the length of the subsequent post; obviously in some cases this will not be possible, e.g. if the tooth has fractured at gingival level. The coronal GP is removed with a heated instrument or Gates–Glidden bur, taking care not to disturb apical seal. The root canal is then prepared according to the particular technique being used. As a general guide the post should be at least equal to the anticipated crown height, but a minimum of 5mm of well-condensed GP should be left. A periodontal probe or silicone stop is helpful to check prepared canal length.

Types of post and core system

Many different types of post system are available and they can be classified in numerous ways:

Prefabricated or custom-made Prefabricated metal posts obviously have the advantage of being cheap and quick, however, they lack versatility and many of the systems require all coronal dentine to be removed. Custom-made techniques are preferred for metal as they are more versatile, but they are also more expensive and require an additional laboratory stage. Pre-fabricated non-metal posts (ceramic or carbon fibre reinforced) are becoming more popular (e.g. LightPosts™, ParaPost®FiberWhite, and RelyX™FiberPost). They are more flexible than metal posts and therefore less likely to cause root fracture. Failure with fibre posts is most commonly due to decementation or 2° caries rather than fracture so failure can be more retrievable.

Parallel-sided or tapered Parallel-sided posts are generally preferred to tapered as they provide greater retention and do not generate as much stress within the root canal. Tapered posts, however, are less likely to perforate in the apical region and are better for small tapered roots, e.g. lateral incisors.

Threaded, smooth, or serrated Threaded posts provide ↑ retention than smooth-sided; however, they will ↑ stress within the root canal and are therefore C/I. Serrated posts do not concentrate stress but simply ↑ the surface area for retention. Other design features include antirotational components and cementation vents.

Indirect custom-made posts

These are usually cast metal. First of all the root canal is prepared using parallel-sided twist drills, and an antirotation groove is placed in the coronal dentine. The post and core can then be constructed in one of two ways:

- From a pattern which is fabricated in the mouth using either inlay wax or a burn out resin (e.g. DuraLay®) which is then sent to the laboratory for casting.
- From an impression taken using a matched plastic impression post placed in the prepared post hole. When using this technique it is generally inadvisable to have the post and subsequent crown constructed on the same impression. Good coronal seal must be maintained between visits.

Direct pre-fabricated posts

Non-metal posts

Fibre posts must be bonded to the root canal space which means remnants of GP/sealer must be removed from the walls of the post space. Rinse with alcohol if eugenol-based sealer has been used. The curing light may not be able to transmit light to all surfaces. Chemical- or dual-cure composites may be used. There are many different systems available. The advantage is they may be placed immediately after endodontic treatment is completed when individual root canal anatomy and orientation is clearly understood and the risk of microleakage is reduced. Treatment time is also reduced. Once the post is cemented the remainder of the core can be built up with the same composite or with a light cured composite.

Metal posts

These are available in various different forms:

- *Parallel, serrated*—e.g. ParaPost®.
- *Parallel, threaded*—e.g. Radix®, Kurer™.
- *Tapered, threaded*—e.g. Dentatus™ screw. These are the poorest design in terms of stress production and, in the authors' opinion, should not be used. If they are used in small tapered roots they should be cemented 'passively'.

Some of these systems have a prefabricated core on the post whilst with others it must be built up around the neck using resin composite. For the majority of crowns choice is one of personal preference. However, no one system will be versatile enough to cover every eventuality, so it is wise to be familiar with more than one method.

Anterior post and core crowns—practical tips

Some problems and possible solutions

- *Subgingival tooth loss.* Either extrude tooth orthodontically or use cast post and core method, extending post into defect in the form of a diaphragm.
- *Extensive tooth loss and calcified canal* (e.g. dentinogenesis imperfecta, severe toothwear). Use adhesive system to retain resin composite core for porcelain bonded crown or consider crown lengthening surgery.
- *Perforation of root by post.* If the post can be removed it may be possible to seal perforation from an orthograde approach with the use of magnification, illumination and MTA. If successful, re-prepare post hole to correct alignment. Alternatively, need surgical approach to cut back excess post and seal perforation with MTA. Perforations of the coronal 1/3 have a poorer prognosis.
- *Loss of post.* Check: (i) ? length adequate. If not, remake with ↑ length. (ii) ? Loose fit or too much taper. Can try sandblasting post and re-cementing with adhesive cement, e.g. Panavia 21. Alternatively, correct and remake. (iii) ? Perforation. Take radiographs in parallax to check, and see previous bullet point. (iv) ? Root #. Extract.
- *Apical pathology.* If post and core, crown, and endodontics satisfactory, arrange periradicular surgery. If not, remove and carry out revision endodontic therapy and place new post and crown.

