Two compliance-free and site-specific caries control techniques: pre-fissure and proximal sealants

Hien Ngo,[1] Kim Seow[2]

Introduction

Pit and fissure sealant has been used both as primary and secondary preventive measures against occlusal caries. After nearly four decades of clinical use, the pit and fissure sealant is now recognized as one of the more effective and compliance independent methods for preventing occlusal caries in children.

Epidemiological data suggests that dental caries of the pit and fissure system in permanent molars is a major issue in school-aged children and there is evidence to suggest that up to 20% of these were initiated during the eruption period. However, older children and young adults present different patterns of caries compared to younger children, longitudinal data indicates that proximal surfaces are more susceptible to caries in older children. At the age of 13 years, proximal caries contributes approximately 30 percent to the annual caries increment and it increases to 50 percent at 27 years of age respectively (Mejare, Stenlund et al. 2004). This article discusses the concept of pre-fissure sealant to protect the occlusal surface of erupting permanent molars and proposes a novel concept of preventing proximal caries using sealant materials.

Site Specificity: *exposed* and *hidden* smooth surfaces

The development of white spot lesions is associated with excessive bacterial acid production and stagnant accumulation of oral biofilms over time; it is site specific with ***exposed*** smooth surfaces being the least susceptible because they are subjected to good mechanical cleansing and salivary flow. The reverse is true with ***hidden*** smooth surfaces, as they are less accessible to mechanical cleansing and chemical protection from saliva and fluoride and are therefore more susceptible to caries. It is important to point out that in some situations, the same surface can change its risk status over time.

Figure 1: A non-cavitated carious lesion was formed on the mesial surface of the maxillary left canine during the time this surface was "hidden". It is likely that, when it became "exposed" the lesion became arrested.

Example 1: a large carious white spot lesion which was formed on the proximal surface of a tooth when it was hidden could become exposed and arrested, or remineralised, with the removal of an adjacent tooth (Figure 1).

Example 2: the distal and mesial surfaces of a first permanent molar can be classified as exposed toward the end of the mixed dentition stage, when the second primary molar exfoliates and the second permanent molar is still unerupted. We propose that in high-risk children, these surfaces can be protected from future proximal caries prior to their returning to a hidden status upon the eruption of the second permanent molar and premolar. These surfaces

[1] *Associate Professor, Dept. of Restorative Dentistry, National University of Singapore.*

[2] *Professor Kim Seow, BDS, MDS, PhD, DDSc, FRACDS, FICD School of Dentistry, University of Queensland, Australia*

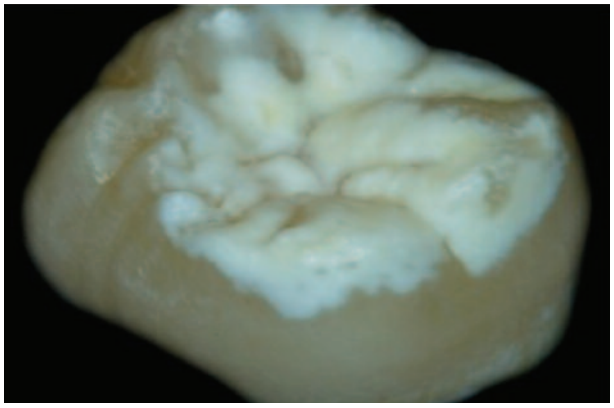

Figure 2: The pattern of demineralisation follows the pattern of plaque accumulation under the operculum. On an erupting tooth, it is possible for the entire occlusal surface to be demineralized.

Figure 3: Food debris impacted under the operculum of an erupting molar, presenting a site specific risk of caries.

should be sealed, with a thin and hard- wearing sealant, while they are still exposed, therefore accessible for good moisture control, this principle should be extended to any smooth surfaces deemed to be at risk.

Example 3: the occlusal surface of an erupting tooth can be classified as hidden while it is covered by an operculum and inaccessible to a toothbrush. It becomes exposed after eruption and benefits from the self-cleansing effect of a functional occlusion.

A slowly erupting permanent molar usually has problems of plaque accumulating under the operculum and requires professional preventive care throughout the erupting phase (Carvalho, Thylstrup et al. 1992).

The prolonged period of eruption results in large areas of plaque stagnation under the operculum so that the area of demineralisation would not be limited to the pits and fissures but usually extends to an extensive area of enamel under an operculum Figure 2.

