Restorative Techniques in Paediatric Dentistry

One of the first books on the market to illustrate the various clinical techniques for restoration, this revised and updated new edition offers new material on treatment planning, local analgesia, biomaterials, biological and contemporary approaches, and aesthetic crowns. The book addresses the specific needs of the paediatric patient and helps the clinician manage the restoration with those needs in mind. As a classic volume, it is essential for every dentist working with children and adolescent patients.

Restorative Techniques in Paediatric Dentistry

An Illustrated Guide to Conventional and Contemporary Approaches

Third Edition

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Treatment Planning

M S Duggal, H Nazzal, and A J Robertson

Children as Individuals

A treatment plan must be developed and designed to provide high-quality restorative care for each individual child's needs. The details will vary according to the types of restorations needed, as will the sequence of placing restorations.

In this book the objective is to provide an atlas describing the techniques for the *restorative* care of children, and therefore, the approach to treatment planning is very much orientated to that end. It is accepted that every child will require some degree of preventive dentistry and behaviour management, but these subjects will not be covered here.

Quality Care for Children

Children are the future dental patients, and the dental care that they receive should therefore promote positive dental experiences, which, in turn, promote positive dental attitudes. It makes disturbing reading when some dental professionals, particularly in the UK, question whether children's teeth should be restored at all. We feel that this type of thinking, promoted usually by some public health dentists, rather than paediatric dentists, is more to do with economics than conviction. There can be no doubt that untreated caries in the primary dentition can cause abscesses, pain, and suffering in children. Indeed, hospital-based consultants in paediatric dentistry frequently deal with patients referred to them with severe infections related to long-standing untreated caries in the primary dentition of children who have had regular check-ups with their dentist (Figure 1.1). These children then require hospital admissions and treatment under general anaesthesia, whereas a simple restoration at the time when the caries was diagnosed would have prevented this extremely distressing episode for the child. There are also implications for costs of carrying out this hospital-based treatment, which is substantially more than the cost of simple restorative and preventive treatment. In addition, a negative dental experience for a young child could alter their attitude to dentistry and dental health for life. It is therefore essential for all dentists involved in the care of young children to learn restorative techniques that give the best results in primary teeth. This approach, alongside excellent preventive programmes, would form the basis of 'quality dental care for children', which this book seeks to promote. Good-quality restorative care, as and when caries is diagnosed, would also obviate the need for extractions of primary teeth under general anaesthesia for thousands of children, particularly in the UK, a practice that should have only a small place in the dental care of young children.

Philosophy of Treatment Planning

In planning for the restoration of teeth, allowance must be made for two types of children. The first will be those for whom no restorative care has been attempted in the past but who now do need it.

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FIGURE 1.1 Photograph of a young child with severe infection resulting from an unrestored carious upper second primary molar.

For these children, a sequenced introduction to the procedures of restoring teeth is needed. Treatment planning for them must include a step-by-step introduction to the use of pain control (local analgesia), use of rotary instruments, rubber dam, and the placing of restorations. The time needed for this introduction may be anything from a few minutes to several visits.

Most children will not normally be afraid, and one of the important aspects of providing care for them will be to ensure that they do not develop a fear of dentistry.

The second group of children comprises those who may already have had some restorations or perhaps attempted restorations. With these children, there may be a history of being totally uncooperative or only reluctant to cooperate but persuadable. In such cases, the treatment planning must take into account the degree of cooperation and again an amount of time allowed for behaviour modification.

In this atlas, it is assumed that a child is cooperative or that cooperation has been obtained.

The technique of treatment planning is to obtain all the necessary information on the dental history and dental status of a child. Using this information, a plan of dental visits is drawn up so as to complete the restorative care needed in the shortest possible time appropriate for that child. It is our philosophy that the ideal approach for restoring children's teeth involves the practice of quadrant dentistry.

Diagnosis

The dental problems of a child must be assessed before a treatment plan is designed. This involves not only examining the teeth but also assessing the child's behaviour. This should start before the child has entered the dental office and should begin by observing the child with his or her parents or carers in the waiting room. As the family enter, the child's behaviour and relationship with parents or carers

should be observed. It is at this stage that any apprehension or difficult behaviour should be noted, since it will affect the sequence of restorative procedures and hence the treatment plan.

A history should be taken from the parents, including details of previous behaviour, restorations, or attempted restorations. In addition, the parents should be asked if previous restorative work has been with or without local analgesia and rubber dam. Any previous history of extractions, again with either local analgesia or general anaesthesia, should be noted. These details should be recorded on a dental history form (Figure 1.2).

The first visit will include a simple examination of the dentition, with an assessment of the extent of dental caries, oral hygiene, gingivitis, and periodontal disease. All oral tissues should be examined for health and possible pathology. Before restorative care is started, the oral hygiene should be of a

Likes to be called .....

DENTAL HISTORY

Name ..... Date of birth .....
Address ..... Siblings 1. ..... Age .....
..... 2. ..... Age .....
..... 3. ..... Age .....

Medical history: .....
.....
.....
.....

Past dental history: Check-ups Yes__ No__ Extractions Yes__ No__
Fillings Yes__ No__ L.A. Yes__ No__
Fiss. Seal. Yes__ No_ G.A. Yes__ No__

Liked: .....
Disliked: .....

Parents' assessment of previous behaviour: Excellent. Good. Fair. Poor. Bad.
Parents' assessment of expected behaviour: Good. Cooperative. Resistant.

EXTRA-ORAL EXAMINATION

.....
.....
.....

INTRA-ORAL EXAMINATION

.....
.....
.....

DENTAL CHARTING:

R	17	16	5	4	3	2	1	1	2	3	4	5	26	27	L
	47	46	5	4	3	2	1	1	2	3	4	5	36	37	

DIAGNOSIS

.....
.....
.....

FIGURE 1.2 Dental history form.

good standard, and the child's behaviour should have been assessed and measures taken to ensure cooperation.