Causes of failure in post and core crowns

A survey of failed posts showed that most failed within 1yr, but that a post crown that has survived satisfactorily for 3yrs has a good chance of lasting for 10yrs. Common causes of failure were caries, root #, and mechanical failure of the post.[21]

Removing old posts and cores

Unretentive posts may be removed by grasping with Spencer–Wells forceps and twisting. Post removers are available (but C/I for threaded posts) that work by drawing out post using root face as anchorage, e.g. the Eggler post remover. Some proprietary kits, e.g. Masseran, can be used to cut a channel around the post to facilitate removal. In some cases an ultrasonic scaler tip can be used to vibrate the post loose, but heat generation can be a problem.

21 R. Lewis B. G. Smith 1988 *Br Dent J* **165** 95.

Notebox:
Summary points for anterior veneers and crowns (you write here)

Posterior crowns

Where there is significant tooth tissue loss (e.g. endodontically treated teeth, caries, tooth wear, or #) indirect restorations may be considered e.g. inlay/onlay (➔ Indirect resin composite or porcelain inlays/onlays, p. 238) or crowns. The decision to place a crown depends on an assessment of the amount of tissue removal required to provide a retentive restoration and the likelihood of pulpal involvement. Posterior crowns may be used as bridge abutments. Prior to preparation replace any doubtful restorations, check vitality and take a pre-operative radiograph.

The types of posterior crowns available are:

Full veneer gold crown

The least destructive but not as aesthetic as tooth-coloured restorations. The benefits versus risks of aesthetic restorations versus metallic need to be discussed with patients. More destructive preparations associated with tooth-coloured restorations ↑ the chance of pulpal problems. Fracture of porcelain from PFM crowns can be a problem.

Principles

- Remove enough tooth substance to allow adequate thickness of gold, i.e. 1.5mm on functional cusp, 1mm elsewhere, following original tooth contours.
- Wide bevel on the functional cusp (normally buccal—lowers, palatal—upper) for structural durability.
- Convergence of opposing walls <10°.
- Height of axial walls as great as possible (without compromising occlusal reduction).
- Chamfer finishing line.
- Where possible, margins should be supragingival and on sound tooth substance.

Preparation

Occlusal Using a short diamond fissure bur reduce the cusp height, maintaining the original anatomy.

Bucco-lingual With a torpedo-shaped bur eliminate undercuts, retaining 5° taper in cervical 2/3, but usually remaining 1/3 will converge occlusally.

Approximal Using a fine tapered diamond bur within the confines of the tooth, eliminate undercuts at an angle of 5°.

Finishing Round axial line angles and cusps. Check no undercuts and smooth preparation with fine diamonds.

Impressions ➔ Impression techniques, p. 648, and temporary coverage ➔ Temporary restorations, p. 260.

Porcelain fused to metal crown

Used where a combination of strength and aesthetics is needed. Preparation is similar to the full veneer gold crown except that where porcelain coverage is required more tooth substance must be removed. The amount of porcelain coverage must be decided before the preparation is commenced, and the patient consulted at this stage to make sure that they are happy.

Occlusal reduction If acceptable to the patient, it is better to provide an all-metal occlusal surface, as less tooth substance needs to be removed. If not and an all-porcelain occlusal surface is required, 2mm will need to be removed from the supporting cusps and 1.5mm from the non-supporting cusps, which will compromise retention in teeth with short clinical crowns and vitality.[22] Porcelain occlusal surfaces can also introduce occlusal interferences and wear of the opposing teeth if unglazed.

Buccal reduction 1.2–1.5mm should be removed to provide enough room for the metal and porcelain.

Margins If it is acceptable to the patient, it is better to produce a metal to tooth margin, which will necessitate a narrow collar of metal around the gingival margin. In this case, the finishing line prepared should be a deep chamfer or a bevelled shoulder. If the patient insists on a porcelain to tooth margin then a 1.2–1.5mm shoulder must be produced. Where no porcelain coverage is needed a chamfer finishing line is produced, as for the full veneer gold crown.

