Restoration of primary teeth affected by Early Childhood Caries

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ABSTRACT. Aim: This was to review the literature on Early Childhood Caries (ECC) for the approaches to prevention and restoration of affected primary teeth. Methods: The methods are reviewed and suggestions made as the approaches necessary for treating very young children. The special problems associated with the need to restore primary incisors in children with very low levels of cooperation are described. The options are outlined and indications for each approach discussed.

KEYWORDS: Early childhood caries, Restorations, Prevention.

Introduction

Early Childhood Caries (ECC) is a severe form of dental decay beginning soon after dental eruption, developing on smooth surfaces, progressing rapidly and therefore affecting infants and toddlers. In the past terms such as ‘rampant caries’, ‘nursing bottle syndrome’, ‘baby bottle tooth decay’, and ‘nursing caries’ have been used to describe this condition, but now all the clinical manifestations have been joined and referred to as ECC. The condition is defined as presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries) or filled tooth surfaces in any primary tooth in a child 71 months of age or younger [AAPD, 2002]. In children younger than 3 years of age, any sign of smooth surface caries is said to be indicative of Severe Early Childhood Caries (S-ECC) [AAPD, 2002].

ECC presents as considerable challenge for the paediatric dentists partly due to its rapid progress, but more so due to the age of the affected children, many of whom are below the cooperative age of 29 months old [Holst et al., 1993; Curzon and Preston, 2004]. In addition, the long-term management of these patients is more complex as children with carious lesions in the primary dentition have a greater chance of developing caries in the permanent dentition compared with caries-free children [Kaste et al., 1992].

The aim of this paper is to review the preventive measures for ECC and the restorative techniques available for management of such cases, and also to consider the long-term management of children who have been affected by this disease.

Prevalence and aetiology

The prevalence of dental caries in children has markedly decreased over the past 50 years in developed countries [Marthaler et al., 1996]; however, a significant number of children is still affected by caries from a very young age [Whittle and Whittle, 1995]. This disease is still considered to be the single most common chronic childhood disease [Evans and Kleinman, 2000] with a wide range of prevalence from 1.0% to 86.5% [Curzon and Preston, 2004]. In developed countries the disease is said to be linked to children from lower socioeconomic backgrounds where higher levels of disease are found in children from poorer, less well-educated, single parent or recent immigrant families [Kaste et al., 1996]. In developing countries the general consensus is that the caries prevalence is increasing, probably related to the increase in consumption of refined sugars in food and drinks [Paikhamov, 1999].

ECC has a complex aetiology and it requires a susceptible tooth surface, fermentable carbohydrates, and cariogenic microorganisms over a period of time to initiate the carious process. Local and systemic protective mechanisms, e.g. oral hygiene, fluoride and saliva, help reduce the rate of caries progression; equally, if the protective mechanisms are reduced or removed, and number of cariogenic bacteria increased, this enhances the rate of progression of the disease [De Grauwe and Martens, 2004].

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Clinical manifestations
ECC has a rapid onset, and often parents believe that the teeth were not formed properly as on eruption they notice the discolouration on the maxillary incisors. This is a classical manifestation of S-ECC where initially the maxillary primary incisors are involved. The lesions normally appear as white areas of demineralisation on the labial surface close to the gingival margin, and as the caries progresses an oval cavitation, which is often pigmented yellow or brown, will be visible on this surface. In more extensive cases, the caries may progress laterally around the contact point and on to the palatal surfaces and eventually result in pathological fracture of the crown [Curzon and Pollard, 1994]. The classical pattern of ECC in anterior teeth is the mesial, distal and buccal surfaces of the maxillary incisors. The buccal and distal surfaces of mandibular primary incisors and canines and palatal surfaces of the maxillary incisors are also affected by caries in S-ECC [De Grauw and Martens, 2004]. If the cause of the caries is not identified and removed, then other teeth such as the primary first molars are affected, followed by the primary canines and second primary molars according to the sequence of tooth eruption. In severe cases, gross destruction of the entire dentition may occur. The mandibular anterior teeth tend to be the last affected, as they are protected underneath the tongue during sucking, where in addition pooled saliva from the sub-mandibular and sub-mental salivary glands will dilute and buffer the fluid from the bottle. If, however, a child is put to sleep with a bottle or comforter, especially if it contains refined sugars or has had prolonged breast-feeding habits, then there is increased risk of caries progression in the lower incisor region as salivary flow is greatly reduced nocturnally [Pollard and Curzon, 1995] and hence there are decreased diluting and buffering effects by saliva.

