REVIEW ARTICLE

Pit and Fissure Sealants in Public Oral Health Care: Prevention by Sealing

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ABSTRACT

Dental caries remains the greatest global burden even in the 21st century affecting the general as well as oral health. It has its detrimental effect on health-related - quality of life and also on the oral-health-related - quality of life of an individual. The most caries prone tooth surfaces are the occlusal pit and fissures especially the molars and premolars. The high caries susceptibility of these surfaces is attributed directly to the morphology. Apart from the usage of systematic and topical fluorides along with regular oral hygiene measures, sealing the potential pit and fissures with pit and fissure sealants aids in the prevention of dental caries. The ineffectiveness of fluorides and oral hygiene practices is related to inaccessibility of the same to the base of pit and fissures. Resin-based sealants provide a perfect method of prevention of dental caries as it penetrates the length and breadth of pit and fissures, thus establishing a tight seal which acts as a barrier against caries susceptible external factors.

Key words: Dental caries, oral health care, pit and fissure sealants, public health dentistry, resin-based sealants

INTRODUCTION

Dental caries is usually treated by both surgical and nonsurgical methods. However, the nonsurgical method is considered much better as it is minimally invasive; thus, minimal intervention dentistry came into being. "Repeat restoration cycle" put forward by Elderton, emphasized on carrying non-operative methods going in conjunction with the restorative modes for a healthy functional life.[1,2] Pit and fissure sealants and fluorides have shown significant yet equivalent role in the reduction in the caries level in mass community level.[3] Sealing modifies the deep pits and fissures into smooth surfaces which prevents bacterial colonization and makes the tooth easy to clean. This acts as a check on non-cavitated enamel lesions on pits and fissures.[2]

CARIES RISK ASSESSMENT

Caries risk is assessed by identifying the age of the patient and other factors that may either contribute to caries or protect from dental caries. Prior caries experience and fluoride history of patients help in simple risk analyses of each individual. Caries protective factors are biologic and therapeutic factors that can collectively offset the pathologic challenge presented by the caries risk factors. In that, sealants are grouped as a protective factor for caries progression.[4] Guidelines by CAMBRA - The Caries Management By Risk Assessment for 0–5 years:

- Low caries risk group: Application of pit and fissure sealant.
- Moderate/high-risk group: Application of high fluoride conventional glass ionomer cement (GIC) after 2 years of age.

INDICATIONS OF PIT AND FISSURE SEALANTS

- Occlusal surfaces with deep pit and fissures in permanent dentition
- Buccal and lingual grooves
- Sound proximal surfaces
- Stained pits and fissures
- High caries risk groups
- Lingual pits in incisors.[5]

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CONTRAINDICATIONS OF PIT AND FISSURE SEALANTS

- Caries free teeth more than 4 years
- Multiple carious lesions
- Wide self-cleansing areas
- Carious proximal surfaces.

STEPS FOR PIT AND FISSURE SEALANT APPLICATION

Step I: Selection of tooth and prophylaxis

Caries detection has been made easier with newer diagnostic advances such as digital radiography and light-based technologies such as fiber-optic transillumination, DIAGNOdent, or light-induced fluorescence (quantitative light-induced fluorescence). Some of the methods in the prophylaxis of tooth are.

Pumice and water slurry

This is a simple method where the tooth is cleaned with water and pumice using pointed or flat rotary brush.[6]

Enameloplasty

Slow or high-speed handpiece is used. This method is simple, cost-effective, and easily accessible showing acceptable sealant retention reduced microleakage as per *in vivo* and *in vitro* studies.[7] This method also reduces any microleakage of pit and fissure sealants irrespective of the burs used.[8]