Dental Caries Assessment

For the restoration of primary and young adult teeth, the extent of dental caries must be known. A clinical examination with a dental mirror and good lighting is required, with a dry field. The presence of all carious lesions and restorations must be recorded on a suitable dental chart. If available, transillumination is also helpful.

In particular, the following should be noted about the dental caries in each tooth:

- Staining of pits and fissures
- Discolouration of the enamel
- Depth of the carious lesion and whether there is any pulpal involvement (Figure 1.3)

At the same time, the presence of chronic or acute abscesses should be noted, as well as draining sinuses, which would indicate pulpal pathology (Figure 1.4).

Existing restorations should be examined with care for recurrent caries and for the type and integrity of the restorations. In particular, glass ionomer cements and composite resin restorations should

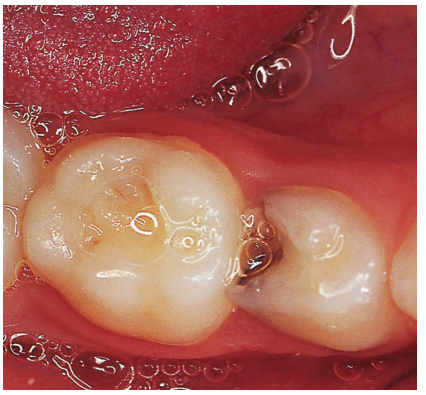


FIGURE 1.3 Photograph of primary molars showing broken marginal ridge. Where there is extensive marginal ridge breakdown, pulpal involvement should be excluded before planning restorative treatment.

FIGURE 1.4 Photograph of primary molars showing a draining sinus on a first primary molar with a failed glass ionomer restoration. In such cases, a pulpectomy (Chapter 4) or extraction should be considered.

FIGURE 1.5 Photograph of a primary molar with a failed glass ionomer cement restoration, now requiring pulp treatment and a preformed metal crown (Chapters 4 and 5).

FIGURE 1.6 Photograph showing decayed primary maxillary incisors due to early childhood caries 'nursing bottle caries'. These can be restored with full coverage restorations, such as strip crowns (Chapter 7), or prefabricated white crowns, such as zirconia crowns (Chapter 8).

be examined most critically, since their success rates in primary teeth are poor and they often need replacement. An example of a poor-quality glass ionomer restoration in a primary molar that has failed is shown in Figure 1.5. Too often, an attempt is made to restore a large cavity in a primary tooth with a material that will not hold for very long. Leakage around the margins or breakdown of the margins leads to failure of the restoration. In many cases, the cavity was originally quite deep, and irreversible pulpal necrosis occurs, leading to the development of an abscess.

Attention should also be paid to the state of the primary incisors. When childhood caries has occurred, an assessment of the possibility of restoring these teeth should be made. In most cases, even quite badly broken teeth can be restored with strip crowns or prefabricated white crowns, as long as there is sufficient coronal dentine and enamel left. Even four badly decayed maxillary incisors (Figure 1.6) can be retained.

Dental Charting

The condition of all teeth should be recorded on a suitable chart. It is important that all teeth, existing restorations (of no matter what quality), and sites of dental caries must be charted. The presence of sound restorations should also be recorded, as should all dental caries.

Any stained, discoloured, or broken marginal ridges, stained pits and fissures, abscesses, or sinuses should also be noted, on the chart. Fractured teeth (incisors) should be recorded, although their restoration is not dealt with in this book.

Accurate dental records for dental caries and restorations are needed prior to drawing up a treatment plan but are also essential for medicolegal requirements. A complete charting should also be documented at each recall visit when a new course of care is planned. This should be done even if no new restorative procedures are indicated.

An intra-oral charting together with diagnostic-quality radiographs and other diagnostic tests enable a logical treatment plan to be drawn up.

The details of the treatment plan, with an outline of the number of treatment visits, should be discussed with the child's parents/legal guardians. This is essential, because the success of the treatment will be dependent on parental/legal guardians' enthusiasm and support. If a parent/legal guardian is not willing to bring the child or cannot afford the necessary costs in time and money, then an alternative plan will need to be drawn up. However, for our purposes, we have assumed that all treatment is accepted by the parent or legal guardian, and restorative work can be completed with the cooperation of parent/legal guardian and child.

It is recommended that once a treatment plan has been agreed with the parent/legal guardian, it be signed by him or her. This is particularly important when financial payment is involved.

Radiographs

The importance of radiographs for the diagnosis of caries in children cannot be overemphasized, as clinical examination alone would mean that many early lesions will be missed (Figures 1.7 and 1.8). In the authors' experience, several dentists have been sued for failing to take radiographs for children under their care for several years and, consequently, for not diagnosing caries before it became symptomatic. It is not possible to diagnose early occlusal or proximal caries by clinical examination alone. Whilst several techniques have been introduced recently, most notable of which is DIAGNOdent (KAVO), bitewing radiography is by far the most acceptable and widely available for use in general practice. Radiographs should form a routine part of dental examination, and it is necessary to repeat radiographs for dental caries diagnosis at intervals. This will depend on the caries history of the child. There are no hard and fast rules regarding the intervals for the taking of bitewing radiographs, but one suggested scheme is shown in Figure 1.9. This is based upon the past caries history of a child and indicates whether bitewings are needed at 6- or 12-month intervals for the primary dentition. As the caries history of a child develops, it becomes necessary to reassess the need for radiographs at each recall examination. If a child does not develop new caries lesions, then the interval between taking bitewing radiographs should be increased. A good approach requires two recall examinations without new carious lesions before this is done.

After one year (two recalls) without new lesions, the bitewing interval is increased to one year. After a further year without any evidence of dental caries, the interval is increased to 18 months.

