Review Article

Pit and Fissure Sealant: Comprehensive Review of Literature

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Abstract

Dental caries is a major public health problem that has far-reaching consequences around the world. Caries in pits and fissures accounts for about 90% of caries in permanent posterior teeth and 44% of caries in primary teeth in children and adolescents. Pit and fissure sealants have long been suggested as a method of avoiding pit and fissure caries in permanent molars. They act as a physical barrier between enamel and the oral environment, preventing food debris and plaque from accumulating. Sealants have been introduced to treat active teeth as the popularity of minimal intervention dentistry has grown. This review of literature aims to provide a detailed review of safe and effective use of pit and fissure sealants as a preventive measure for caries.

Keywords: Caries prevention, Pit and Fissure Sealants, Pit and Fissure, Preventive Dentistry.

Introduction

The term pit and fissure sealant is used to describe a material that is introduced into the occlusal pits and fissures of caries-susceptible teeth, thus forming a micromechanically-bonded and protective layer cutting access of caries-producing bacteria from their source of nutrients.[1]

Dental caries remains as one of the most widespread disease of mankind. It is the single most common chronic childhood disease. Caries in children begins shortly after eruption of the deciduous teeth and continue to increase at a remarkable rate in their school age. Deep pits and fissures favor food retention and are difficult to clean by routine brushing. It provides a favorable environment for the oral microorganisms to thrive and convert the carbohydrates to acids, leading to demineralization of the enamel.[2] The most efficient way to prevent pit and fissure caries is by effectively sealing the fissures using resins called pit and fissure sealants.[3]

Pit and fissure sealant acts on the susceptible teeth by micromechanically bonding to the tooth preventing access by cariogenic bacteria to their source of nutrients, thus reducing the risk of caries in those susceptible pits and fissures.[3]

Sealant application is a preventive and conservative approach involving the introduction of sealants into the pits and fissures of caries prone teeth; this sealant then bonds to the tooth micromechanically, providing a physical barrier that keeps bacteria away from their source of nutrients.[4,5] This review of literature aims to provide a detailed review of safe and effective use of pit and fissure sealants as a preventive measure for caries.

History of pit and fissure sealants

Wilson (1895): Placement of dental cement in pits and fissures to prevent caries[6]

Hyatt (1923): Insertion of small restorations in deep pits and fissures before carious lesions had the opportunity to develop: "Prophylactic odontomy".[7]

Bödecker (1929): Deep fissures could be broadened with a large round bur to make the occlusal areas more self-cleansing: "Fissure eradication".[8]

Ast *et al*. (1950): Attempted either to seal or to make the fissures more resistant to caries with the use of topically applied zinc chloride and potassium ferrocyanide and the use of ammoniacal silver nitrate; they have also included the use of copper amalgam packed into the fissures.[9]

Buonocore (1955): Use of acid to etch the enamel surface before the application of acrylic Resin.[10]

ADA (1971): Pit and fissure sealant recognized by ADA.[3]

Simonson (1978): Introduced Preventive resin restoration.[3]

Garcia-Godoy (1986): Involves the use of a glass-ionomer cement as the preventive glass-ionomer restoration Preventive glass ionomer restoration.[3]

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Classification of pit and fissure sealants		
Based on filler content	**Based on the color of the sealants**	**Based on generation**
Filled and unfilled resin systems in regard to the presence or absence of filler particles in the system.	Transparent and opaque	First generation: UV light polymerization Second generation: Self-polymerization Third generation: Visible light polymerization Fourth generation: Additional fluoride release

Rationale of Using Pit and Fissure Sealants

Tooth surfaces with pits and fissures are particularly vulnerable to caries development. Pit and fissure caries account for 90% of all dental caries in permanent molars even though occlusal surfaces represent only 12.5% of the total surfaces of the teeth.[11]

There is a need for special protection for the occlusal surfaces of these teeth. The deep developmental pits and fissures on the occlusal surfaces predispose them to carious lesions. Fluoridated drinking water and topical fluoride application are effective preventive services. The effect of fluoride, however, is preferential for smooth surfaces, with the occlusal surface receiving little protection. Occlusal sealants are organic polymers which mechanically bond to acid-etched enamel. The resin forms an impervious barrier between the occlusal fissures and the oral environment, preventing the impaction of food debris and the ingress of bacteria.[12]