All ceramic crowns

These new systems (e.g. In-Ceram®, Empress I and II®, Procera®, Techceram) are built on high-strength alumina cores and may be used for posterior crowns. Few long-term clinical studies have been completed; although 5yr data for Procera® is good.[23] Zirconia all ceramic restorations appear promising. CAD/CAM can be used.

Crowning root-filled posterior teeth

Single-rooted posterior teeth can be treated as anterior teeth (➔ Anterior post and core crowns, p. 254). In multirooted teeth there is divergence of the root canals. Pre-formed posts can be cemented into one or more canals. Amalgam may also be packed into the coronal aspect of the root canals (Amalcore or Nayyar technique) and an amalgam core built up, which is the preferred technique. RMGIC or resin composite may also be used. These materials have the advantage that the preparation can be completed at the same visit. A dentine adhesive system should be used with resin composite to enhance retention.

A gold shell or porcelain-bonded crown can be used for the final restoration.

22 W. P. Saunders & E. M. Saunders 1988 *Br Dent J* **185** 137.

23 P. A. Brunton *et al.* 1999 *Br Dent J* **186** 430.

Temporary restorations

Indications

- Protection of pulp and palliation of pulpal pain.
- Restoration of function.
- Stabilization of active caries prior to permanent restoration.
- Aesthetics.
- Maintenance of position of prepared and adjacent teeth.
- To prevent over-eruption of opposing teeth.
- To prevent gingival overgrowth.

Temporary dressings

Choice of material depends upon the main purpose of the dressing, i.e. therapeutic or structural, but the dressing must also be capable of promoting a good seal and being readily removed. For palliation of pulpal pain ZOE is indicated. For caries control, a calcium hydroxide liner and traditional GI cement. If the remaining tooth tissue requires support this can be gained using a copper ring or an orthodontic band. The interim seal during RCT is very important, a relatively strong material which prevents microleakage (e.g. GI) should be used.

Temporary crowns

Three main types:

Pre-formed

- Polycarbonate crown (e.g. Directa™), which is trimmed to correct shape and customized by lining with a bis-acryl material (e.g. Protemp™). *NB* Roughen the inside of the crown to facilitate retention.
- Stainless steel crowns.

Laboratory made Advisable if preparing multiple crowns or if temporary crown needs to last for several months while other aspects of treatment are completed. Preferred method for temporary bridges.

Chair-side This is a versatile technique. Crowns are custom-made using an alginate impression of the tooth taken prior to preparation as a mould. When the preparation is completed, any undercuts should be blocked out with carding wax to prevent the temporary crown material locking in the mouth. The material for the crown is then syringed into the impression around the preparation and re-seated in the mouth. When the initial set has been reached the impression is removed and the temporary left to finish curing before being polished. Suitable materials are Protemp™ (a bis-acryl resin) and Trim™ (poly-n-butyl methacrylate). Care must be taken when using the latter due to high exotherm on curing. An alternative technique is to make a duplicate model of the diagnostic waxing. This approach is useful for multiple crowns or where changes are being made to occlusion/aesthetics. Applicable to both anterior and posterior crowns.

If preparing several adjacent teeth, consider linking temporary crowns to aid retention.

Temporary post and core crowns

Some systems (e.g. ParaPost®) come complete with temporary posts, otherwise they can be made at the chair-side with a suitably sized piece of wire. The length of the post should be adjusted so that it protrudes 2–3mm out of the canal without interfering with the occlusion. A one-piece temporary post and crown is made either by the chair-side method (➔ Temporary crowns, p. 260) or with a polycarbonate crown-former and acrylic.

Temporary bridges

The best type is made in the laboratory in acrylic and re-lined at the chair-side. Alternatively, make a chair-side bridge using the diagnostic waxing.

Veneers

Temporary coverage is usually not necessary, but if the patient complains of sensitivity tack a temporary composite veneer to the prepared surface by etching two small areas of enamel.

Temporary inlays

A light-cured temporary material (e.g. Fermit™, Clip™) is useful.

Temporary cements

The preferred material is TempBond® or similar. Fears about eugenol-containing cements and subsequent use of resin composite materials are unfounded as the etching stage removes residual eugenol from the dentinal tubules.

Notebox:
Summary points for repairing teeth
(you write here)