Seal Away Tooth Decay: A Case Report & Review

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Abstract

Pits and fissures are the most susceptible sites for the development and progression of dental caries and keeping these areas clean is extremely difficult and at times impossible. Over a period of time sealants have evolved to a major extent and are successful in preventing dental caries. This article has a case presentation along with detailed review the indications, properties, caries-preventing capacity, recommendations, safety and optimum time-period for recall of pit and fissure sealants.

Key words : Pits & Fissures, Pit & Fisure Sealant, Dental Caries

Introduction

Dental caries is an infectious and transmissible disease, caused by cariogenic bacteria of the oral cavity. The incidence of the dental caries has vastly been reduced courtesy the introduction/inception of fluorides. Unfortunately fluorides are not as effective in preventing Occlusal caries (accounting for more than two third of caries in children) when compared to smooth surfaces due to the tricky morphology of the pits and fissures.

Several methods have been tried historically to deal with the pit and fissures on occlusal surfaces. Wilson in 1895 placed cement in pit and fissure, Bodecker in 1929 suggested enameloplasty to broaden the fissures to make the Occlusal areas more self-cleansing, Hyatt in 1924 and in 1936 advocated prophylactic odontotomy which involves insertion of small restorations in deep pits and fissures before carious lesions had the opportunity to develop. But the major disadvantage of all the above mentioned procedures was first, sound tooth structure had to be sacrificed and second, these were all more of treatment options rather than preventive approach.[1]

Later, several methods have been unsuccessfully tried in an attempt either to seal or make the fissures more resistant to caries. These included the use of topically applied zinc chloride & potassium ferrocynide, ammoniacal silver nitrate and the use of copper amalgam packed into the fissures. Pit and fissure sealants were introduced in 1967 and their effectiveness was recognized by the American Dental Association in 1971.[2] Pit and fissure sealants primarily work by forming a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissures.[3] The increased susceptibility of the occlusal surfaces of the permanent molars to dental caries has mandated the use of pit and fissure sealants as a part of a comprehensive approach to caries prevention on an individual

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basis or as a public health measure for at-risk populations.

Indications for Placing the Sealant

Many authors strongly recommend the use of sealants for children after eruption of molar teeth. They also advocate that there is benefit in placing sealants within 4 years after eruption and that placement of resin-based sealants on the permanent molars of children and adolescents is effective for caries reduction.[4] However, none of the authors have advocated the use of sealant beyond adolescence.

Jokovic A, David Locker assessed two risk factors namely past caries experience (where susceptibility to onset of further caries was positively associated with a child's previous dmfs/DMFS scores) and pit and fissure morphology (where children with deep pit and fissures were at a greater risk of dental decay) and concluded that permanent molars appeared to remain at high risk for dental decay beyond 4 years after eruption.[4]

Based on the dentist's overall assessment of the individual's caries risk status and a thorough assessment of the tooth surface, other teeth such as premolars, third molars and the palatal surfaces of maxillary incisors can also be considered for sealant application.

In high risk populations(First Nations and Inuit groups), all children should receive sealants and in low risk populations the recommendation is to seal the molar teeth of susceptible children that is those who have already had caries at the time of assessment, those who are medically compromised and others at risk.[4]

Caries Risk Assessment

A Caries Risk Assessment Checklist (CRAC) has been recently developed in order to formalize a risk-based approach to the management of caries in children. The checklist takes into account the reasons that might put the patient at high caries risk i.e. previous caries experience, dietary habits, tooth morphology, deprivation (measured by medical card status) and medical and other conditions, together with the factors that might reduce a patient's caries risk (e.g. adequate exposure to fluorides, presence of fissure sealants).[5]

The risk of experiencing dental caries exists on a continuum and changes across time as risk factors change. Therefore, a patient's caries risk status should be re-evaluated periodically. There is not a single system of caries risk assessment that has been shown to be valid and reliable.[2] Therefore caries risk assessment should be integrated with the practitioners' professional expertise to determine treatment options.

