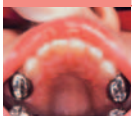
5 Restorative paediatric dentistry



Contributors
Erin Mahoney, Nicky Kilpatrick, Timothy Johnston

Primary teeth

Why restore primary teeth?

Our child patients deserve the best dental treatment that clinicians can provide as any treatment – preventive or restorative – will shape their dental future. The objective of any restorative treatment is to:

- Repair or limit the damage of dental caries.
- Protect and preserve remaining the pulp and remaining tooth structure.
- Ensure adequate function.
- Restore aesthetics (where applicable).
- Provide ease in maintaining good oral hygiene.

In addition restoring primary teeth ensures that the natural spaces in the child's primary dentition are retained for the developing permanent dentition.

Choice of materials

The choice of material to use in a given situation is not always simple and should not be based merely on technical considerations. Factors other than durability may be equally important in the choice of material, particularly in children.

Age

The age of a child will influence their ability to cooperate with procedures such as rubber dam application and local anaesthesia. The age of the child will also dictate for how long a restoration is required to remain satisfactory. A restoration in a first primary molar in a 9-year-old child does not require the same durability as a restoration in a first permanent molar in a 6-year-old child or a second primary molar in a 4-year-old child.

Caries risk

Restorations in a child considered to be at high risk of caries may need to fulfil different objectives from restorations in a low-risk child. Although the use of a fluoride-releasing material has obvious preventive advantages, glass ionomer cements (GICs) may not be the most appropriate choice in a mouth that is at high risk of further acid attack. Stainless steel crowns may involve a significant amount of tooth destruction, but this will be appropriate if it eliminates the need to re-treat in the future. Alternatively, GICs have a useful role in initial caries control in cases of rampant caries.

Cooperation of the child

Many young children have behaviour that is not conducive to perfect, textbook, cavity preparation and restoration. In these cases highly technique-sensitive procedures are inappropriate. A more forgiving restoration such as an amalgam that can tolerate a certain amount of moisture contamination, without detriment to its longevity, may be suitable. The use of GICs in the management of caries in anterior primary teeth may be an excellent method of slowing the carious process and temporarily restoring aesthetics in a 2-year-old child, without recourse to general anaesthesia. By the age of 3 or 4 years, the child may be able to cope with more definitive treatment with composite resin and strip crowns.

Restorative situation

Unfortunately not all children are able to cooperate with respect to dental treatment under local anaesthesia. This may be because of their age or due to physical or intellectual disabilities necessitating the completion of treatment under sedation or general anaesthesia. When treatment is provided this way, the highest standard of dentistry possible should be provided to reduce future dental treatment for these high-need children. Use of materials and techniques that are known to have longevity, such as stainless steel crowns, is mandatory.

Restorative materials

Owing to the variety of restorative materials available today, many appropriate materials can be used to restore carious lesions in the primary dentition. Given the large number of techniques and products available on the market, and the unavoidable experimentation that clinicians undertake, the mixing and matching of materials is common place. When replacing any lost dental tissue, whatever the procedure favoured, it is important for clinicians to understand exactly the nature of the system they are using and to be aware that all systems are operator and technique sensitive.

Table 5.1 summarizes the main advantages and disadvantages of the various dental restorative materials.

Amalgam

Historically, owing to the simplicity of its use dental amalgam is the most popular restorative material. Amalgam possesses excellent physical properties and its use in primary molars has resulted in highly successful long-term restorations. However, there are many disadvantages to the use of amalgam. Amalgam is not adhesive and therefore cavity design needs to include some form of mechanical retention resulting in larger restorations which are inevitably closer to the pulp. Possibly the biggest problem associated with its use is the recent upsurge in public opinion concerning its safety. In many countries the use of amalgam in children's teeth has been restricted. The rationale for these restrictions is based on environmental concerns rather than concerns over amalgam toxicity. Nevertheless, the dental profession may be forced to use alternatives to amalgam by a combination of public opinion and legislation.

Table 5.1 Advantages and disadvantages of restorative materials used in paediatric dentistry

	Advantages	Disadvantages
Amalgam	Simple Quick Cheap Technique insensitive Durable	Not adhesive Requires mechanical retention in cavity Environmental and occupational hazards Public concerns
Composite	Adhesive Aesthetic Reasonable wear properties Command set	Technique sensitive Rubber dam required Expensive
Glass ionomer cement (packable)	Adhesive Aesthetic Fluoride leaching	Brittle Susceptible to erosion and wear
Resin-modified glass ionomer	Adhesive Aesthetic Command set Simple to handle Fluoride release	Water absorption Significant wear
High-viscosity glass ionomer	Adhesive Aesthetic Simple to handle Fluoride release High compressive strength and wear resistance	Water absorption Colour not as good a match as composite resins, compomers and other GICs Poorer mechanical properties than compomer and composites
Polyacid-modified composite resin	Adhesive Aesthetic Command set Simple to handle Radiopaque	Technique sensitive Less fluoride release than GICs
Stainless steel crowns	Durable Protect and support remaining tooth structure	Extensive tooth preparation Patient cooperation required Unaesthetic

Glass ionomers

One of the most significant advances in contemporary paediatric dental practice has been the development of GICs. A glass ionomer consists of a basic glass and an acidic water-soluble powder that sets by acid–base reaction between the two components. A principal benefit of GIC is that it will adhere to dental hard tissues. A number of GICs are available on the market today, each having its advantages and disadvantages.

Conventional GICs

Conventional GICs are chemical-set glass ionomers with the weakest mechanical properties. The setting reaction is complete within minutes but continues to ‘mature’ over the following months. It is important to protect these materials from salivary contamination in the hours following placement or the material may shrink, crack and even debond.