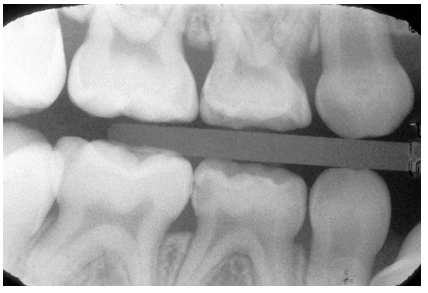


FIGURE 1.7 A bitewing radiograph showing a medium-sized distal lesion in 84, which was only diagnosed because radiographs were taken and would not have been diagnosed on clinical examination alone.

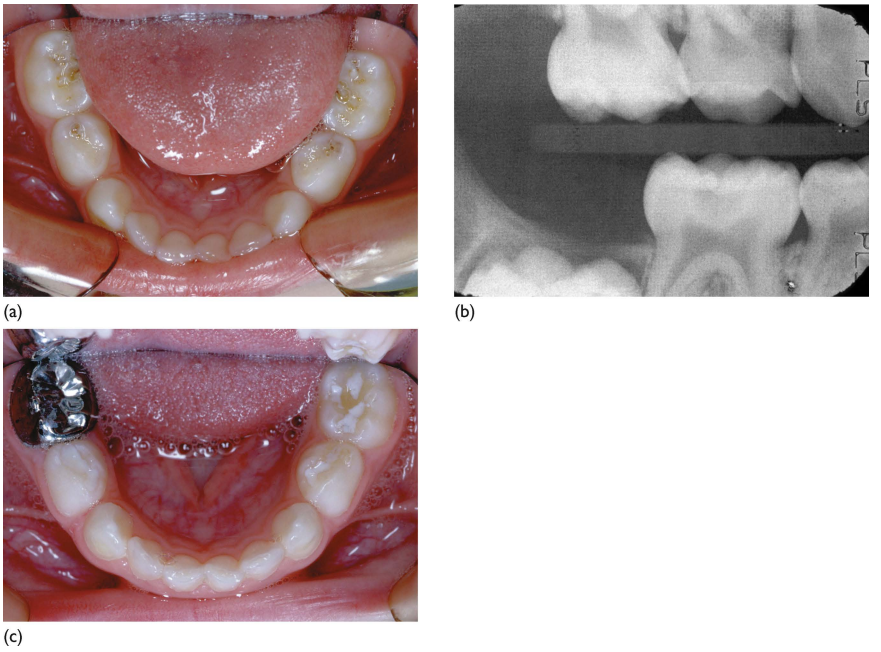


FIGURE 1.8 Bitewings are also essential for the diagnosis of occlusal caries. (a) Clinical photograph showing a fissure sealant on the 85 that had been placed on a previous visit to the dentist without bitewing radiographs being taken before its placement. A shadow is evident around the sealed area. (b) Bitewing radiograph showed large occlusal caries below the sealant. (c) This then required pulp therapy and a preformed metal crown on the 85.

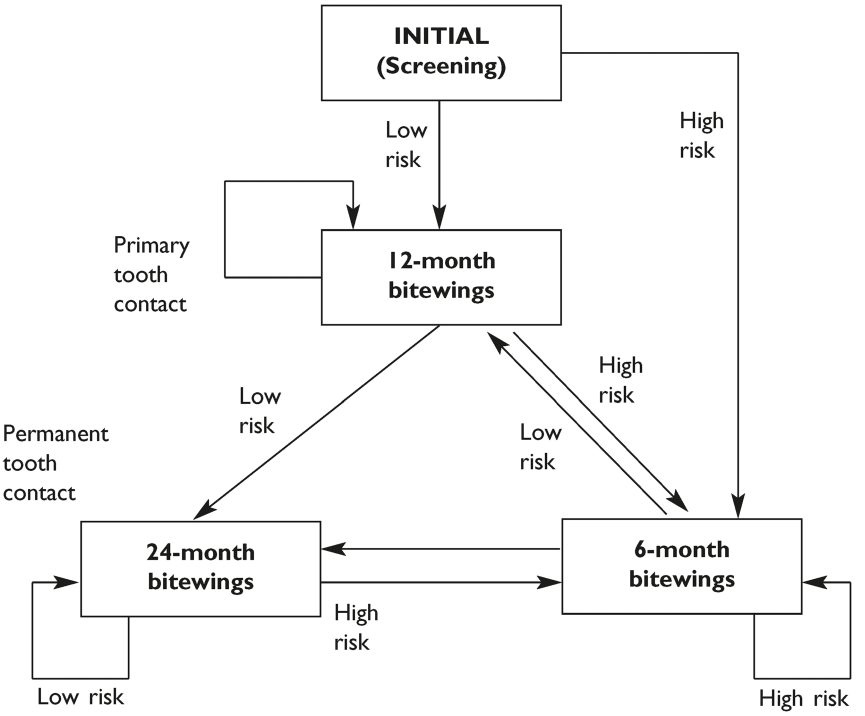


FIGURE 1.9 Scheme for deciding when to take bitewing radiographs of a child based upon dental caries experience.