There is a tremendous difference in plaque accumulation on the occlusal surface of erupting and fully erupted molars, due to the lack of functional usage (Ekstrand, Nielsen et al. 1993) and the presence of an operculum, which covers an erupting or partially erupted tooth. There is also the risk of food debris impacted in the space between the enamel and the soft tissue (Figure 3).

The duration of the eruption period is a further risk factor because teeth with longer eruption time tend to have more occlusal caries. For example, occlusal caries is much more prevalent in molars, which have a relatively long eruption time of 12 to 18 months, compared to premolars, with an eruption time of only a few months. Occlusal caries in molars is usually initiated during the eruption period due to conditions conducive for plaque accumulation. In a study where children with erupting molars were provided with intensive education and professional cleaning over a period of 3 years there was a significantly lower rate of filled teeth. The authors concluded that "our data indicate that professional care for erupting teeth on an individual basis has long term effect on occlusal surfaces" (Carvalho, Thylstrup et al. 1992). These results suggest that certain erupting teeth would benefit from temporary protection of the partially exposed surfaces.

"Pre-fissure sealant" procedure: controlling caries risk in erupting permanent molars

The first suggestion that an erupting tooth should be protected from occlusal caries was made by Hyatt (Hyatt 1923) when he suggested that the occlusal surface of an erupting tooth should be sealed with zinc phosphate cement as soon as possible. However he also suggested that when the tooth is sufficiently erupted, a Class I amalgam should be placed to prevent the fissure from becoming carious. Fortunately, this concept did not gain popularity even though the eradication of enamel fissures was once again discussed by Bodecker.(Bodecker 1929)

Today, it is accepted that a preventive regimen, commencing when the first permanent teeth is erupting, is essential for overall caries prevention. The emerging and immature enamel surface is vulnerable to caries attack and as the process of eruption is relatively lengthy. A few preventive methods can be instituted during this period to reduce the caries risk. First, tooth brushing with fluoridated toothpaste performed twice daily, using a soft brush to scrub the occlusal surfaces of the emerging teeth can remove the biofilm. Daily rinsing with 0.2 percent fluoride solution will further decrease the caries risk. In addition, the child's diet should be monitored to reduce frequency of sugar consumption. However, the most important risk factor to consider is the fact that the enamel under the operculum cannot be cleaned by the child or care givers due to lack of access.

Figure 4: The space under the operculum is cleaned with conditioner and a micro-brush.

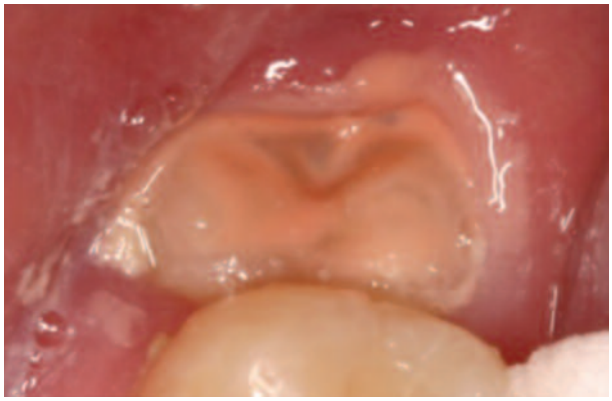

Figure 5: Fuji 7, is applied to the space under the operculum and on to the occlusal surface of this erupting molar.

Obtaining a dry field on a partially erupted tooth is not possible so the only material which can be used for this purpose is a fast setting, high fluoride releasing, conventional glass-ionomer cement (GIC). These materials are less sensitive to moisture and the sealants can provide additional fluoride which can be replenished from the fluoride rinses and tooth paste.(Salar, Garcia-Godoy et al. 2007) When the teeth are fully erupted, the need to place a long term sealant can be re-assessed.

The procedure to apply glass ionomer under the operculum is called a "pre-fissure sealant", and is designed to provide protection during the entire eruption period of a permanent molar. The alternative is intensive professional intervention with regular recalls and repeated applications of fluoride varnish which carry higher cost and require high level of compliance.