Adhesion of all GICs is enhanced by the use of enamel and dentine conditioning agents before placement.

Resin-modified glass ionomers

Resin-modified glass ionomers were developed to overcome the problems of moisture sensitivity and low initial mechanical strength. They consist of a GIC along with a water-based resin system which allows curing with light before the acid–base reaction of the glass ionomer takes place. This reaction then occurs within the light polymerized resin framework. The resin increases the fracture strength and wear resistance of the GIC.

Another type of resin-modified glass ionomer is a 'tri-cured' material. It has three setting reactions:

1. The acid–base reaction between glass and polyacid.
2. A light-activated, free-radical polymerization of methacrylate groups of the polymer.
3. A dark-cure, free-radical polymerization of methacrylate groups.

The potential advantage of this material is that it will continue to cure in the depth of the cavity after the light source has been removed. Only one proprietary example of this type of GIC is currently available.

High-viscosity GIC

High-viscosity GICs were developed for the atraumatic restorative technique (ART). These chemically cured GICs have significantly better mechanical properties than the other materials. They do not command set as with the resin-modified glass ionomers, but they are fast setting. Although no GIC yet has the ideal physical properties of a restorative material, the high-viscosity GIC have the best physical properties and therefore should be used in posterior primary teeth when a GIC is contemplated.

Composite resins

Resin-based composites (along with photopolymerization) have revolutionized clinical dentistry, although problems related to wear resistance, water absorption and polymerization contraction can limit their use in larger restorations in the posterior permanent dentition. In the primary dentition, composite resins are being increasingly used in combination with GICs in a 'sandwich'-style aesthetic restoration. Placement of these materials is highly technique sensitive, and patient compliance and adequate moisture isolation can prove difficult in the younger, more challenging child patient.

Compomers (polyacid-modified composite resin)

Polyacid-modified resin composite resins or compomers are materials that contain a calcium aluminium fluorosilicate glass filler and polyacid components. They contain either or both essential components of a GIC. However, they are not water-based and therefore no acid–base reaction can occur. As such, they cannot strictly be described as glass ionomers. They set by resin photopolymerization. The acid–base reaction does occur in the moist intra-oral environment and allows fluoride release from the material. Successful adhesion requires the use of dentine-bonding primers before placement.

Stainless steel crowns

Stainless steel crowns are preformed extra-coronal restorations that are particularly useful in the restoration of grossly broken down teeth, primary molars that have undergone pulp therapy, and hypoplastic primary or permanent teeth. They are also indicated when restoring the dentition of children at high risk of caries, particularly those having treatment under general anaesthesia. Stainless steel crowns are a very durable restoration and should be the technique of choice in the high-caries mouth.

Recently stainless steel crowns have been shown to provide such a good seal to external cariogenic stimuli that researchers in the UK have attempted to cement stainless steel crown without any caries removal or tooth preparation, directly over the carious tooth. The results to date show that this simple technique can provide successful restorations in the short term. Although this technique of stainless steel crown placement, now called the 'Hall' technique, is not advocated at present, the findings of ongoing studies using this technique may change the recommendations for its use in the coming years.

Restoration of primary anterior teeth

Composite resin strip crowns (Figure 5.1)

Composite is the material of choice for the restoration of primary anterior teeth. An anterior strip crowns with composite resin provides an aesthetic and durable restoration.

Method

1. Local anaesthesia and rubber-dam isolation should be used if possible. Alternatively, because of age and poor cooperation of younger children, the restorative work may be completed under general anaesthesia.
2. Select the correct celluloid crown form depending on the mesiodistal width of the teeth.
3. Remove the caries using a slow-speed round bur.
4. Using a high-speed tapered diamond or tungsten carbide bur, reduce the incisal height by around 2 mm, prepare interproximal slices and place a labial groove at the level of gingival and middle thirds of the crown.
5. Protect the exposed dentine with a glass ionomer lining cement.
6. Trim the crown form and make two holes in the incisal corners by piercing with a sharp explorer.
7. Etch the enamel for 20 seconds, and wash and dry.
8. Apply a thin layer of bonding resin and cure for 20 seconds, ensuring all surfaces are covered equally.
9. Fill the crown form with the appropriate shade of composite and seat with gentle, even pressure, allowing the excess to exit freely. The use of small wedges may be helpful in avoiding interproximal excess.
10. Light cure each aspect (labially, incisally and palatally) equally.

A B C D E F

Figure 5.1 Placement of anterior strip crowns on the primary incisors. **A** Bottle caries affecting the upper anterior teeth. **B** Initial reduction of incisal edge and caries removal under rubber dam (butterfly clamp). Proximal reduction is achieved using a high-speed tapering diamond bur. **C** Placement of a glass ionomer cement base over the dentine. **D** Trial fitting of the cellulose acetate strip crown which is then filled with composite resin. **E** Removal of the strip crown with a small excavator. **F** Final restoration after polishing. (Courtesy of Dr E Alcaino.)

11. Remove the celluloid crown gently, and adjust the form and finish with either composite finishing burs or abrasive discs.
12. Check the occlusion after removing the rubber dam.

Interproximal stripping

Stripping of interproximal enamel may be used occasionally for minimal caries in the anterior primary teeth. Opening of the contact points allows saliva and fluoride to arrest the carious process, even when the caries involves the dentine. This is often, however, an unaesthetic alternative. It goes without saying that the initiating cause, such as a nursing-bottle habit, must be eliminated.

Method

The contact points are removed with a long tapering diamond or tungsten carbide bur and a topical fluoride is applied to the enamel and dentine. Placement of a fluoride varnish is useful for these cases. Regular follow-up is required.

