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# Pit and fissure sealants: Review of literature

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***Abstract*---**Dental caries is a disease caused by a change in the composition and activity of bacterial biofilms exposed to fermentable carbohydrates over time, resulting in a breach in the demineralization–remineralization equilibrium. Preventive methods such as water fluoridation, fluoride toothpaste, fluoride varnishes, and sealants were largely responsible for the general decrease in dental cavities. Pit-and-fissure sealants reduce the risk of carious lesions by efficiently penetrating and sealing anatomical grooves or fissures on molar occlusal surfaces that trap food debris and increase the presence of bacterial biofilm with a dental material. The aim of present review of literature is to discuss the development of sealant materials, rationale for using sealants, recommended clinical procedures and its indications for use.

***Keywords*---**fissure sealants, dental caries, prevention, pit and fissure.

## Introduction

Dental caries is mainly a disease of pits and fissures. Manton and Messer (1995) reported in their study that pit and fissure caries represents a greater proportion of coronal lesions than inter-proximal lesions.[1] This can be explained by the fact that enamel in the area of pits and fissures do not receive the same level of caries protection from fluoride as smooth surface enamel.[2] Over the last few decades, several advancements have been made in caries prevention. Sealants protect the occlusal surfaces, inhibiting bacterial growth and providing a smooth surface that increases the probability that the surface will stay clean. The purpose of a sealant is to provide physical barrier to seal off the pit or fissure, and to prevent the bacteria and their nutrients from collecting within the pits or fissures to create the acid environment necessary for the initiation of dental caries.[3]

Sealing pits and fissures with a resin material in caries-susceptible teeth forms a micromechanically retained, physically protective layer that acts to prevent the demineralization of enamel by blocking the interaction of cariogenic bacteria and their nutrient substrates, thus eliminating the harmful acidic by-products, and this is regarded as a definitive mode of treatment in the prevention of dental caries.[4],[5] The aim of present review of literature is to discuss the development of sealant materials, rationale for using sealants, recommended clinical procedures and its indications for use.

## Anatomy of Fissures

Occlusal fissures are deep invaginations of enamel that can be extremely diverse in shape and have been described as broad or narrow funnels, constricted hourglasses, and multiple invaginations with inverted Y shaped divisions and irregularly shaped. (Figure no. 1)

- **V type:** They are wide at the top and gradually narrowing towards the bottom. They are shallow and wide and tend to be self-cleaning, somewhat caries resistant, and non-invasive technique is recommended.
- **U-type:** They are also shallow and wide, tend to be self-cleaning and somewhat caries-resistant, and non-invasive technique is recommended.
- **I-type:** They are extremely narrow slits. They are deep, narrow, and quite constricted, resembling a bottleneck, caries susceptible, and may require invasive technique.
- **IK- type:** They are seen as a narrow slit associated with a larger shape at the bottom, may require invasive technique, very susceptible to caries.

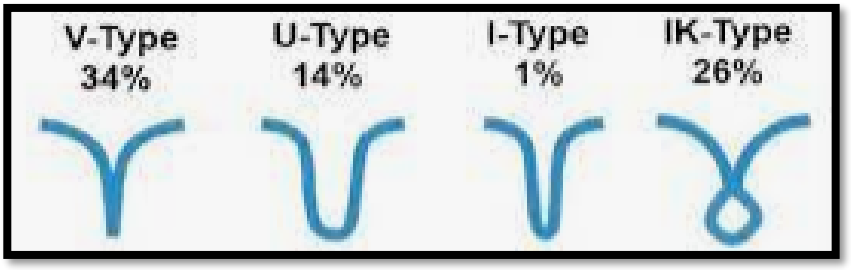


Figure 1. Different Shapes of Fissure

**Historical Evolution of Pit and Fissure Sealants**[7-11]

- **Arthur (1867):** Stated that decay was inevitable and that *obliteration* of the fissures could prevent its occurrence.
- **Wilson (1895):** Placement of dental cement in pits and fissures to prevent caries.
- **Miller (1905):** Application of silver nitrate in pit and fissure.
- **Hyatt (1923):** Insertion of small restorations in deep pits and fissures before carious lesions had the opportunity to develop: "prophylactic odontomy".
- **Bödecker (1929):** Deep fissures could be broadened with a large round bur to make the occlusal areas more self cleansing: "fissure eradication".
- **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.
- **Buonocore (1955):** Use of acid to etch the enamel surface prior to the application of acrylic Resin.
- **Bowen (1965):** BisGMA was developed
- **NuvaSeal (1971):** Introduction of first pit and fissure sealant
- **ADA (1971):** Pit and fissure sealant recognized by ADA.
- **Simonson (1978):** Introduced Preventive resin restoration.
- **Garcia-Godoy (1986):** Involves the use of glass-*ionomer cement* as the *preventive glass-ionomer restoration* preventive glass ionomer restoration.