The tooth to be treated was previously illustrated in Figure 3. The material used in this case was a fast setting (90sec), high flow, high fluoride releasing glass-ionomer. It is pink in colour so the treated surface can be easily identified and monitored and the colour is a marker for the temporary "pre-fissure sealant" treatment. When the tooth become fully exposed a decision on further treatment can be made.

Placement protocol

The area should be isolated using cotton rolls and high volume suction. Debris can be gently removed from under the operculum and the tooth surface treated with conditioner using a small micro-brush Figure 4. The glass-ionomer is then used to cover the entire exposed surface of the erupting tooth as well as the space under the operculum. It will now remain until the tooth becomes fully exposed. The excess material, as seen in Figure 5, will be removed with tooth brushing after placement.

'Proximal sealant' procedure: a new concept

Proximal sealant is proposed as a method for preventing smooth/proximal caries based on the concept of sealing susceptible surfaces.

The high effectiveness of sealants in preventing caries in pits and fissures is well established by randomized clinical trials and cost-benefit analyses. However, such preventive measures have not been tested in the prevention of smooth surfaces caries. Of all the smooth surfaces, the proximal surfaces are at highest risk for caries due to the presence of contact areas which act as areas of stagnation that are difficult to reach by toothbrush and accessible only by flossing. In high-risk children, white spot lesions on the proximal surfaces can be visible approximately 12-18 months after the establishment of the contacts in the posterior teeth.

Traditional approaches for preventing proximal lesions such as flossing and rinsing with fluoride usually have limited success as they rely heavily on patient compliance (Alm, Wendt et al. 2007). More recently, treatment of proximal caries has been focused on arresting initial caries by sealing these lesions with low viscosity resins (Ekstrand, Bakhshandeh et al. 2010). Although early success has been reported, this technique requires to gain access to the proximal lesions using physical separation of the teeth.

An alternative method would be to seal the teeth while it is possible to gain access to the proximal smooth surfaces before the contacts with adjacent teeth are established. There are a few stages in the development of the primary and permanent dentitions which provide windows of opportunity to gain such access to specific proximal surfaces of the posterior teeth.

Placement protocol

An opportunity to seal the proximal surfaces of the first molars would be towards the end of the mixed dentition stage. As depicted in the case below, the premolars are fully erupted

Figure 6: There is already a white spot lesion on the mesial surface of the first molar (green arrow) there is also easy access to the other proximal surfaces.

Figure 7: The proximal surfaces were cleaned with an abrasive strip.

Figure 8: All proximal surfaces are acid etched.

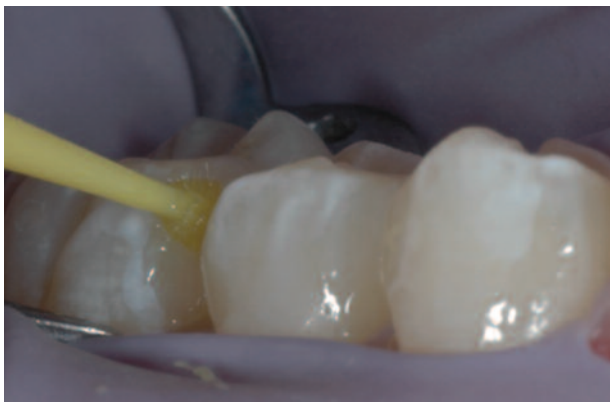

Figure 9: A hard wearing, nano filled resin was applied then light cured.

but there is relatively easy access to all proximal surfaces. There is a white spot lesion which was formed during the time when the primary molar was present (Fig6). Rubber dam isolation is applied then the exposed surfaces are cleaned using an abrasive strip (Fig 7). All proximal surfaces are prepared with the application of 37% phosphoric acid for 20sec then washed and dried with a triple syringe (Fig8). A hard-wearing nano-filled resin is applied as a sealant then light cured (Fig 9). It is important to ensure that there is no overhang of the material after placement.

Conclusions

In this article, we further extended the traditional concepts of sealants to propose a method of pre-fissure and smooth surfaces sealing, eg: the proximal surfaces of molars during windows of opportunity which present when the teeth are partially erupted and before the establishment of contacts with adjacent teeth. Together with the established methods of caries prevention such as topical fluoride, these exciting innovations in sealant applications will contribute further to decreasing caries in children. Sealants should be reviewed regularly and be part of a comprehensive prevention strategy, which includes both population and individual risk assessment.

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