It has been observed that placement of pit and fissure sealants significantly reduced the number of non-cavitated carious lesions in children, adolescents and young adults for five years after sealant placement, as compared with unsealed teeth.[3]

The authors are of the view that placement of sealants on primary molars is beneficial to an extent,[6] also supported by an Irish article which states that the impact of fissure sealants alone on reducing caries is likely to be less for primary teeth than for permanent teeth.[5] However they strongly recommend the placement of sealants on permanent molar teeth as both cost effective and efficacious in the prevention of caries.[4] This view was also supported by Beauchamp et al who found that placement of resin-based sealants on permanent molars of children and adolescents resulted in caries reduction.[3]

Clinical Detection of Non-Cavitated Pit and Fissure Carious Lesions

Visual examination after cleaning and drying the tooth is sufficient to detect early non-cavitated lesions in pits and fissures. It is important to note that external stain is not equivalent to a non-cavitated carious lesion. The use of explorers is not necessary for the detection of early lesions, as forceful use of a sharp explorer can damage tooth surfaces.[3,4] The clinicians can use radiographs if available, but cannot obtain radiographs for the sole purpose of placing sealants.

Case Report

A 10 year old male patient, reported to Department of Public Health Dentistry, with chief complaint of pain in right and left lower teeth since 1month.

On examination, he had poor oral hygiene and deep caries in relation to 74, 84 with the presence of deep fissures in relation to 36 & 46. Treatment plan involved restoring carious teeth 74 and 84 with help of GIC and application of Pit & fissure sealants to 36 & 46 (Figure 1).

Figure 1. Pre operative

The treatment was carried out in the following steps:

1. Scaling & polishing was performed
2. Isolation with help of cotton rolls was done (Figure 2).

Figure 2. Isolation

3. Acid etching was done with help of 37% phosphoric acid which increased the surface area of the tooth and helped in the formation of enamel resin interface (Figure 3).

Figure 3. Acid Etching

4. Tooth surface was washed and dried and frosted appearance was checked on tooth surface.
5. Application of sealant material (Helioseal) Figure 4

Figure 4. Application of Material

6. Light curing was done following manufacturer's directions Marginal integrity was evaluated and occlusal integrity was checked (Figure 5).
7. Patient was asked to report in case of any discomfort or else report after 6 months for evaluation.

Figure 5. Post Operative

Recommended Indications :

1) Sealants can be placed on permanent molars free of caries, on permanent molar tooth which have deep pit and fissure morphology, on permanent molars with sticky fissures or stained grooves.[5,6,7] When indicated, sealants should be applied as early as the tooth is sufficiently erupted to be isolated.[8]
2) Sealants should be placed on deciduous molars of children who are susceptible to caries.[9]
3) Sealants should be placed on first and second permanent molar teeth within 4 years after eruption.[5,6,7]
4) Resin based sealants should be the material of choice, till GIC sealants with better retention capacity could be developed.[5,6,7]
5) Glass ionomer may be used as an interim preventive agent when there are indications for placement of a resin-based sealant but concerns about moisture control may compromise such placement.[10,11]
6) The sealants should be monitored and reapplied when necessary to maximize their effectiveness.[2]
7) Sealants should be used in conjunction with other preventive measures.[5]

Recommended Contraindications :

1) Sealants should not be placed on partially erupted teeth, teeth with cavitation or dentinal caries.[5]
2) The standard acid-etching technique is found to be more retentive than self-etching bonding agents and hence self etching bonding agents are not recommended.[12,13]
3) Routine mechanical preparation of the enamel before acid etching is not recommended.[1,14,15]

Factors Affecting Retention

Isolation :

It is very important to adequately isolate the teeth since salivary contamination is one of the major causes for failure of the sealant in the first year.[16] Lingual aspects of Occlusal grooves in mandibular molars area is

particular at-risk surface for saliva contamination. Similarly, molars that are sealed with the operculum covering the distal marginal ridge of the occlusal surface have twice the probability for retreatment as teeth not treated until the entire marginal ridge was exposed.[17] Isolate the tooth to be sealed with either a dental dam or cotton wool rolls/isolation shields combined with effective aspiration.[5] When possible, a four handed technique should be used for placement of sealants.[3]

Sealant Materials Used

The main bone of contention was between resin based sealants and GICs.Reinforced GICs had better retention compared to regular GICs.[4] The resin-based sealants had best retention rates and were more effective in caries reduction than glass ionomer cement in permanent teeth of children and adolescents.[2] Retention was a major problem with GICs but if this problem were to be rectified, than there may be advantages to the GIC sealants through the release of Fluorides.[4]