Another clinical finding in children with ECC due to prolonged bottle-feeding is an anterior open bite. This is more apparent in the older children of 3-4 years of age in whom the bottle has been used as a comforter on demand.

Preventive measures
Prevention should start in prenatal and perinatal periods by nutrition and dietary advice to mothers, especially in the third trimester of the pregnancy, and also in an infant’s first year of life when the enamel of primary teeth undergoes maturation [Ismail and Sohn, 1999]. It is well established that poorly formed enamel is associated with increased caries risk and this can be demonstrated in studies looking at low birth-weight babies with subsequent hypoplasia and associated ECC [Horowitz, 1998; Seow, 1998]. Hence it is paramount that expectant mothers are informed about the importance of nutrition throughout the pregnancy and after. In addition, education of the expectant parents on good oral health and hygiene for themselves will help reduce the cariogenic bacterial count (S. mutans) and hence there will be a reduced risk of the child developing ECC [Berkowitz et al., 1981; Karn et al., 1998].

Many first time expectant mothers are concerned about the volume of milk, and later food, their newborn intakes. This can often lead to the development of bad habits for the child like breast-feeding on demand, feeding during the night and prolonged use of bottles. Therefore, it is again important to guide parents towards a better feeding regimen and encourage them to eliminate night feeding as soon as possible, especially by the time the first primary tooth erupts. Advice should also be given to start weaning the child away from the bottle at 12-14 months by diluting the milk in the bottle over a 4 week period and gradual introduction of non-spill training cups to substitute the bottle. It is vital that parents are informed not to put any juice or other sweetened drink in the bottle or on pacifier.

It is recommended that parents obtain an oral health consultation from a dentist or a health educator within the first 12 months of life. Home visits have been shown to be successful in preventing ECC when given on a regular basis [Kowash et al., 2000]. This allows further advice to be given regarding oral hygiene, diet advice, weaning children off the breast, bottle and eventually training cups, and hence provide parents with anticipatory guidelines for prevention of dental disease. It is important to emphasise that early visits not only educate the parents but also can result in early detection of ECC. This can then be resolved with the aid of improved oral hygiene and diet as well as supplemental fluorides.

Restorative management
Management of ECC is multifactorial. Accordingly, factors such as extent of the disease process, parents’ attitude and motivation towards treatment, and also the child’s age and level of co-operation must be taken into consideration prior to any definitive treatment plan. It must also be remembered that restorative management of ECC is only the first phase of treatment and its success lies in maintaining a favourable oral environment. Therefore treatment should be definitive, yet specific for each individual child, with long term follow-ups and reinforcement of preventive measures.

Early ECC may present as wide spread enamel demineralisation. When caries is detected in its white spot stage and hence there is minimal or no loss of
enamel surface integrity, the initial treatment should involve diet assessment and advice. Oral hygiene instructions are needed for the mother or carer and advice given on use of topical and systemic fluoride depending on the child’s age group. Periodic topical fluoride therapy with an acidulated phosphate fluoride (APF) gel (1.23% F) or fluoride varnish 4 times a year has been shown to be effective in remineralisation of early carious lesions [Beltran-Aguilar and Goldstein, 2000; Vaiduntam, 2000]. If the parents follow this protocol, then the need for restorations may be avoided.

Advanced ECC, involving extensive cavitation of primary teeth, is more commonly the stage at which children are seen by the dentist. Unfortunately, as this is an aggressive disease and cavitation of teeth has already occurred, these children will require a definitive restorative treatment. The problem in treating such patients is two-fold. Firstly extensive restorative intervention is required in a very young child, secondly there is absence or minimal exposure of such patients to dentistry in the past and hence the lack of confidence and trust in the dental setting. So the dentist and the parents are left with the difficult task of deciding what would be the best method of treatment for that individual patient. The factors to be considered are:
- method of pain control (local analgesia, local analgesia with sedation or general anaesthesia - GA);
- parent and patient compliance and hence whether to restore or extract the teeth involved.