GICs, resin-modified GICs, compomers

All of these materials have a place for one-surface restorations in primary anterior teeth. They provide aesthetically acceptable results and provide a degree of prevention as a result of fluoride release. It is important that the preparations must be caries-free for optimum results.

Restoration of primary posterior teeth

Amalgam

The use of dental amalgam to restore primary molars is common and supported by evidence from clinical trials. Clinical studies, evaluating the durability of dental amalgam in primary molars, have laid down the benchmarks against which other restorations should be judged.

Indications

- Amalgam may be useful in children who are at moderate caries risk or who are not totally cooperative, i.e. when moisture control is a problem.
- There is limited indication for the use of amalgam in Class I cavities in children as a high-viscosity GI, compomer or composite resin will provide a comparably successful restoration while preserving the tooth tissue.

Success

The success rate for Class II amalgam restorations in primary molars has been reported to be between 70% and 80%.

Method for interproximal (Class II) amalgam restoration

1. Use local anaesthesia and rubber-dam isolation.
2. Use a small round or pear-shaped diamond bur in a high-speed handpiece to gain access to the caries. The occlusal outline should not extend into all the fissures but needs to incorporate a small isthmus and a dovetail for retention (Figure 5.2).

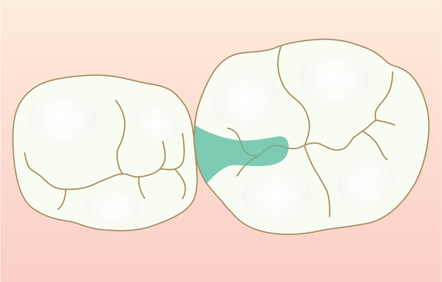


Figure 5.2 The modified outline form of a Class II amalgam for primary molars.

3. Extend the cavity into the proximal area by gently proceeding gingivally until the contact point is broken. Buccolingually, the cavity should extend so that just a tip of an explorer can reach the margins of the restoration.
4. Deeper caries should be removed using a slow-speed round bur.
5. Bevel the floor of the cavity at the junction of the axial wall and occlusal floor to increase the strength of the restoration. One of the most common sites of failure of the class II amalgam is at the isthmus, which probably results from insufficient bulk of amalgam to withstand occlusal forces.
6. In deep lesions a calcium hydroxide or Ledermix liner should be placed whereas in moderately deep lesions a light-cured glass ionomer liner is appropriate over the whole area of dentine.
7. Adapt a matrix band to the circumference of the tooth. A narrow curved brass T-band is useful for this procedure, particularly if back-to-back restorations are being placed. Both the Siqveland and Tofflemire matrix bands are adequate for single restorations. Wedging is essential for creating a good contact point.
8. Insert the amalgam incrementally, starting with the proximal box, using a small plugger to ensure good condensation in all the line angles.
9. Slightly overfill the cavity and carve the occlusal form using a small ball-ended burnisher and cleoid-discoid carver. An explorer is useful for creating the form of the marginal ridge.
10. Remove the matrix band carefully and pass a length of floss between the contact point to remove any debris.
11. Check the occlusion after removing the rubber dam.

GICs, resin-modified GICs and compomers

These materials have an increasingly important role in the management of carious lesions in primary molars because of their adhesive and fluoride-leaching properties.

Indications

- Because of their lack of strength GICs should not be used in large restorations that are to be subject to significant occlusal load in teeth that need to be retained for more than 3 years.
- Small occlusal and interproximal cavities.
- Where possible, use the stronger, high-viscosity GIC and avoid using resin-modified GICs for posterior restorations, as wear resistance is better.

Success

- The failure rate of GICs is higher than amalgam (33% over 5 years compared with 20% for amalgam).
- The average survival time for a GIC has been reported as 33 months.
- The incidence of secondary caries is reduced around fluoride-releasing materials.
- The use of polyacid-modified composite resins/compomers show considerable potential, particularly in terms of handling characteristics and radio-opacity. However, they have limited fluoride-leaching ability.
- Four-year results available now suggest that they are adequately durable for use in the primary dentition.

Method for glass ionomer restorations

1. Local anaesthesia and rubber-dam isolation should be used where needed (Figure 5.3).
2. The outline of the cavity should follow the extent of the carious lesion. There is no need for extension for prevention. A small occlusal dovetail is not usually necessary for interproximal restorations, however, additional retention form for minimal proximal cavities can be achieved by placing grooves into the dentine using very small (size ½) round burs (Figure 5.4).
3. Remove all soft caries using a slow round bur or with hand instruments. Be aware of the large pulp chamber as it is easy to expose the pulp of a primary molar.
4. Precondition the dentine using 10% polyacrylic acid for 10 seconds, and wash and dry.
5. When using encapsulated materials, ensure that the capsules are compressed for at least 3 seconds to facilitate adequate mixing of the powder and liquid components. After mixing for 10 seconds in the amalgamator, discard the first 3–4 mm of the mixed material as this is often unsatisfactory. Place the remainder directly in to the cavity.