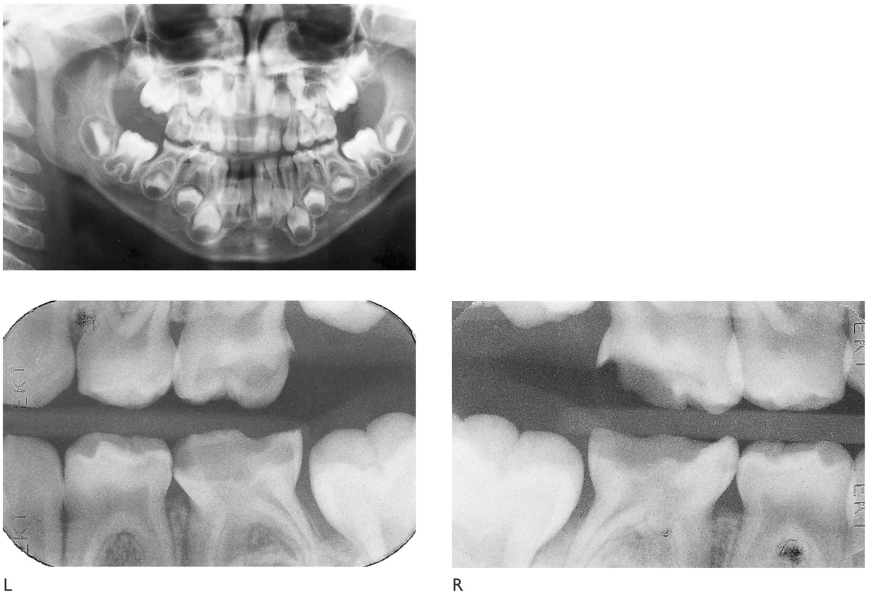


FIGURE 1.10 A typical sequence of radiographs for a preschool child, comprising an orthopantomogram and a set of bitewings. An orthopantomogram should be considered in some cases in order to show all alveolar bone structures, development of primary and secondary teeth, and periapical or furcation pathology associated with the primary teeth and bone and other structures of the maxilla and mandible. Bitewings show the presence/absence of dental caries.

However, if at any time new caries is diagnosed or there is caries around restorations, then the interval between bitewing radiographs is returned to six months.

This approach is used not only for the primary dentition but also for the mixed and permanent dentitions, as indicated in Figure 1.9.

The set of radiographs taken for a child at any one course of dental care will vary according to the needs and age of the child. At least one orthopantomogram or its equivalent should be available at least once during the development stage of the dentition (age 6 years). Bitewings and/or periapical views are also appropriate. Two suggested sequences of radiographs are shown in Figures 1.10 and 1.11.

Choice of Restoration

The type of restoration used for a primary tooth will depend on:

- The tooth to be restored
- Past caries history
- Child cooperation

An important consideration in restoring primary teeth, as with all teeth, is that a tooth should only need restoring once. A need for repeated restoration of a primary tooth indicates bad dental care. The cooperation of a child may well deteriorate if for every course of treatment the same teeth need restoration. It will also not encourage confidence on the part of the parent if teeth have to be restored repeatedly.

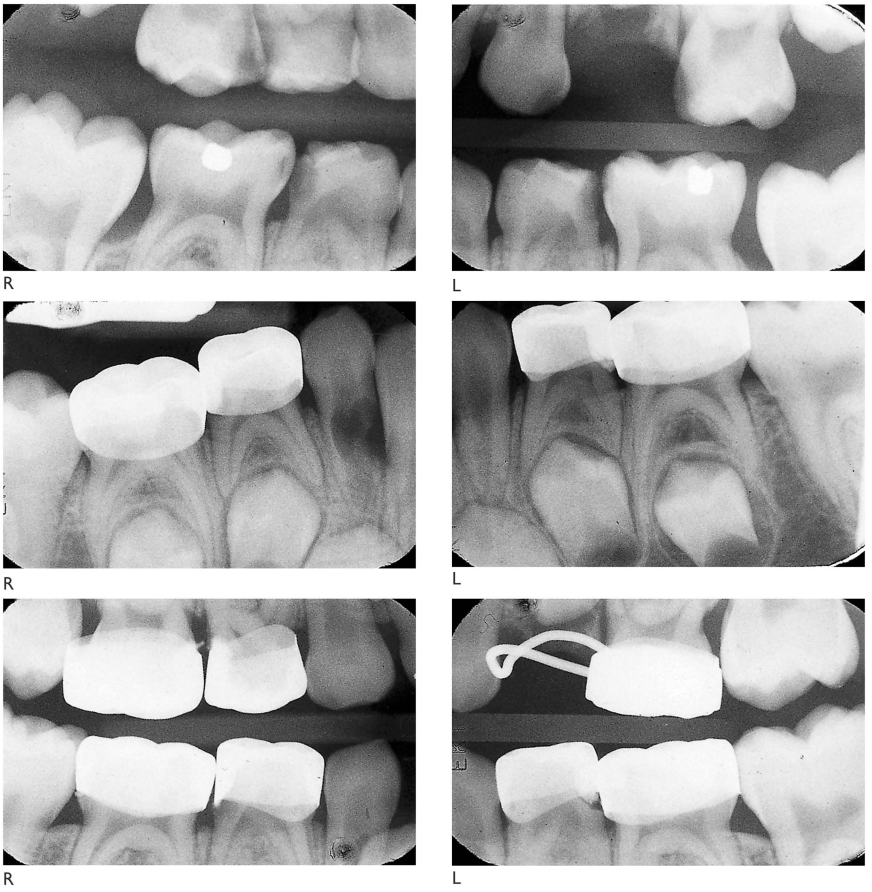


FIGURE 1.11 A suggested sequence of radiographs for a child of school age who has already had a number of restorative procedures. The bitewings serve to diagnose new or recurrent caries, while the periapical views are usually taken of the primary molars for pathology secondary to pulp therapy.

Various research groups have studied the longevity or failure rate of restorations of primary teeth. Where caries involves at least two surfaces or the marginal ridge has broken, a preformed metal crown (PMC) is considered the restoration of choice. In most countries around the world, the use of amalgam is being replaced by other modern restorative materials for one-surface or small two-surface restorations.

It is clear from Figure 1.12 that composite resin restorations and glass ionomer cements under clinical conditions did not survive beyond 48 months (four years) out of the possible five years covered by the study. Other researchers have found similar results. On this basis, our present recommendation is that great care must be taken when composite resins and glass ionomer cements are used for primary molars.

Both composite resins and glass ionomer cements are technique-sensitive and ideally need to be placed under rubber dam. Therefore, these types of restorations are recommended for small single surfaces only. Glass ionomer cements can be used as semi-permanent restorations in primary molars when the teeth are close to exfoliation. Alternatively, glass ionomer cements may be used as a temporary measure for a few months, until a permanent restoration can be placed.