The Effect Of Fissure Morphology And Eruption Time On Penetration And Adaptation Of Pit And Fissure Sealants

Nagano classified occlusal fissures on the basis of morphology into 5 types: V, U, Y, I, I and K. Grewal N et al found that the depth of penetration of the sealant was greatest in V shaped fissures followed by U type, Y type, I type and IK type fissures in decreasing order respectively. Penetration of the sealant to the base of the fissure occurred more frequently in shallow fissures than in deep fissure.[9] An invasive technique for the placement of sealants in constricted fissures has shown higher retention rates.[9]

Sealant Viscosity

Pilar baca et al[18] Conducted a study in which they compared the success rates of two unfilled sealants (Delton and concise), one fluoride and filled sealant (Delton plus) with a self-priming adhesive system (optibond Solo) and found that the best retention rates in both deciduous and permanent dentition was obtained using Delton (a non-Fluoride and unfilled sealant). The success rate was similar between all the four materials in the deciduous second molars and between the three sealants in the permanent molars, but Optibond Solo showed a worse success rate in permanent first molars (mandible). This was attributed to sealant contamination by saliva accentuated by the fact that the application was done by under-graduate students.

Other Modifications

There is limited and inconclusive evidence regarding the use of air abrasion as a cleaning method before acid etching and the use of burs for mechanical preparation both of which resulted in improved retention of sealants.[3] Sealant retention could also be improved by the application of a bonding agent containing an adhesive and primer between the previously acid-etched enamel surface and the sealant material.[3] The use of flowable resin, and pretreatment with an adhesive also enhance retention.[3]

Reduction Of Caries Increment By Use Of Sealants

Overall the reduction in caries incidence in children and adolescents after placement of resin-based sealants ranged from 86% at one year to 78.6% at two years and 58.6% at four years respectively.[2] Beiruti et al in their study compared GIC and rein-based sealants and

found the relative risk of caries to be 0.22, 0.32 and 0.28 at 3, 4 and 5 years after placement respectively.[19] In permanent molars alone, sealants were effective in reducing caries by 76.3% at 4 years and 65% at nine years (when sealants were applied as necessary).[19] However, when sealants alone were compared with placebo controls (either no treatment, fluoride varnish or mouth rinse treatment, or oral hygiene instructions) there was reduction in caries increment up to 50%.[5]

Effect of Dental Sealants on Bacteria Levels in Carious Lesions:

Sealants were effective in reducing total bacteria counts in carious lesions. The reduction increased with time since sealant placement. There was a 100-fold decrease in mean bacteria counts in two studies.[3] And a 1000-fold decrease in the remaining two studies. Thus when sealants are placed and retained, access to fermentable substrates is blocked and bacteria do not appear capable of exerting their cariogenic potential.[8]

Fluoride- releasing sealants were thought to be more caries preventive through the release of Fluorides. Menon Preetha V et al[2] compared the antibacterial property of two fluoride releasing sealants (Teethmate F1 and Helioseal-F) and a non-fluoride releasing sealant and concluded that Teeth mate –F1 was the only sealant that showed zones of inhibition against the two main bacteria (Streptococcus mutans and Lactobacillus acidophilus). They attributed this difference to the method of incorporation of Fluoride into the sealant where organic Fluoride compound is chemically bound to the resin (in case of teethmate-F1). Hence Fluorides and sealants should be used to supplement each other.

Cost-effectiveness of the Sealants :

Multiple Models have shown that bring selection criteria for sealants on the patient's caries risk is cost-effective.[3]

In order to assess the cost-effectiveness of the sealants, a systematic review was done in many European countries and after taking into account the various limitations, the conclusions arrived at were[5]:

In children at high caries risk, sealing first permanent molars was cost-effective.

When children were selected without any risk, the results were contradictory.

For children with low caries risk, the results were unclear on a long term basis

In order to see the overall cost-effectiveness of pit and fissure sealants, long-term monitoring was necessary.