Classification of Pit and Fissure Sealants

First generation

The initiators in the materials that initiate polymerization are polymerized by the activity of UV rays. This sort is not, at this point being used. Nuva-Seal® (LD. Caulk Co.: Milford, DE, USA) was the sealant first introduced to the market and is an example of a resin-based sealant polymerized by an ultraviolet light source.[3]

Second generation

They are known as the auto polymerizing resin-based sealants. Tertiary amine (the activator) is added to one component and mixed with another component. The reaction between these two components produces free radicals that initiate the polymerization of the resin sealant material.[3]

Third generation

This sort involves visible light polymerizing resin-based sealants. Here, the visible light activates the photoinitiator which is available in the material of the sealant. This is very responsive to visible light in the frequency of about 470 nm (blue area).[13]

Fourth generation

Fluoride resin-based sealant is the product resulting from adding fluoride-releasing particles to previous sealants in an attempt to inhibit caries.[14]

Indication of Pit and Fissure Sealants[15-17]

1. Pits and fissures of deciduous teeth in children when the tooth, or the patient, is at an increased risk of experiencing caries.
2. Pits and fissures of permanent teeth in children and adolescents when the tooth, or the patient, is at risk of experiencing caries.
3. Pits and fissures of permanent teeth in adults when the tooth, or the patient, is at risk of experiencing caries.
4. Incipient carious lesions (non-cavitated) of pits and fissures in children, adolescents, and adults.
5. Pit and fissures of primary and permanent teeth should be considered in children and young people with medical, physical, or intellectual disabilities, mostly when systemic health could be jeopardized by dental disease or the need for dental treatment.
6. Lingual pits in incisors.

Contraindication of Pit and Fissure Sealants[18]

1. Pit and fissure sealants are contraindicated on tooth surfaces having frank caries or on surfaces that have well-coalesced pits and fissures.
2. Caries free teeth more than 4 years.
3. Multiple carious lesions.
4. Wide self-cleansing areas.
5. Carious proximal surfaces.

Clinical Steps in Pit and Fissure Sealants Application

Step I – Selection of tooth

Caries detection has been made easier with newer diagnostic advances such as digital radiography and light-based technologies such as fiber-optic transillumination, DIAGNO dent, or light-induced fluorescence (quantitative light-induced fluorescence).[18]

Step II – Isolation of the tooth

Moisture control is the most crucial aspect of the pit and fissure sealant placement, and therefore absolute isolation using a rubber dam is preferred. As a result of inadequate isolation, the enamel porosities formed during etching can be filled by any fluid blocking the resin tags, decreasing the retention of the material. There are cases where absolute isolation is not possible, or it is not practical, like in the case of newly erupted teeth due to the need for local anesthesia to place the clamp. In such cases, a dry field can be achieved by cotton rolls and isolation shields, and clever use of the evacuation tip. The application of glass ionomer may be considered as a temporary measure.[19]

Step III – Preparation for tooth surface

The tooth is cleaned well (10–15 s) with a prophy brush and a mixture of flour of pumice and water. It is important that the pumice mixture contain no oil or fluoride. Furthermore,

because fluoride renders the outer layer of enamel more resistant to demineralization or acid etching, fluoride treatment if indicated should be accomplished after the sealant is placed, not before.

Step IV – Acid etching

The most critical step in sealant application technique is acid conditioning or acid etching procedure. Etching enhances the tooth's receptivity to bonding with the sealant. During this critical step, meticulous maintenance of a dry tooth surface is essential for bonding to be successful.

In general, 30–50% orthophosphoric acid is used for acid etching. It is available in two forms – liquid and gel forms. 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.[20]

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.[21]

Steps of etching[22]

- Most frequently used: 37% orthophosphoric acid (gel).
- Gel applied either directly with special application tips or with a small disposable brush.
- Should be applied to all the susceptible pits and fissures and extend up to cuspal inclines.
- Etch for 15 s for permanent molars, 15–30 s for primary teeth. Teeth with dental fluorosis require additional etching time.
- If glass ionomer cement is being used, etching is not required, and a surface conditioner may be used.