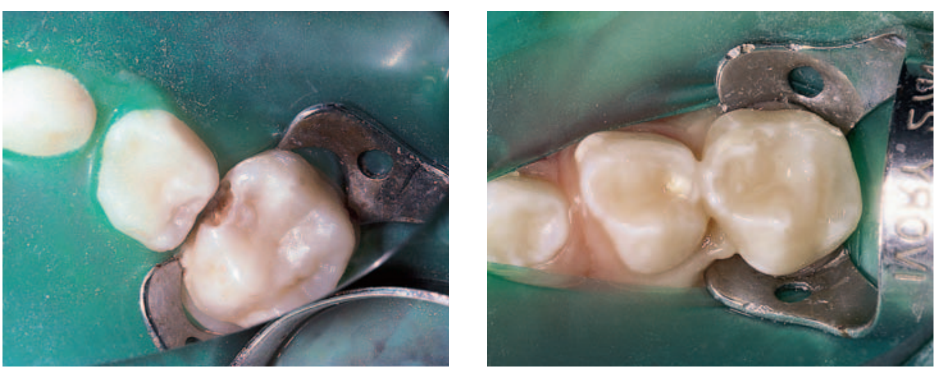
A  B

Figure 5.3 Two methods for using rubber dam in children. **A** Traditional isolation of single teeth. **B** Split-dam technique, isolating the teeth from the canine to second primary molar with one large hole in the dam.

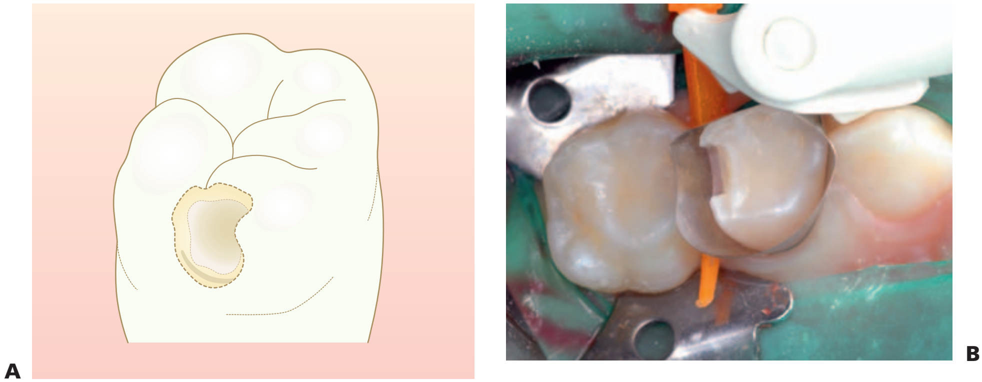


Figure 5.4 **A, B** Class II cavity design for the placement of resin-modified glass ionomers.

6. Once the relatively thick material has been placed in to the cavity it is compressed with a ball burnisher – dipping the tip in a small amount of bonding agent or unfilled resin prevents the material sticking to the instrument.
7. The final restoration must be protected from moisture contamination. This is best achieved by the placement of a thin layer of unfilled resin over the surface and polymerizing for 20 seconds. In young children with behaviour management problems, Vaseline rather than unfilled resin, may be appropriate.
8. The occlusion should be checked on removal of the rubber dam.

Composite resins

In primary molars composite is a satisfactory restorative material provided that the child is cooperative.

Indications

Small to moderately sized occlusal and proximal cavities.

Success

Clinical studies suggest that Class II composite restorations in primary molars are only moderately durable, with one study reporting less than 40% success after 6 years. However, recent studies have shown greatly improved success rates with the newer resin-based composites.

Method

For interproximal lesions the cavity design needs to be modified slightly from that described for amalgam – a bevel should be prepared around the occlusal margins for additional adhesion to enamel. The biggest problem encountered with composite restorations is the integrity of the bond at the depth of the proximal box. Placement of composite is technically difficult and highly sensitive to moisture contamination. Placement of a glass ionomer liner over the dentine not only ensures a good bond at the base of the cavity, reducing microleakage, but also provides fluoride release locally. The use of rubber dam and incremental placement of composite in the proximal box may reduce handling and polymerization contraction problems.

Increasingly, parents are requesting tooth-coloured restorations. It should be recognized, however, that use of these materials is associated with increased technical demands and expense.

Stainless steel crowns

Indications

Stainless steel crowns are preformed extra-coronal restorations that are particularly useful in the restoration of:

- Grossly broken down teeth.
- Primary molars that have undergone pulp therapy.
- Hypoplastic primary or permanent teeth.
- Dentitions of children at high risk of caries, particularly children having treatment under general anaesthesia.

Success

- Stainless steel crowns undoubtedly provide the most durable restoration for the primary dentition with survival times in excess of 40 months.
- They are relatively expensive in relation to both time and money in the short term. However, the rate of replacement of these restorations is low (3% compared with 15% for class II amalgam restorations). This makes them economically more attractive over the long term.
- They may be considered unaesthetic and require a significant amount of tooth preparation, and invariably local anaesthesia.

Method (Figure 5.5)

Irrespective of whether the tooth to be restored is vital or non-vital, local anaesthesia should be used when placing a stainless steel crown because of the soft-tissue manipulation. Rubber dam, although sometimes difficult to place in the broken down dentition, should be used where possible.

1. Restore the tooth using a GIC or compomer prior to preparation for the stainless steel crown.
2. Reduce the occlusal surface by about 1.5 mm using a flame-shaped or tapered diamond bur. Uniform occlusal reduction will facilitate placement of the crown without interfering with the occlusion.
3. Using a fine, long, tapered diamond bur, held slightly convergent to the long-axis of the tooth, and cut interproximal slices mesially and distally. The reduction should allow a probe to be passed through the contact area (Figure 5.6).
4. Little buccolingual reduction is needed unless there is a prominent Carabelli's cusp etc. However, such reduction should be kept to a minimum as these surfaces are important for retention.
5. An appropriate size of a precontoured crown is chosen by measuring the mesiodistal width.
6. A trial fit is carried out before cementation. It is important that the crown should sit no more than 1 mm subgingivally. If there is excessive blanching of the gingival tissues the length of the crown should be reduced. The margins should be smoothed with a white stone.