Retrospective cohort study of 2,132 children continuously enrolled in the Iowa Medicaid program over a 4-year period found that while the cost of treatment associated with sealed first permanent molars was higher than that for unsealed teeth, the utility was also slightly higher. Sealing first permanent molars in low utilizers of dental services (i.e. children with one preventive visit or less per year) was found to be the most cost-effective approach for prioritizing resources.[20]

Two economic analyses compared the cost of three different sealant delivery strategies: 'seal all', 'Risk-based[21] and 'seal none'[22] Both studies found that, under baseline assumptions, the 'risk-based' approach was the most cost-effective strategy over a simulated 9 or 10 year period. The 'seal all' approach was the most effective, but also the most costly strategy.

Another study in Finland found that costs per child were 21% higher in the 'seal all' area compared to the 'risk-based' area, due mainly

due to the higher costs for restorative treatment required by children who had not attended for sealant in the 'seal all' area. However, there may have been fundamental differences in the caries profile and risk status of the 'non-sealed' children in the two areas: in the 'seal all' area, children without sealant were non-attenders, which would suggest that they were likely to have greater treatment needs when they did attend; in the 'risk-based' areas, children without sealant were assessed as low risk. Differences in background preventive programmes and caries levels between the two communities could also have biased the results of this study.[23]

Are Pit and Fissure Sealants Safe?

A systematic review on possible harm or toxic effects of sealant concluded that patients are not at risk of exposure to BPA from the use of dental sealants, but has issued precautionary measures to reduce potential exposure to BPA which include:

1. Rinsing the surface of the cured material for 30 seconds with water while using effective suction.
2. Getting the patient to rinse for 30 seconds and spit out after the procedure
3. Removing the surface residual monomer layer with pumice on a cotton pellet.

A comprehensive review of potential human reproductive and developmental effects of BPA estimated that approximately 99% of BPA exposure comes from diet and exposure from dental sealants was an acute and infrequent event with little relevance to estimating general population exposures.[20]

Optimum time for Reviewing Sealants

Sealants need to be maintained once applied. When sealants are placed in high caries risk children, the recall interval should not exceed 12 months.[24] If there is a concern regarding isolation or if the sealant is placed on a suspicious carious lesion than recall within 6 months would be appropriate. A 3-year sealant study involving children aged 5–14 years with partially or newly erupted first or second permanent molars found that irrespective of the methods of isolation, the re-treatment rate was higher at the first 6-month recall than at any other recall during the study (rubber dam or cotton rolls).[25]

Pit and Fissure Sealants & Nano-Composites :

A study comparing the flowable composites, pit and fissure sealants and nano-composites showed that micro leakage was highest with flowable composites and least with pit and fissure sealants. The nanocomposite values were intermediate. The nano-composite was found to be an excellent material for penetration into deep pit and fissures though it exhibited mild micro leakage and hence could be recommended for use in pediatric patients as a pit and fissure sealant.[26]

Conclusion

The use of pit and fissure sealants have been mainly used for primary caries prevention, but recent evidence suggests that it can also be used as a secondary preventive approach when used on early non-cavitated lesions. Therefore, sealants when used judiciously after taking into account the caries risk assessment could be an effective comprehensive approach.

References

1) Primary Preventive Dentistry (6th edition, 2004): Norman Harris, Franklin Garcia-Godoy and Christine N. Nathe: 285-318.

2) Menon Preetha V, Sashikaran N D,Reddy V V S: Comparison of antibacterial properties of two

Fluoride Releasing and a non Fluoride-releasing pit and fissure sealants. J Ind Soc Pedod Prevent Dent 2007: 133-6.

3) Beauchamp J, Caufield PW, Donly K, Feigal R, Gooch B, Ismail A, Kohn W, Siegal M, Simonsen R : Evidence-based clinical recommendations for the use of pit and fissure sealants. J Am Dent Assoc 2008; 139: 257-68.

4) Azarpazhooh A, Patricia A, Main: Pit and Fissure Sealants in the prevention of dental caries in children and adolescents: A systematic Review: J Canad Dent Assoc 2008; 74(2): 171-7.

5) Irish Oral Health Services Guideline Initiative. Pit and Fissure Sealants: Evidence-based guidance on the use of sealants for the prevention and management of pit and fissure caries, 2010.

6) Feigal RJ, Musherure P, Gillespie B, Levy-Polack M, Quelhas I, Hebling J: Improved sealant retention with bonding agents: a clinical study of two-bottle and single-bottle systems. J Dent Res 2000;79(11): 1850-6.