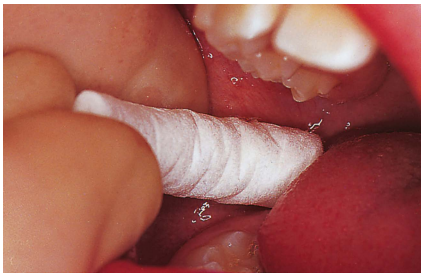


FIGURE 2.28 The gel is placed in contact with the tissues overlying the injection site.

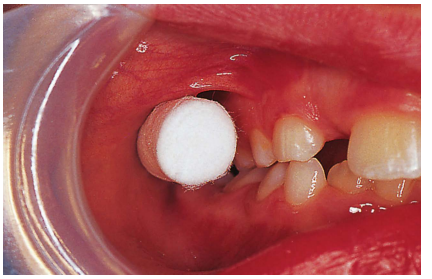


FIGURE 2.29 The patient is asked to occlude, holding the cotton wool roll in situ.

FIGURE 2.30 The patient is instructed to open the mouth as wide as possible. The thumb palpates the external oblique ridge and tautens the mucosa between the pterygomandibular raphe and the external oblique ridge.

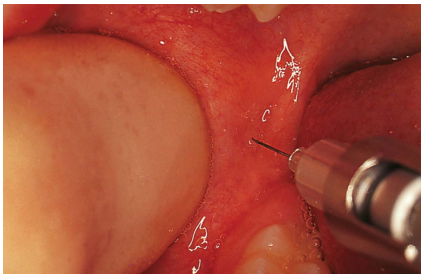


FIGURE 2.31 The needle is inserted from the opposite side of the mouth, the barrel lying over the first primary molar. The needle enters the tissues at a point midway between the external oblique ridge and the pterygomandibular raphe at the level of the occlusal plane. Once the mucosa has been penetrated, a small amount of analgesic solution is immediately deposited; the needle is then gently advanced, with slow injection and aspiration, until the resistance of the bone of the internal surface of the ramus is felt. The periosteum at this site is sensitive, and so great care should be exercised. The needle is withdrawn 1 mm, and the remainder of the solution slowly deposited.

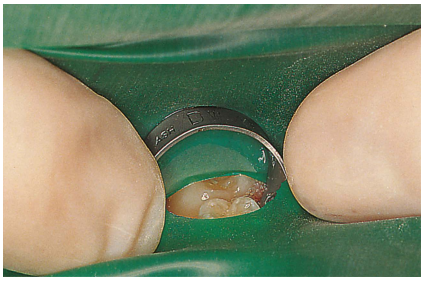


FIGURE 3.14 The rubber dam sheet is carried into the mouth, with both index fingers being used to stretch the hole and position it over the bow of the clamp.

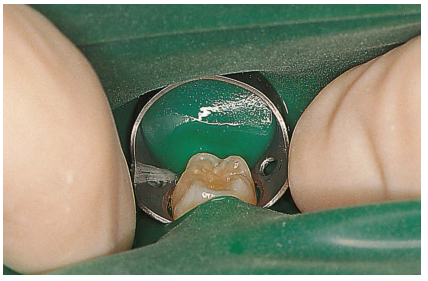


FIGURE 3.15 The dam is pulled down over the clamp and stretched below the buccal and lingual jaws.

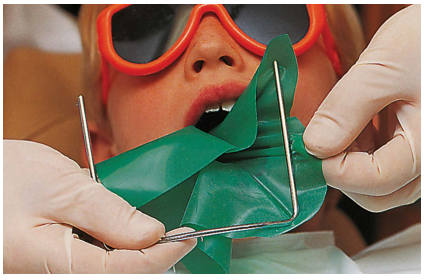


FIGURE 3.16 The frame is then placed, first stretching the lower dam onto the bottom corners, then hooking it onto the upper prongs. The aim is to have the isolated tooth positioned equidistant between the two sides of the frame, with the top ends of the frame just below the level of the nostrils.

FIGURE 3.17 The dam is finally stretched over the remaining prongs on the frame.

b. *Haemorrhage from amputation site*. After removal of coronal pulp, the haemorrhage from the root canal tissue should be pale red and easy to control. Extensive and persistent bleeding implies inflammation of the radicular tissue.

- At least two-thirds of the root length of the primary tooth still present.
- Absence of an abscess or fistula.
- No inter-radicular bone loss. Any loss would suggest a more extensive involvement, indicating the need for a pulpectomy (next section of this chapter).
- No evidence of internal resorption in either the pulp chamber or the root canal.
- Instances where extraction of the primary tooth is contraindicated, such as in some blood dyscrasias (e.g., haemophilia).

Contraindications for Pulpotomy

- An unrestorable tooth.
- Bi- or trifurcation involvement or the presence of an abscess.
- Less than two-thirds of the root remaining.
- Permanent successor close to eruption.

Medical Contraindications

- *Heart disease*. A pulpotomy should not be performed in a child with an increased risk of developing infectives endocarditis as a result of heart defect.
- *Immuno-compromised children*. Such as those with malignant disease (e.g., leukaemia) who are neutropaenic for considerable periods during the treatment of the condition. Even a low-grade infection such as that from an unsuccessful pulpotomy can make such children seriously ill, and therefore, pulpotomy should not be undertaken.

Armamentarium for the Pulpotomy Technique

FIGURE 4.12 The armamentarium comprises the following: topical and local analgesics; burs No 330 FG high speed and No 8 RA slow speed; Dappens pot; syringe; zinc oxide eugenol (Kalzinol); rubber dam kit; mouth mirror, probe and tweezers; cotton pellets (small); large and small excavators; mixing spatula; flat plastic instrument; pulpotomy material, such as ferric sulphate, MTA, or biodentine.

Step 3: Remove caries and determine site.