Air abrasion

Propelled stream of aluminum oxide particles generated from compressed air and bottled carbon dioxide or nitrogen gas is used to abrade the tooth. An exposure of 40 pounds per square inch with a small tip is used. This technique includes mechanisms such as enamel roughening, the opening of questionable fissures, removal of suspected caries, and cleaning pits and fissures.[9] Apart from this, prophy jet is also an air polishing system used successfully. It has sodium bicarbonate instead of aluminum oxide which results in significantly higher bond strength for sealant.[10]

Laser

Lasers can also be used to pre-treat the tooth surface. The advantage of laser treatment is acid resistance induced by recrystallization of enamel. On applying laser on the tooth structure, the calcium: Phosphorus ratio is altered which makes them more resistant to caries. In addition to this, lasers also have a sterilization effect on pits and fissures.[10]

Acid etch technique

One of the accepted methods which show lower microleakage with phosphoric acid etching than the laser and air abrasion though pellicle and remaining debris might not be removed from the base of the fissure.[11,12]

Hydrogen peroxide

Hydrogen peroxide (3%) is normally used, but there is no evidence to prove that it provides good retention.

After prophylaxis, active carious lesions appear as light yellow to dark brown and dark stains on the pits and fissures indicate inactive lesions.[13]

Step II: Isolation

Moisture control is necessary as it affects the bond. The saliva contamination causes precipitation of glycoproteins on the enamel which inhibits or reduces the resin tag formation.[14] Rubber dam can be used for isolation during sealant application. The major disadvantage is that the rubber dam clamp cannot be placed on the partially erupted tooth. Another modern alternative is the isolite system. It is a newer isolation device that controls moisture and retracts cheek, tongue and has a bite block to keep the mouth open.[15]

Step III: Enamel etching

Acid etching transforms the tooth surface from a low energy area to a susceptible surface to adhesion.[16] This creates a morphological porous layer of 5–50 μm by removing about 10μm of enamel.[17] In general, 30–50% orthophosphoric acid is used for acid etching. It is available in two forms - liquid and gel forms[41].[18] Maleic acid and polyacrylic acid can also be used for etching the tooth surface. In addition to that, enamel demineralization can occur after acid etching with phosphoric acid. Saliva contamination can strictly affect the sealant retention and efficacy.[19]

In children, Er: YSGG laser is the most efficient laser used than others such as CO_2 laser, Nd: YAG laser, Er: YAG laser, and Er, Cr: YSGG laser. The laser method is safer for children as it needs no isolation and also avoids the fear of drill in children. Lasers also prevent secondary caries and microleakage to a greater extent.[20] This may also promote stronger resistance to microleakage of self-etching adhesive.[21]

Studies prove that sealant retention and shear bond strength are unaffected with topical fluoride treatment before acid etching.[22-24] There are no established effects of post-etching drying agents on retention, even though they are being manufactured.[25]

Step IV: Rinsing and drying

This step involves rinsing of the tooth surface with water, to wash out the acid etchant and later drying of the same surface. Rinsing should take just 20–30 s. After drying, the enamel surface should appear white, chalky, and frosted. Re-etching for another 15–20 s is recommended if this appearance is not obtained with the initial etching.[26]

The solution should never be mopped up with cotton or any other material. This can lead to any precipitation of the solution leaving out crystalline reaction product. Rapid evacuation of the site during washing helps in patient comfort and prevents stimulation of increased salivary flow. After drying of the conditioned site, saliva should never come in contact with the same as this may cause contamination of the surface. This is because enamel possess higher surface energy at this time and contact with saliva can lead to attachment of proteins to the surface and thereby contamination. Reapplication of acid for 10 s is suggested if such contamination occurs. Delivery of air alone is suggested while using a triple syringe. Warm air can also be provided continuously for 30 s. Use of chip blowers and other drying agents can leave a layer of contaminated film on the treated surface. A better sealant placement would demand good light, suction, and compressed air.[27]

Step V: Sealant application

Resin-based sealants are applied to the enamel which penetrates into dentinal tubules. It is necessary to evaluate the applied sealant before any sort of contamination by saliva contact. Any deficiencies should retreat with more sealant. Physical properties and adhesion of the sealant are governed to a major extent by orientation and diameter of the light probe tip.[28] Polymerization shrinkage is a common threat to sealant application. To reduce this drawback, manufactures of sealants increased their filler content thereby lessening polymerization shrinkage.