A
B
C
D
D4
E
F
G
H
D5

Figure 5.5 Placement of a stainless steel crown after a pulpotomy. **A** The intermediate restorative material (IRM) base has been covered with a glass ionomer cement **B**. **C** Interproximal reduction has been completed with a fine tapering diamond bur in addition to occlusal reduction of 1.5 mm. **D** Trial fit of the crown, by seating from the lingual onto the buccal surface. **E** The crown is filled with a glass ionomer cement for luting and **F** the crown placed with finger pressure and a seating tool. **G, H** The completed restoration should last the lifetime of the tooth. (Courtesy of Dr J Winters.)

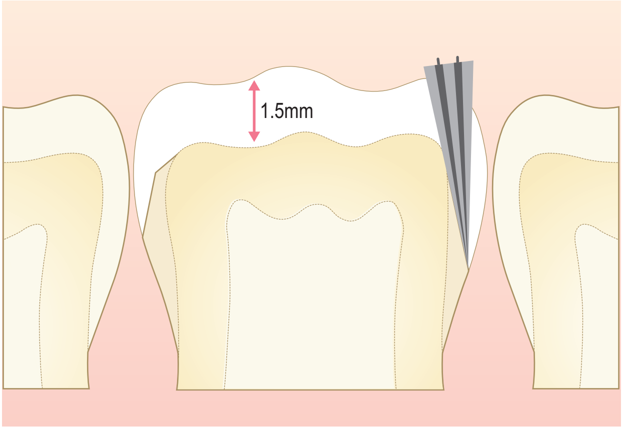


Figure 5.6 Coronal and proximal preparation required for the placement of a stainless steel crown. Note that in the proximal areas there is a smooth contour without any ledge or step. Any such step will cause great difficulty in seating the crown.

7. Cement the crown with a GIC or polycarboxylate cement. If the crown has been built up before the placement of the crown, a glass ionomer luting cement may be used, otherwise a restorative GIC should be used. Care should be taken while holding the crown as it can be easily dropped during placement. Excess cement should be wiped away and a layer of Vaseline placed around the margins while the cement is setting.

Minimal intervention dentistry

The philosophy of minimal intervention

Minimal intervention is based on an increasing body of evidence that the traditional approach to cavity design involved excessive removal of tooth structure. Traditionally, all discoloured dentine was removed. However, it is now accepted, that beneath the infected, soft and discoloured carious dentine lies a layer of 'affected' demineralized, and often discoloured, but not 'infected' dentine. Using the adhesive technology of

Figure 5.7 Breakdown of GIC restorations from conservative (minimal intervention) dentistry. Note however, that there has been a substantial slowing of the caries rate such that all the lesions are inactive and the teeth have been preserved in the mouth. While it is easy to criticize the quality of these restorations, these had been placed in a child whose behaviour was extremely difficult, without the access to general anaesthesia or other forms of sedation. Although some arch length has been lost, as the crowns have not been restored to their natural contour the majority of the space occupied by the teeth has been preserved. This still permits the placement of stainless steel crowns in the future, when the child is better able to cope with more extensive treatment procedures in the event of an improvement in behaviour. The question should be asked whether these restorations have 'successfully' retained the teeth. Is this treatment better than having no treatment or having all these primary teeth extracted?

materials such as GICs with their innate ability to release fluoride and other minerals, it is possible to remineralize this affected layer. This enables us to minimize the amount of tooth tissue that is removed, which is of potential advantage in restoring primary molars with their thin enamel and dentine, and relatively large dental pulps.

Atraumatic restorative technique

ART was designed for use by dentists and dental auxiliaries working in remote areas of underdeveloped countries with no access to modern dental equipment (such as turbine handpieces). Essentially ART involves the use of hand instruments for removal of the carious infected dentine and severely weakened enamel followed by restoration with a chemically cured, high-viscosity GIC. In general, in Australasia and elsewhere, access to modern dental equipment and facilities enables the provision of superior dental treatment. Therefore ART is not regularly used in most Australasian clinics, although the ART technique is of particular use as an interim treatment modality in children with behaviour management problems (Figure 5.7). Clinicians should be aware, however, that this form of treatment is only appropriate when the child can be regularly reviewed and any deficiencies in the restoration can be remedied. Thus, this type of restoration must only be considered as an interim measure prior to the placement of a definitive restoration.

Management of occlusal caries in permanent teeth

Of great importance is the preservation of tooth structure. Over the past decade, papers by Elderton and others have highlighted the deficiencies of the use of accepted concepts such as 'extension for prevention'. The placement of unnecessarily large amalgam restorations undermines the marginal ridges and weakens the cusps which will eventually fracture. The tooth then will require even larger restorations with the risk of pulp disease, root canal treatment and finally full coverage restoration. There must be a different approach to the management of permanent teeth that have not been previously restored compared with those teeth which require replacement of restorations.

Amalgam is an inappropriate material for the restoration of early lesions on the occlusal surfaces of permanent teeth. Here, the preventive resin restoration is more desirable. Minimal tooth structure is lost in cavity preparation and has the advantage that the occlusal table is protected by a fissure sealant (Figure 5.8).

Fissure sealants

In fluoridated communities throughout Australasia, where the average DMFT (decayed, missing and filled permanent teeth) is less than 1.0, the majority of caries occurs in the pits and fissures of the first permanent molar teeth. A simple and economical way of preventing pit and fissure caries is by the use of fissure sealants.

The indications for a fissure sealant are controversial. On a population basis it has been suggested that only those children who are at moderate risk of caries should have sealants placed, but because nearly 90% of children up to 18 years have some caries (mainly in the first permanent molars) all children should be assessed for fissure sealants throughout the eruption of the permanent dentition. Treatment should be prescribed according to the individual patient's need (Figure 5.9).