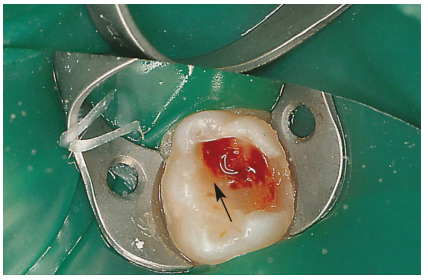


FIGURE 4.15 It is important to remove all visible caries before the pulp chamber is entered; otherwise, bleeding from the pulp will make visualization of caries difficult. It is also necessary to determine the exposure site (arrow), since it is easier to gain access to the pulp chamber through the exposure.

Step 4: Remove roof of pulp chamber.

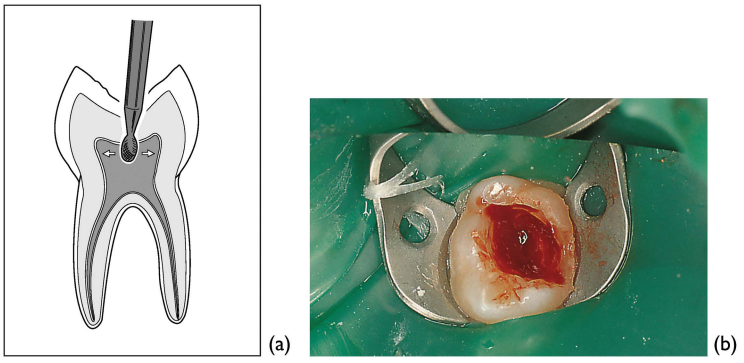


FIGURE 4.16 The bur is placed in the exposure, and the site is widened until the whole of the roof of the chamber is removed. If there is no apparent exposure, the cavity is made deeper until a 'dip' is felt, when the bur passes through the roof into the void of the pulp chamber. Once the pulp chamber has been entered, the bur is not taken any deeper but is moved sideways to remove the roof of the chamber (a). Haemorrhage from the pulp will be evident at this stage (b).

Step 5: Remove coronal pulp with a large excavator or a large round bur.

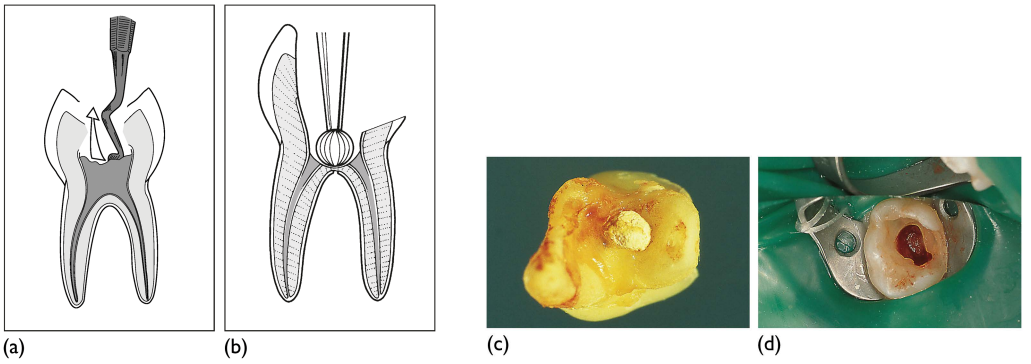


FIGURE 4.17 A large excavator is preferred to remove the coronal pulp tissue (a). When a round bur is used, care must be taken that it is only moved lightly along the floor of the pulp chamber. Any excessive pressure can result in perforation of the floor and failure of the pulpotomy (b, c). After removal of the inflamed coronal tissue, the haemorrhage into the cavity should be reduced (d).

FIGURE 4.23 Ferric sulphate is available commercially as Astringedent (15.5%), from Ultradent, USA. It is usually applied using applicator tips or cotton pledgets.

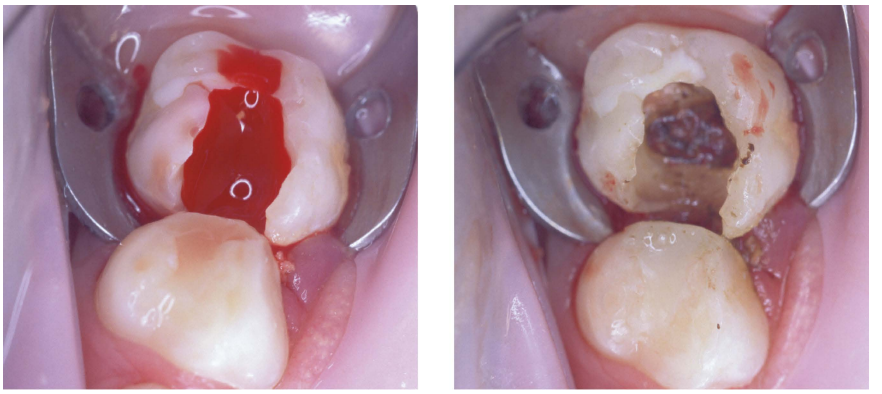


FIGURE 4.24 Typical bleeding after the removal of the roof of the pulp chamber during the pulpotomy procedure (a). After 1 minute application of 15.5% ferric sulphate, showing complete haemostasis (b). Bleeding should have initially been controlled via the use of a moist cotton pledget to assess the inflammatory status of the radicular pulp before using ferric sulphate as a pulpotomy medicament.

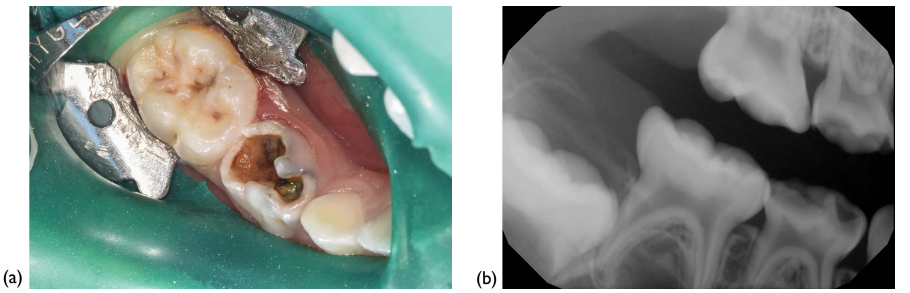


FIGURE 4.25 A, B Large occlusal caries in 84, with history of reversible pulpitis, and radiograph showing close proximity of the cavity to the distal pulp horn.