7) Boksman L, McConnell RJ, Carson B, McCutcheon-Jones EF: A 2-year clinical evaluation of two pit and fissure sealants placed with and without the use of a bonding agent. Quintessence Int 1993; 24(2): 131-3.

8) Oong EM, Griffin SO, Kohn W, Gooch BF, Caufield PW: The effect of dental sealants on bacterial levels in caries lesions-A review of evidence. J Am Dent Assoc 2008; 139 (3): 271-8.

9) Grewal N, Chopra R: The effect of fissure morphology and eruption time on penetration and adaptation of pit and fissure sealants: An SEM study. J Ind Soc Pedo Prevent Dent 2008: 59-63.

10) Oba AA, Dulgergil T, Sonmez IS, Dogan S: Comparison of caries prevention with glass, ionomer and composite resin fissure sealants. J Formos Med Assoc 2009; 108(11): 844–8.

11) Songpaisan Y, Bratthall D, Pantumvanit P, Somridhivej Y: Effects of glass ionomer cements, resin-based pit and fissure sealant and HF applications on Occlusal caries in a developing country field trial. Comm Dent Oral Epidemiol 1995; 23(1): 25-9.

12) Fiegal RJ, Quelhas I: Clinical trial of a self etching adhesive for sealant application:success at 24 months with Prompt L-Pop. Am J Dent 2003; 16(4): 249-51.

13) Venker DJ, Kuthy RA, Quain F, Kanellis MJ: Twelve month retention in a school-based program using a self-etching primer/adhesive. J Public Health Dent 2004; 64(4): 191-7.

14) Yazici AR, Kiremitçi A, Celik C, Ozgünaltay G, Dayangaç B: A two-year clinical evaluation of pit and fissure sealants placed with and without air abrasion pretreatment in teenagers. J Am Dent Assoc 2006; 137(10): 1401-5

15) Kanellis MJ, Warren JJ, Levy SM: Comparison of sealant placement techniques and 12-month retention rates. J Public Health Dent 2000; 60(1): 53-6.

16) Kervanto-Seppälä Ilpo Pietilä S, Meurman JH, Kerosuo E: Pit and fissure sealants in dental public health – application criteria and general policy in Finland. Br Med Coun Oral Health 2009;9(5).

17) Walsh LJ: Pit and fissure sealants current evidence and concepts. Dent Practice 2006: 122-4.

18) Baca P, Bravo M, Baca AP, Jiminez A, Gonzalez-Rodriguez MP: Retention of three fissure sealants and a dentin bonding system used as a fissure sealant in caries prevention: 12-month follow-up results. Med Oral Patol Oral Cir Bucal 2007; 12: E459-63.

19) Poulsen S, Beiruti N, Sadat N: A comparison of the retention and the effect of caries on fissure sealing with a glass ionomer and a resin based sealant. Comm Dent Oral Epidemiol 2001; 29(4):298-301.

20) Bhuridej P, Kuthy RA, Flach SD, Heller KE, Dawson DV, Kanellis MJ: Four-year cost-utility analyses of sealed and nonsealed first permanent molars in Iowa Medicaid-enrolled children. J Public Health Dent 2007; 67(4):191–8.

21) Griffin SO, Griffin PM, Gooch BF, Barker LK: Comparing the costs of three sealant delivery strategies. J Dent Res2002; 81(9): 641–5.

22) Quinonez RB, Downs SM, Shugars D, Christensen J, Vann WF Jr: Assessing cost-effectiveness of sealant placement in children. J Public Health Dent 2005; 65(2): 82–9.

23) Leskinen K, Salo S, Suni J, Larmas M: Practice-based study of the cost-effectiveness offissure sealants in Finland. J Dent 2008; 36(12):1074–9.

24) Irish Oral Health Services Guideline Initiative. Strategies to prevent dental caries in children and adolescents: Guidance on identifying high caries risk children and developing preventive strategies for high caries risk children in Ireland. 2009.

25) Straffon LH, Dennison JB, More FG: Three-year evaluation of sealant: effect of isolation on efficacy. J Am Dent Assoc 1985; 110(5): 714–7.

26) Singh S, Pandey RK: An evaluation of nanocomposites as pit and fissure sealants in child patients. J Ind Soc Pedo Prevent Dent 2011; 29(4): 294-9.