Step VI: Follow-Up

Records should be maintained with date, surfaces sealed, and type of material used. It should be checked annually; if some material is lost, it should be replaced. This can be done with the help of regular radiographs. Canary system is a recent advancement in the field of caries detection. This helps in checking sealed surfaces as they can be used for detection of any caries beneath the sealants.[29,30]

RECENT ADVANCES IN SEALANTS

Colored sealants

Colors have been incorporated in sealant during curing phase, for example, Clinpro, which changes from pink to white. Helioseal is another example for colored sealants that change color during polymerization phase, from clear to green when exposed to visible light.

Hydrophilic sealants

Hydrophilic sealants can replace hydrophobic monomers in situations where the latter cause more serious disadvantages. An example is Embrace wet bond TM. This is a type of resin-based pit and fissure sealants that readily penetrates down into the fissures and adapts to surface. Embrace wet bond materials are designed especially for the moist oral environment.[31,32]

Sealants with antimicrobial property

Chlorhexidine and fluoride are newer additions in the modifications of Resin-Based Pit and Fissure Sealants.[33,34] MAE-DB modified resin materials exhibit more long-lasting antibacterial property and an antibiofilm against *Streptococcus mutans*.[35] Addition of silver and zinc oxide nanoparticles have shown a beneficial effect against *S. mutans*. Compared to conventional sealants, silver nanoparticles reduce tooth demineralization and increase remineralization much satisfactorily.[36]

Sodium hypochlorite for enamel Pre-etching

Sodium hypochlorite (5.25%) has been suggested as a deproteinizing agent before acid etching to increase the bond strength.[37]

Pre-etching with surfactant

When surfactants are used in fissures, it penetrates to complete depth within 1 min with lower surface tension and contact angle. Surfactants with lower viscosity can increase wettability and retention of sealants.[38]

Glass carbomer sealant

Glass carbomer cement can be used as an alternative fissure sealant material especially in young children where moisture control is difficult as compared with conventional GIC in terms of solubility and microleakage.[39]

RECENT EVIDENCE-BASED RECOMMENDATIONS

Ahovuo-Saloranta *et al*. (2017)[40] conducted a Cochrane systematic review with the objective to compare the effects of the different pit and fissure sealants on occlusal surfaces of permanent teeth in children and adolescents. The authors concluded that 11–51% reduction in dental caries was evident when compared between resin-based sealant application and no sealant application. Naaman *et al*. (2017)[41] stated that the pit and fissure sealants are a cost-effective means of dental caries prevention in incipient caries lesions.

In a comprehensive review by Cvikl *et al*. (2018) the authors concluded that sealing pit and fissures of both primary and permanent teeth are an effective way of preventing and arresting dental caries.[42] Alirezaei *et al*. (2018)[43] concluded after conducted a systematic review and meta-analysis that there is no difference in dental caries development percentage when GIC is used as sealants as compared to resin-based sealants; however, the retention of the latter is superior that former. Results of systematic review and meta-analysis performed by Bagherian and Shiraz (2018)[44] concludes by stating that Flowable composite has increased retention rates as compared to conventional resin-based sealants.

CONCLUSION

The incidence of caries in primary and permanent molar teeth of children and adolescents are effectively reduced when compared with no use of sealants or application of fluoride varnish. The effectiveness of pit and fissure sealant preventive therapy has been reported to be superior as there are fewer incidences of secondary caries. Scientific evidence shows that fully retained pit and fissure sealants are capable of caries prevention even after 22 years of placement. Prevention of dental caries can be attained by sealing pit and fissure sealants, especially through public oral health-care programs.

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