As fissure sealants should not be thought of as permanent restorations, diligent diagnosis and technique should be followed when one is contemplated. All teeth should be checked radiographically immediately prior to placement of the fissure sealant. Other options to aid diagnostic accuracy before sealing of fissures include the use of miniature burs to investigate staining, laser fluorescence, electronic caries

Figure 5.8 While this amalgam restoration has been well placed, it is an inappropriate restoration for a patient of 20 years whose only caries is an incipient lesion on the occlusal surface. This amalgam will weaken the marginal ridges and supporting cusps and compromise the tooth in the long term. A preventive resin restoration would have been a much better alternative.

A B

Figure 5.9 Fissure sealants. **A** An assessment must be made in the individual of caries risk. Not every tooth in every arch requires sealing, but it is important to remember that risk can change. **B** Caries-susceptible fissures. Sealing of the buccal pit in this child is essential.

detectors and micro abrasion. If caries is noted or suspected, a preventive resin restoration should be placed.

Indications

- All permanent molars in children at medium or high risk of caries (see Table 3.1). Premolars should be sealed in those children at high risk.
- In children at low risk, only the fissures that are deep and retentive need to be sealed.
- Primary posterior teeth in children at risk high of caries.

Risk assessment should continue throughout teenage years, even where caries risk was initially low. Risk status can change and fissure sealing continues to be protective into adulthood.

Sealant material

- Although some studies show differences, there seems to be no strong evidence to favour light-cured over chemically cured sealants or either opaque, clear or coloured fissure sealants at this time.
- Sealants should be opaque so that they can be detected by other clinicians. Use of clear sealants shows stains in the fissures, which are most probably inactive caries. However, another clinician, on seeing these stains, may choose to cut a cavity into a sound tooth, defeating the whole purpose of the sealant.
- Current studies support resin-based sealants over glass ionomer sealants, which do not have as good retention.
- Glass ionomers are useful in high caries-active individuals as temporary sealants until the teeth have erupted sufficiently to allow conventional fissure sealing.

The main problem with the use of GICs as fissure sealants is the brittleness of the material when used in thin section over the occlusal surface. However, it has been shown that despite very low retention rates, the incidence of caries under GIC sealants is low in long term similar to retained resin-based sealants. It has been suggested that either the GIC is retained in the depths of the fissures at a microscopic level or that fluoride, from the GIC, is taken up by the surrounding enamel so increasing the resistance of the fissure walls to demineralization.

Method (Figure 5.10)

1. Isolate the tooth with rubber dam. If the tooth cannot be isolated then a high-dose fluoride treatment such as a fluoride varnish or a GIC material should be applied. Review the eruption of the tooth in the following months and when the tooth has erupted sufficiently, place a fissure sealant.
2. Remove gross debris with a blunt probe and if necessary, clean the occlusal surface with oil-free pumice and water. In many instances, minimal widening of the occlusal fissure with a very, thin, small, tapered diamond fissure bur will facilitate the penetration of sealant material into the depth of the fissure. It also removes the more acid-resistant surface layer of enamel lining the walls of the occlusal fissure.
3. Etch the tooth with a gel etchant for 20 seconds and wash with copious water and dry with air irrigation for 20 seconds.
4. If the tooth is contaminated it should be re-etched for 15 seconds.
5. Apply a thin coat of sealant to the pits and fissures, making sure to include the buccal extension on lower molars and the palatal groove in upper molar teeth. Apply the polymerization light for 20 seconds.
6. Remove the rubber dam and check the occlusion.

Preventive resin restoration

Due to its superior wear resistance and superior mechanical properties, composite resin materials rather than glass ionomers are the material of choice for the treatment of early occlusal caries in permanent teeth. The development of preventive resin restorations has changed the management of occlusal caries dramatically in young patients.