Anaesthesia. The acceptance, and thus the usage of rectal premedication, varies widely between countries. Jensen and Stjernqvist [2002] investigated whether the child’s temperament affected his ability to accept treatment under rectal sedation with midazolam. Highly emotional or shy children showed less acceptance of treatment by this approach. The use of GA for very young children can cause great anxiety for parents. It might be thought that parental presence during the induction would alleviate this state of mind, but Kain et al. [2003] showed that this was not so. Balmer et al. [2004] showed that children’s anxiety did not change throughout the various stages leading up to induction, but that of the parents rose significantly following assessment and also just prior to the anaesthetic. Preinduction fasting can be a problem for young children who might be used to frequent intake of food and drink. Splinter and Schreiner [1999] reviewed and summarised the available studies and concluded that clear fluids could be taken up to 2 hours before surgery and solid foods up to approximately 8 hours prior to induction. Law and King [2003] provide a full discussion of considerations for general anaesthesia for children.

Restoration of primary anterior teeth

The ultimate goal of restoring decayed primary incisors and canines is to allow the patient to retain these teeth. This allows natural exfoliation without any pulpal complications, ultimately resulting in damage to the permanent successors. In the past the solution for restoration of such teeth has been extraction or alternatively restoration of Class III, IV and V cavities with plastic materials such as composite resins, compomers or glass ionomer cements (GICs). These small restorations are clinically challenging but have been shown to be capable of long-term survival success rates [Croll et al., 2001].

Introduction of bonded resin composite strip crowns in the 1970’s enabled the paediatric dentist to provide durable and aesthetically acceptable restoration of carious primary incisors [Webber et al., 1979]. This approach is considered to be the gold standard restoration of maxillary incisors with extensive or multisurface carious lesions. Studies looking at the aesthetics and durability of these restorations have shown this technique to be very successful [Eidelman et al., 2000; Kupietzky et al., 2003]. It is however important to mention that this is a technique-sensitive procedure and requires good patient cooperation and optimal isolation.

As many of the patients with ECC are below a cooperative age, then it is not always possible to carry out resin composite strip crown restorations unless under GA. Therefore, if the child does not suffer from extensive caries and the lesions could be stabilised in the dental chair until a cooperative age is reached, then materials such as GICs or compomers may be used. The authors’ choice is resin modified GICs as they are command set and release small amounts of fluoride, which may help to slow or arrest the caries process in the area applied. However, the aesthetic qualities and durability of these materials are not as good as resin composite. Lo and Holmgren [2001] assessed a GIC cement used in the atraumatic restorative technique (ART) in children, over 30 months. For primary teeth the survival rates were high for Class V restorations (70%), but low for Class III and IV, with more than half missing after 12 months. The ART approach cannot be considered as anything more than a holding technique until a more definitive restoration can be placed.

Restoration of interproximal caries in the mandibular primary incisors is an even greater challenge than for the maxillary teeth; there are no preformed crowns for these teeth and with the pulp chamber so relatively close to the enamel layer preparation of these teeth without iatrogenically causing pulpal exposure is difficult. It is recommended that interproximal caries in these teeth
should be treated conservatively by disk ing the interproximal surfaces to open the contact between the teeth and hence allow for easy flow of the saliva and cleansing of these teeth. Prescription of fluoride supplements will help reduce or arrest caries. However, in grossly carious teeth caries should be arrested with the aid of GICs if possible; otherwise extraction should be the option. Another alternative is to use the small size maxillary lateral incisor strip crowns for the contralateral lower incisors, as shown in Case 1 (Figs. 1-3).

**Restoration of primary molars**

In the past, a number of materials have been used for intracoronal restoration of primary molars. These include amalgam, composite resin, compomer, GICs and preformed metal crowns, depending upon the extent of the lesion and the clinical situation.

*Amalgam, composite, GIC.* These materials are indicated in minimal classical design intra-coronal restorations. Historically amalgam has been used in Class I and II restorations; however, with development of new materials such as composites and GICs, the aesthetics of this material is no longer acceptable to many parents and children. Also in some European countries, resin-based composites or GICs are the material of choice in primary teeth because of the controversial aspects of dental amalgam and its alleged adverse health effects. Therefore, although amalgam has been used for over a century and has been shown to perform well in minimal cavities [Roberts and Sherriff, 1992], it is becoming less commonly used. This means that alternative materials such as composites and GICs are becoming more widely used in the restoration of primary molars.