**Ideal Requirement of Pit and Fissure Sealant (According to Braures)** [7]

- Be capable of forming a strong and prolonged adhesion to tooth surface
- Have sufficient strength to withstand masticatory forces
- Be non toxic
- Adequate working time
- A viscosity allowing penetration into deep and narrow fissure
- Rapid cure
- Cariostatic in nature
- Low sorption and solubility
- Minimum irritation to tissues

**Indications of Pit and Fissure Sealant**[12]

- The occlusal surfaces of permanent teeth having well defined pit and fissures and/or deep fossa. Occasionally, primary molars with significantly deep grooves or pits may be sealed.
- Stained or slightly white pit and fissure, especially in patients with high caries incidence.
- Buccal and lingual grooves when only the appropriate teeth have erupted sufficiently to be free of gingival and operculuctum contact Incisors with lingual pits.

**Age Period for Sealant Placement**

The susceptibility of the tooth to caries should be considered when selecting teeth for sealants and not the age of the individual.[13]

- Ages 3 and 4 years are the most important times for sealing the eligible deciduous teeth.
- Ages 6-7 years for the first permanent molars.
- Ages 11-13 years for the second permanent molars and premolars.

**Contraindication of Pit and Fissure Sealant**[12]

- Synthetic porcelain restorations veneers
- Amalgam restorations
- Gold foil restorations, inlays, onlays, or crown
- Evidence of caries on occlusal or Interproximal surfaces
- Teeth that cannot be sufficiently isolated
- Sealing margins of existing non-resin restorations
- Vital dentin, which is more sensitive than enamel and has a much poorer retention rate
- In children who are too young to cooperate during the procedure.

**Classification of Pit and Fissure Sealants**[14]

| | |
|---|---|
| Based on filler content | Depending on the presence / absence of fillers, sealants are classified into filled and unfilled resin systems. Most of the self-cured resins are unfilled. |
| Based on material | Sealant materials can be divided into two main groups: Resin-Based Sealants and Glass Ionomer Cement Based Sealants |
| Based on the translucency of the sealants | On the basis of translucency sealant materials are also divided as transparent and opaque.<br>A transparent sealant appears as clear, pink, or amber, whereas an opaque sealant is white or tooth coloured. Dental sealants that are white opaque is easier to see while applying and will be easier to identify clinically throughout routine check-ups and follow-ups than those that are clear |
| | • 1st Generation: Polymerization is initiated by initiators that are polymerized by UV light. This kind of sealant |

| | |
|---|---|
| Based on polymerization | is not currently being used. One example of a 1st generation resin-based sealant is Nuva-seal, which was first introduced to the market.<br>• 2nd Generation: Also called chemically cured sealants, these resin-based sealants auto-polymerize. However, the 3rd era of sealants has now supplanted the second era.<br>• 3rd Generation: Using visible light for this type of polymerization involves resin-based sealants. The visible light activates a photo initiator that is present within the sealant. The photo initiator is highly responsive to visible light at around 470nm (purple area)<br>• 4th Generation: Fluoride resin-based sealant is the product resulting from adding fluoride-releasing particles to previous sealants in an attempt to inhibit caries. |

**Clinical technique**[14]

- **Step 1:** To prevent salivary contamination isolation of tooth surface.
- **Step 2:** Preparation of tooth.
- **Step 3:** Etching.
- **Step 4:** Rinse and etch dry.
- **Step 5:** Application of the sealant substance.
- **Step 6:** Examining the surface of a sealed tooth.
- **Step 7:** Examine the sealed surface's occlusion.
- **Step 8:** When needed, reassessment and reapplication of sealant material.

**Recent advances in pit and fissure sealants**

**Nano - Composites as Pit and Fissure Sealants:** Although it displays modest microleakage, nanocomposite has been shown to be an effective dental material for penetration in deep pits and cracks. As a result, it can be suggested for use as a pit and fissure sealant in juvenile dental patients. According to the study carried out by Singh S *et al.* nanocomposite were 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[15]

**Polyacid-Modified Resin Based Sealants:** Polyacid-modified, resin-based composite material, which is also referred to as compomer, has been used as a fissure sealant. It combines the advantageous properties of a visible light polymerized resin-based sealant with the fluoride releasing property of the GI sealant. A polyacid-modified resin-based sealant has a better adhesion property to enamel and dentin and is also less water-soluble, compared to GI sealant material, and less technique-sensitive, compared to resin-based sealants.[16]

**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, i.e., 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.[17]

**Fluoride releasing Pit and Fissure 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% was completely lost.[17]

**Follow-Up and Review**: All sealed surfaces should be regularly monitored clinically and radiographically. Bitewing radiographs should be taken at a frequency consistent with the patient's risk status, especially where there has been doubt as to the caries status of the surface prior to sealant placement. The exact intervals between radiographic reviews will depend not only on risk factors, which may change over time, but also on monitoring of other susceptible sites, e.g., proximal surfaces.[18]

## Conclusion

Carious lesions most commonly occur on the occlusal surfaces. It is impossible to foresee which teeth will become carious but if the surface is sealed with a pit and fissure sealer, no caries will form as long as the sealant is kept in place. Ideally, high-risk patients should have sealants placed on all posterior permanent teeth upon eruption. Proximal caries or self-cleansing pits and fissures are contraindications for dental sealants. The dental practitioner should be familiar with the various categories of sealants and the specific application methods for each product. With proper placement and maintenance, sealants can last years.

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