Indications

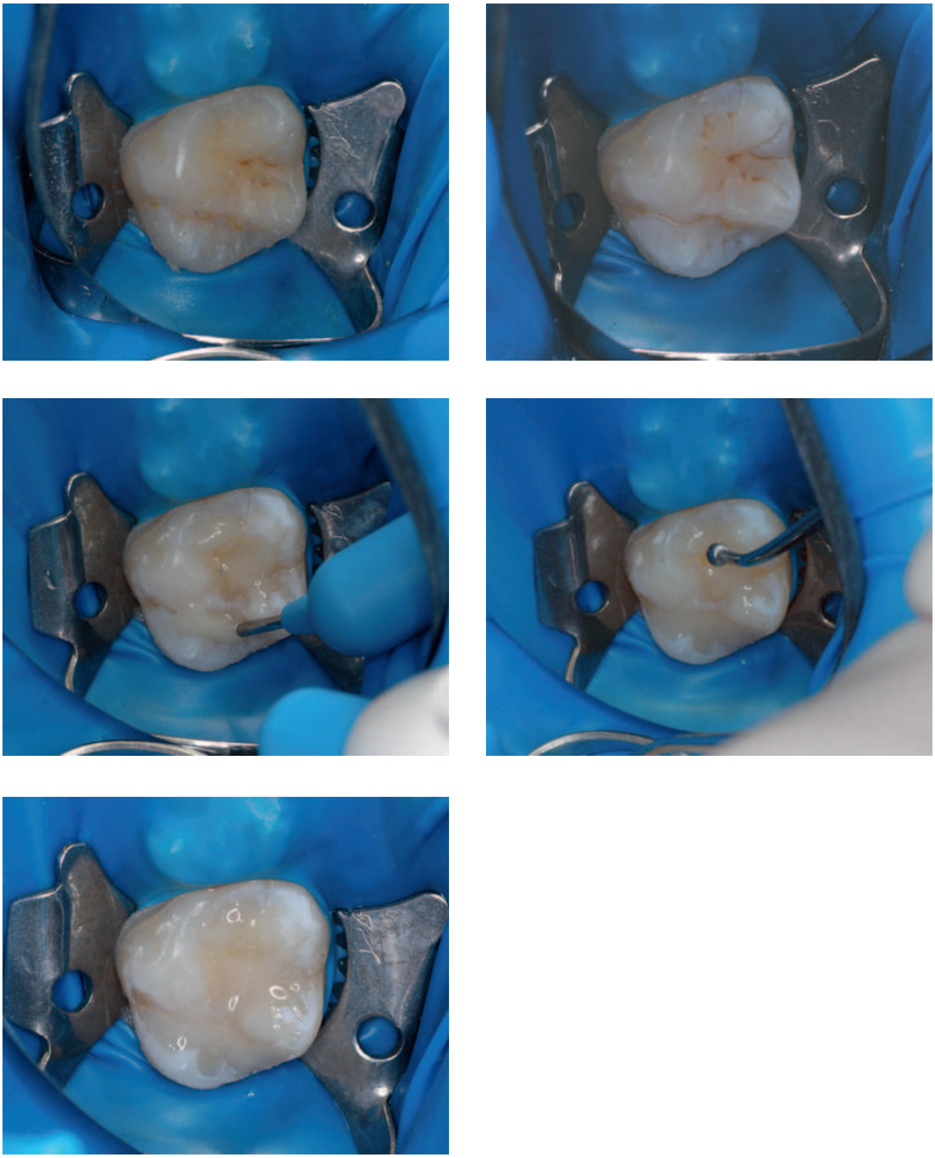
- Enamel-only lesions.
- Incipient lesions just into dentine.
- Small class I lesions.

Success

The durability of preventive resin restoration has been proved to be as good as occlusal amalgam restorations and can be achieved with significantly less removal of sound tooth tissue.

Method for preventive resin restoration

1. Use local anaesthesia and rubber-dam isolation if caries extends into dentine.
2. With a small high-speed diamond bur obtain access into the questionable fissure.
3. Remove the carious dentine. Although it is important not to remove more enamel than necessary it is essential to have adequate access to the underlying dentine to be certain of complete caries removal. Unsupported enamel need not be



A B C D E

Figure 5.10 Placement of a fissure sealant. **A** Caries-susceptible fissure in an upper first permanent molar. The tooth is isolated with rubber dam. **B** Tooth surface etched. **C, D** A flowable composite resin has been used and is spread into the fissures with a ball-burnisher. **E** The completed sealant placement after curing.

removed if access and vision are clear. The cross-section most closely resembles a tear drop shape (Figures 5.11, 5.12).

4. Deeper dentinal caries should be removed using a slow-speed round bur.
5. Place a glass ionomer liner over the dentine extending it up to the amelodentinal junction and light cure for 40 seconds.
6. Gel etchant is placed for 20 seconds on the enamel margins and occlusal surface, and washed and dried. It is not necessary to etch the liner; sufficient roughening of the surface of the GIC will result from the washing process.
7. Place a thin layer of bonding resin into the cavity and cure for 20 seconds. An excess of resin will produce pooling and reduce the integrity of the bond.
8. Incrementally fill and polymerize the cavity with hybrid composite resin until it is level with the occlusal surface.
9. Flow opaque unfilled fissure sealant over the restoration and the entire occlusal fissure pattern and cure for 20 seconds. There is no need to re-etch the occlusal surface prior to placing the fissure sealant.
10. Remove the rubber dam and check the occlusion.

New techniques for tooth preparation

From the discussion above, clearly paediatric dentistry relies heavily on the use of standard high-speed and low-speed handpieces. Standard handpieces allow clinicians to remove carious dentine and shape a cavity. However, in recent years several hard-tissue removal techniques have been developed that also have a place in modern paediatric dentistry.

Air abrasion

Air abrasion is a technique that uses kinetic energy to remove carious tooth structure. When the aluminium oxide particles hit the tooth surface, without heat or noise of

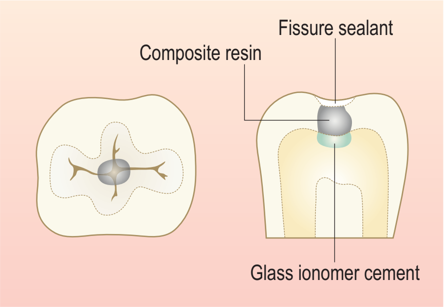
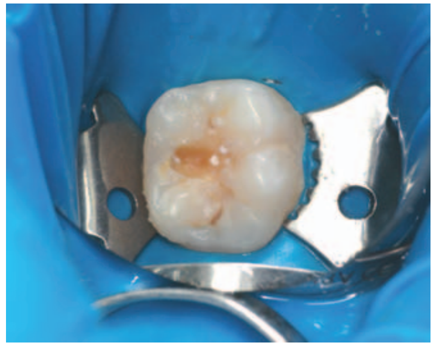


Figure 5.11 Preventive resin restoration.