After conditioning, the tooth is rinsed again with water for 10–15 s to remove the acid and its residues. Then, the tooth is dried thoroughly for 10–15 s and examined carefully. The etched surface should not be disturbed with further instrumentation. If conditioning is adequate and the etch is good, the tooth will appear white, opaque, and frosty. If the tooth does not have this appearance, it should be re-etched for another 30 s. Should saliva contact the tooth at any time during etching, the etching procedure should be repeated from the start. If saliva should contact the tooth after etching, rerinse, and dry the tooth and re-etch for 30 s. Reassess the tooth for the desired white, opaque, and frosty appearance. When a good etch has been achieved, the tooth is ready to be sealed.

Step V – Placement of sealants

During sealant application, all the susceptible pits and fissures should be sealed for maximum caries protection. This includes buccal pits of mandibular molars and lingual grooves of maxillary molars. The sealant material can be applied to the tooth in a variety of methods. Many sealant kits have their own dispensers, some preloaded that directly apply the sealant to the tooth surface. Some common problems occur during sealant application. Small bubbles may form in the sealant material. If these are present, they should be teased out with a brush before polymerization. Unfilled sealants have a low viscosity that makes them prone to pooling in the distal pit area of maxillary molars due to patient position and gravity. This can be rectified by applying the sealant judiciously or by removing excess amounts with a brush.[3]

The sealant is next cured with the light source according to the manufacturer's recommendations. In general, this will be at minimum a 20-s cure time for each surface that is being sealed.[19]

Step VI – Checking the polymerized sealant

After complete polymerization, any resin flash and ledges of sealant that extend beyond etched enamel should be removed with a sharp scaler, curette, or carbide finishing bur. An explorer should be used to examine the sealant after it has polymerized. Aggressive attempts to remove the sealant should be used to ensure that the bonding is successful. If the sealant has been placed properly in only the deep pits and fissures, occlusal adjustment will be unnecessary. Still, the occlusion should be examined for high spots and the sealant may be adjusted with round carbide finishing bur.

Step VII – Maintenance at recall

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. The effectiveness of pit and fissure sealants is increased by monitoring and maintaining the intact sealant.[23]

Recent Advances in Pit and Fissure Sealants

Nanocomposites as pit and fissure sealants

Singh *et al.* (2011) conducted a study to evaluate nanocomposites as pit and fissure sealants in child patients. According to the results, the nanocomposite was found to be an excellent dental material for penetration in deep pits and fissures, though it exhibits mild microleakage. Hence, it can be recommended for use in pediatric dental patients, as a pit and fissure sealing agent.[24] Enamel deproteinization and intermediate bonding in the retention of pit and fissure Sealants: Enamel deproteinization along with the use of intermediate bonding layer significantly enhances the retention of pit and fissure sealants in terms of enhanced marginal integrity, decreased marginal discoloration, and preserving the anatomical form as confirmed by the study done by Rishika *et al.*[25]

Moist-tolerant pit fissure and sealants

There has been a significant advancement in resin-based sealants with the development of moisture-tolerant chemistry. Traditional sealants were hydrophobic, where a completely dry field is required. Recently, a new advanced resin-based sealant with the development of moisture control chemistry, that is, a hydrophilic moisture-tolerant resin-based sealant named

Embrace Wet Bond has been developed. A study by Joseph P. O'Donnell in 2008 shows the moisture-tolerant Embrace. Wet bond sealant had a 95% success after 2 years, which is comparable to other sealant studies where teeth that were difficult to isolate were excluded from the study.[26]

Fluoride releasing pit fissure and sealants

Fillers are added to resin sealants which contain fluoride. In a clinical evaluation of 2 years, Helioseal-F is applied in school children at risk of caries. Out of 431 FSs, complete retention was found on 77%, while 22% were partially lost and 1% were completely lost.[27]

Sealants and safety

In a time of increased patient litigiousness and OSHA concern for the safety of employees, it is imperative to discuss safety concern associated with sealant application. Safety concern includes systemic toxicity, eye safety, local hard, and soft-tissue effects.[28]

Conclusion

The incidence of caries in primary and permanent molar teeth of children and adolescents is 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. Sealants are easy to apply, but the application of sealants is an extremely sensitive technique. Hence, only trained staff should be allowed to place the sealants.

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