FIGURE 4.25 C Removal of caries reveals involvement of the pulp.

FIGURE 4.25 D Haemostasis was initially achieved following the application of a moist cotton pledget, indicating healthy radicular pulp tissues. The application of 15.5% ferric sulphate for 1 minute could be used to maintain haemostasis while MTA is applied.

FIGURE 4.25 E MTA placed to cover the whole floor of the pulp chamber. A cotton pledget is used to apply gentle pressure on the MTA after placement to ensure excellent contact with radicular pulp.

FIGURE 4.25 F Glass ionomer placed over the MTA and allowed to set before preparing the tooth for a preformed metal crown.

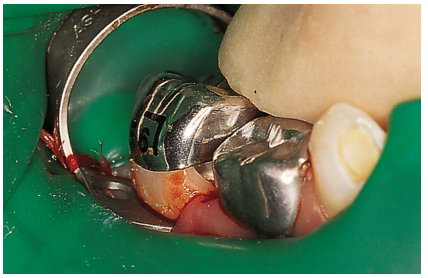


FIGURE 5.35 A preformed metal crown is selected and tried on the tooth, and any necessary adjustments are carried out.

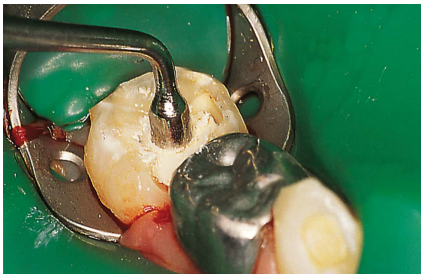


FIGURE 5.36 The pulp chamber is restored with appropriate material (dependent on the pulpotomy technique used).

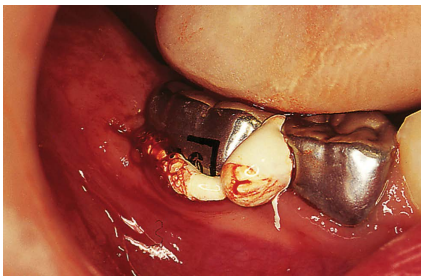


FIGURE 5.37 The rubber dam is now removed, and the crown full of cement is seated on the tooth.

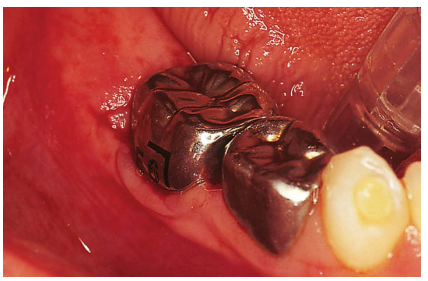


FIGURE 5.38 Finished restoration on 85.

FIGURE 7.3 All caries is removed using a small round bur in a slow-speed handpiece.

FIGURE 7.4 The teeth are then prepared for the strip crown. Using a tapered diamond or tungsten carbide bur in a high-speed handpiece, the length of the crown is reduced incisally. Mesial and distal slices are made, tapered to a knife edge at the gingival margin.

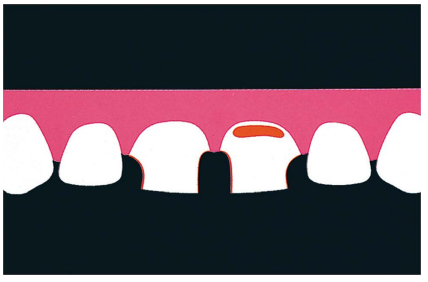


FIGURE 7.5 Diagram illustrating the mesial and distal walls of incisors prepared for strip crowns. The caries has been removed.

FIGURE 7.6 The shade of composite resin is chosen. When the tooth is discoloured, an adjacent tooth or the lower incisors can be used for shade matching.

FIGURE 7.19 A labial view of the finished strip crown restoration.

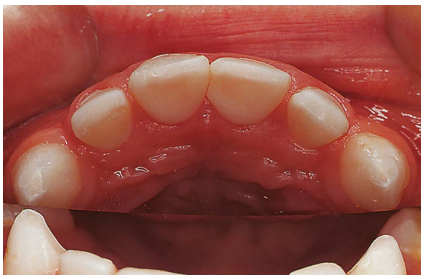


FIGURE 7.20 A palatal view of the finished strip crown restoration clearly demonstrating the full coverage provided by this restoration technique.

FIGURE 7.21 Pre-operative photograph of extensive caries of primary maxillary incisors.

FIGURE 7.22 Post-operative photograph showing restored primary maxillary incisors from Figure 7.21.

FIGURE 9.26 The cavities are etched, as are the remaining sound occlusal surfaces, which would allow the placement of fissure sealant to protect the tooth from future caries attack.

(a)

(b)

FIGURE 9.27 (a) Showing the Omni-Matrix Pedo-Band (Ultradent Products, USA) that can be used in children; (b) matrix band applied to 84.