A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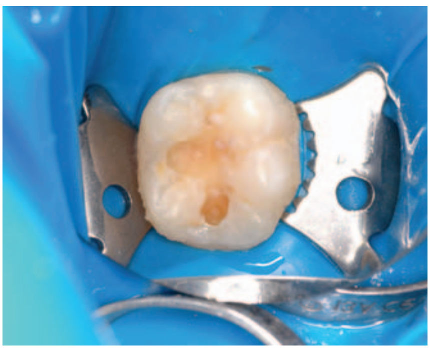
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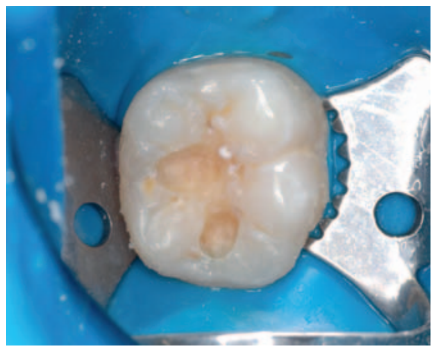
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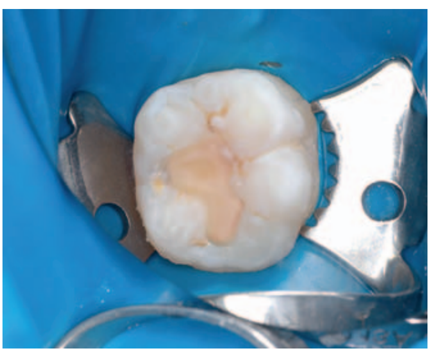
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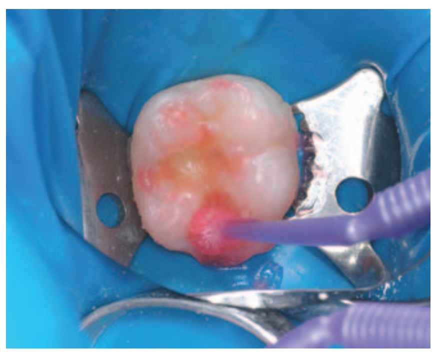
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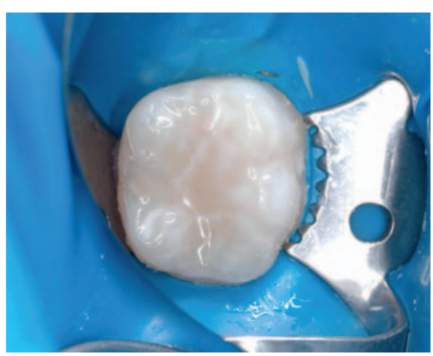
H

Figure 5.12 Technique for Class I composite restoration in a permanent molar. **A** The true extent of the caries may not be visible from the occlusal surface. **B–D** Progressive investigation of the fissures reveals further extension of dentinal caries. **E** Placement of a glass ionomer base. **F** Etching. **G** Incremental placement with nanofilled composite resin. **H** Final restoration with sealant placed over surface.

vibration, they remove tooth tissue. This technique requires additional equipment in the dental office for safe particle extraction and requires the use of rubber dam, but has been shown to be useful in some child patients who may be nervous of the noise or the feeling of conventional handpieces. Care should be taken due to the possibility of particle inhalation when using this method in children with severe dust allergy, open wounds and lung diseases such as asthma.

Laser-assisted dentistry

Laser is an acronym for *l*ight *a*mplification by *s*timulated *e*mission *r*adiation. Dental lasers are devices that use the energy generated by atomic electron shifts producing coherent monochromatic electromagnetic radiation between the ultraviolet and the far infrared section of the electromagnetic spectrum. The photo-biological effects of the lasers most commonly used in dentistry are:

- Laser-induced fluorescence (caries/calculus detection).
- Photo-acoustics causing disruption and ablation (soft- and hard-tissue treatments).
- Photo-thermal effect inducing coagulation and vaporization (soft-tissue treatments).

Bio-stimulation and photochemical effects induced by short-wavelength lasers for treatments including wound healing, analgesia and tissue growth will become more commonplace in time. Laser-assisted fluoride and bleaching treatments also show promising application.

Erbium lasers display bio-resonant properties on neural tissue causing Na^+/K^+ pump blockade and polarization of the A delta fibres and possibly C fibres. For many applications, local anaesthesia can be reduced and occasionally eliminated due to the analgesic properties of the lasers themselves.

Hard-tissue application

The two lasers most commonly used for dental hard-tissue treatments are in the 2790 nm (ErCr : YSGG (erbium-chromium : yttrium-scandium-gallium-garnet)) and 2940 nm (Er : YSG (erbium-doped yttrium aluminium garnet)) wavelengths. The tissue is removed by a non-contact beam that ablates based on the photo-acoustic affect on water molecules. The water content of the treated tissue and the power density of the laser beam affect the cutting efficiency. Hard-tissue applications include cavity preparation, caries and calculus removal, endodontic treatments, desensitization and bone surgery. The advantages of lasers include:

- Ability to selectively remove only carious dental tissue.
- Limited noise.
- No vibration.
- Ability to cut dental tissue without the need for local anaesthesia (in some cases).

Table 5.2 Guide to the use of restorative materials in paediatric dentistry

Primary dentition	
Occlusal (Class I)	Glass ionomer cement (GIC) Composite resin Compomer
Interproximal (Class II)	GIC Compomer Amalgam Composite resin/GIC sandwich Stainless steel crown
Gross carious breakdown or restoration after pulp therapy	Stainless steel crown
Permanent dentition	
Occlusal table	Fissure sealant
Occlusal enamel caries	Fissure sealant
Occlusal caries with minimal involvement of dentine	Preventive resin restoration
Occlusal caries with extension into dentine	Composite resin
Interproximal	Amalgam
Incisal edge	Composite resin
Cervical	GIC Composite resin

Therefore, lasers can be extremely useful for nervous patients; however, they are expensive and care must be taken during use to ensure that excess heat is not generated, which may be detrimental to the pulp tissue.

Indications for the use of restorative materials in paediatric dentistry

See Table 5.2.

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