*Preformed metal crowns.* Extensive caries in molars in cases of ECC may present as a large Class II cavity with or without marginal ridge breakdown or a Class V cavity buccally or lingu ally, and in addition the tooth may require pulp therapy. Here, preformed metal crowns, also referred to as stainless steel crowns (SSC), are the treatment of choice. These preformed crowns are available in a variety of sizes for first and second primary molars. After caries removal and minimal preparation of the tooth, the correct size of SSC is chosen to fit over the crown of the tooth where, as well as by cementation, it is held in position mechanically using the residual undercuts around the tooth beyond the preparation. This is possible as the elasticity of the metal allows expansion of the crown past the maximum bulbosity whereupon it subsequently springs back into position forming a tight collar around the cervical section of the tooth [Curzon et al., 1996]. This treatment is however considered as aggressive by some authors [Milsom et al., 2003]. But not only does it decrease the number of tooth surfaces at risk of new or recurrent caries, it has also been shown to be more robust with less chance of failure and hence necessity for re-treatment compared with other restorative materials mentioned above [Braff, 1975; Roberts and Sherriff, 1992; Einwag and Dunninger, 1996; Randall, 2002].

Although very successful from the longevity standpoint, the aesthetic considerations of anterior or posterior SSCs can be a barrier to their acceptance. For molar crowns one

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**Fig. 1** - Case 1: both central primary incisors prepared, with strip crown forms trial-fitted, using rubber dam.

**Fig. 2** - Case 1: postoperative intraoral photograph showing mandibular lateral incisors restored using maxillary lateral incisor strip crown forms.

**Fig. 3** - Case 1: postoperative intraoral photograph showing aesthetics of maxillary and mandibular strip crowns two years after placement.
suggestion has been to cut a window in the buccal aspect prior to cementation, and to apply an etched composite facing [Roberts, 1983], but this only provides a relative improvement as shown in Case 2 (Fig. 4). More recently fully veneered SSCs have been introduced and an early pilot study into their use [Fuks et al., 1999] showed that at 6 months there was no chipping of the veneer. However, the gingival health around the veneered SSC was poorer than around the conventional SSC. The authors also commented that the new SSCs were more expensive, bulky and of poor appearance.

Veneered primary anterior SSCs have been in production for a number of years. With regard to their aesthetic qualities, Hosoya et al. [2002], in a laboratory study stated that none of the brands tested showed excellent colour matches and suggested they be used where adjacent crowns are being placed, for uniformity of appearance, using the strip crowns where a single tooth requires a crown. Guelmann et al. [2003] tested different brands of veneered anterior SSCs, finding that crimping the crown margins prior to cementation improved the retention rates.

The question arises of how far should measures be taken under GA to restore the teeth affected by ECC rather than extract. Some are firmly in favour of extracting pulpally involved primary teeth particularly first primary molars when GA is being used [Robertson and Ball, 1973; O’Sullivan and Curzon, 1991]. This aggressive approach seems at odds with the reportedly high success rates for vital and non-vital pulpotomies performed under general anaesthesia [O’Brien and Suthers, 1983]. However, it does seem justifiable to preferentially choose SSCs rather than multisurface composite or amalgam restorations. Al-Eheideb and Herman [2003] found a failure rate of 5% for SSCs compared with 50% for Class II amalgam and composites placed under general anaesthesia for children. Tate et al. [2002] found a failure rate of 8% for SSCs, 21% for all amalgams and 30% for composite resins, again under general anaesthesia. The high caries risk of children with ECC is probably a factor in the failures of restorations in their mouths.

Fissure sealants. They are recommended for primary molars in children with ECC. Children would benefit from fissure sealants on the pits and fissures of molars that have not been affected by caries or have been restored with tooth coloured restorative material, as a preventive measure against future caries. Fissure sealants have been shown to be effective, however they require regular maintenance, as they may be partially or completely lost [Simonsen, 2002].

Follow-up visits. Frequent visits following restorative/surgical care should lead to increased confidence and cooperation from the patients, as it involves preventive rather than invasive treatment. Every effort should be made to provide subsequent treatment without the use of GA, as it is unjustifiable to subject patients and parents to the risks and stresses of an avoidable GA [Nunn et al., 1995; Harrison and Nutting, 2000].

References
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