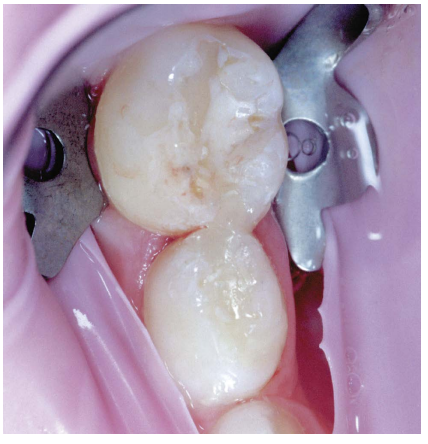
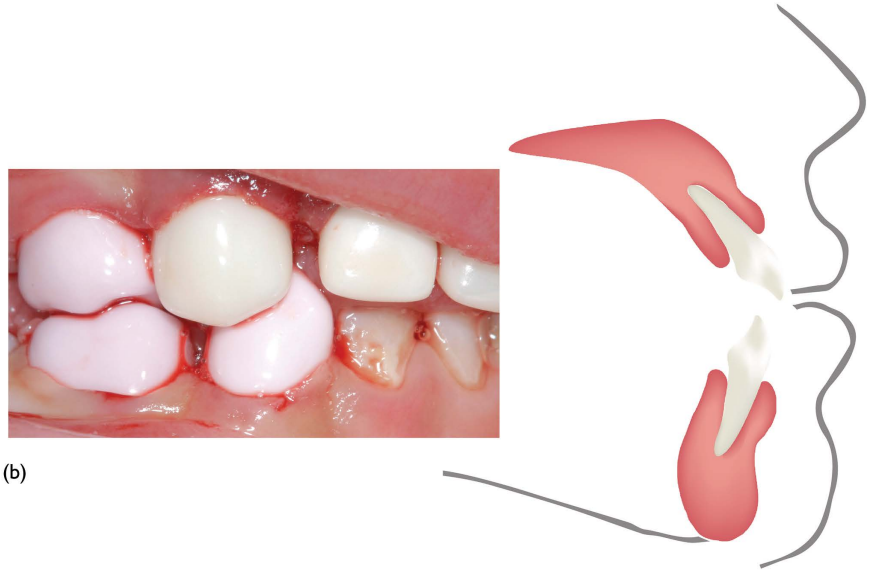


FIGURE 9.28 Shows compomer restorations in both 84 and 85 before application of fissure sealant.

Visit 2

- *Comprehensive treatment under general anaesthesia*. All teeth were prepared to receive zirconia crowns (Figure 10.26a). After trial fitness and bite assessment (Figure 10.26b), crowns were cemented using glass ionomer cement (Figures 10.27a, b). No pulp therapy was required on any of the prepared teeth.

(a)



(b)

FIGURE 10.26 (a) Upper occlusal view showing immediate post-operative preparation of upper teeth. (b) Right-side view showing pre-cementation occlusal assessment of temporary crowns on 54, 83, and 84.

(a)

(b)

FIGURE 10.27 (a) Anterior view showing crowns post-cementation with well-aligned teeth and good occlusion. Minimal gingival trauma is evident immediately after cementation. (b) Upper occlusal view showing cemented crowns post-cementation, showing well-aligned teeth.

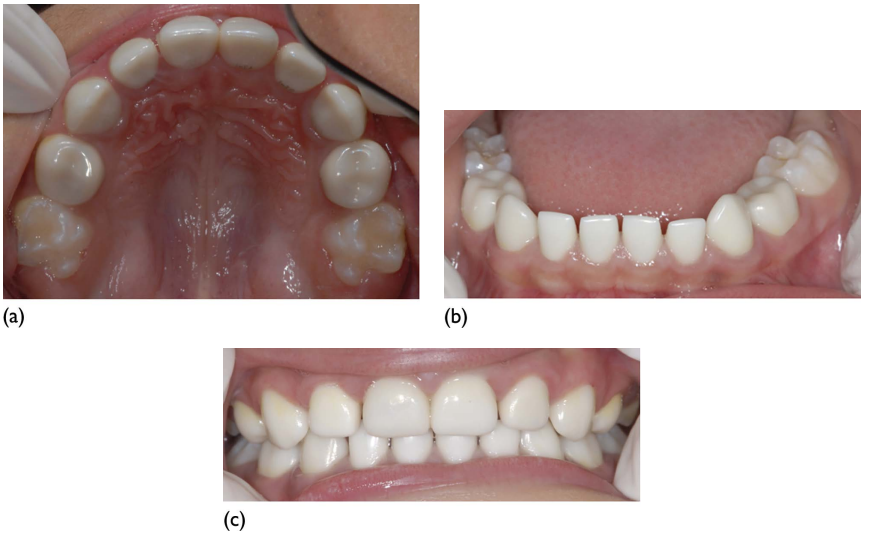


FIGURE 10.28 (a) One-year follow-up upper occlusal view showing well-retained restoration and erupted upper second primary molar. (b) One-year follow-up lower occlusal view showing well-retained restoration and erupted upper second primary molars. (c) One-year follow-up anterior view showing well-retained crowns in good occlusion.

Visit 3 (One Week Post-Operatively)

- Check all restorations.
- Reinforce oral hygiene and prevention programme.
- Arrange regular recall sessions.

The patient was reviewed on regular basis, with last review at 3.5 years, showing retention of all zirconia crowns, however with calculus build-up (Figure 10.29a). Plaque removal was done, and oral hygiene instructions were given.

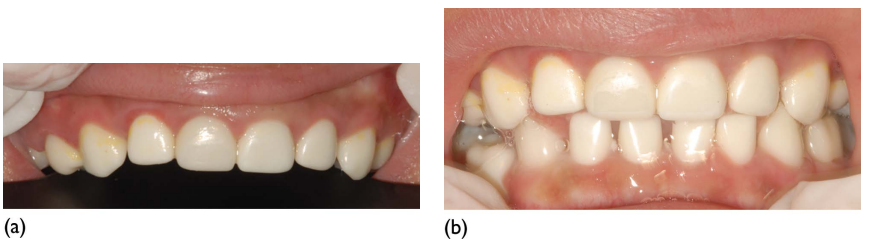


FIGURE 10.29 (a) Three-and-a-half-year follow-up anterior view of upper teeth showing gingival inflammation and plaque accumulation. (b) Three-and-a-half-year follow-up anterior view showing well-retained crowns in good occlusion.