

Prevention-- 5th class

Pit and fissure sealants

- **Fissure sealant** can be defined as “a material that is introduced into the occlusal pits and fissures of caries susceptible teeth, thus forming a micromechanically or chemically bonded, protective layer cutting access of caries-producing bacteria from their source of nutrients.”
- **Pit-and-fissure sealants** is a material flowed over the occlusal surface of the tooth where it penetrates the deep fissures to fill areas that cannot be cleaned with the toothbrush, the hardened sealant presents a barrier between the tooth and the hostile oral environment.
- **Placement of sealants is a non-invasive technique** (used both as primary and secondary preventive measures against occlusal caries) that maintains tooth integrity through the caries active period and will at least delay the need for an occlusal restoration until proximal lesion develops

Historically

- Several agents have been tried to protect deep fissures on occlusal surfaces: In 1895, Wilson reported the placement of **dental cement** in pits and fissures to prevent caries.
- In 1929, Bodecker suggested that deep fissures could be broadened with a large round bur to make the occlusal areas more self-cleansing, a procedure that is called **enameloplasty**. Two major disadvantages, accompany enameloplasty.

First, it requires a dentist, which immediately limits its use.

Second, in modifying a deep fissure by this method, it is often necessary to remove more sound tooth structure than would be required to insert a small restoration.

- In 1923 and again in 1936, Hyatt advocated the early insertion of small restorations in deep pits and fissures before carious lesions had the opportunity to develop. He termed this procedure **prophylactic odontotomy**. Again, this operation is more of a treatment procedure than a preventive approach, because it requires a dentist for the cutting of tooth structure.

- Several methods have been unsuccessfully used in an attempt either to seal or to make the fissures more resistant to caries. These included 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.

A final course of action to deal with pit-and-fissure caries is one that is often used: **do nothing; wait and watch**. This option avoids the need to cut good tooth

- structure until a definite carious lesion is identified. It also results in many teeth being lost when individuals do not return for periodic exams

- The major event that made resin pit and fissure sealants possible came from the early work of Buonocore (1955) who earned the title of being the “Father of Adhesive Dentistry” by introducing the acid etch and bonding technique for resin-based materials. The purpose of his original research was the development of a sealant to prevent occlusal caries on posterior teeth. In the 1960s, Bowen converted them to an entirely acceptable restorative group by introducing bisGMA and including a variety of fillers for physical reinforcement and control of setting shrinkage. *Bisphenol A-Glycidyl Methacrylate (Bis-GMA) Sealants* is now the sealant of choice.

- In the same time period, Smith recognized the biological benefits of the polyalkenoic acid group and combined these with zinc oxide to develop the polycarboxylate cements, which was the first group of materials to have both self-adhesion and fluoride-releasing capabilities. Wilson and others (1985) modified this through the use of a powdered glass instead of zinc oxide and thus introduced glass-ionomer cements, which exists today as both restorative and preventive materials.

Development of occlusal caries

Caries affecting pit and fissures are the first types of lesions encountered in children. In addition to general risk factors, the following three site-specific risk factors are associated with the development and progression of occlusal caries

1. Morphology of pit and fissure systems
2. Eruption stage
3. Functional use

Criteria for Selecting Teeth for Sealant Placement

Previously routine application of sealant was recommended for all

posterior deep occlusal fissure, fossa or lingual pit present in teeth because it was

believed to be the only realistic way to prevent occlusal decay, but now sealants

should only be applied *to patients and placed in teeth after careful clinical*

judgment of the individual, it needs to be considered in the context of **risk factor**

both for individual patients and for individual teeth

- Thus, teeth in caries-free patient and caries-free occlusal surfaces, which have been fully erupted for more than 3 years, do not need application of sealant.
- While where caries has affected one or more permanent molar teeth, (*and those who have experienced of caries in primary teeth*) the remaining sound fully erupted pits and fissure should be sealed

Therefore the decision to place sealant on sound teeth based on :

- ❖ Oral hygiene of the patient
- ❖ Individual history of dental caries
- ✱ ❖ Dietary habits
- ❖ Patient cooperation and reliability in keeping recall appointments
- ❖ Tooth type and tooth morphology (fissure morphology: V, U, Y, I, IK types).

Because the time from tooth emergence to full occlusion is the most critical period for caries initiation (Eruption stage, Functional use) adequate timing of sealant application is important.

- ✱ The duration of the eruption period is a further risk factor. So 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

If the risk factors outlined above are identified in-patient then it is prudent to seal all susceptible sites on permanent teeth as soon after eruption as is practicable.

Because no harm can occur from sealing, when in doubt seal and monitor A sealant is probably indicated if:

- The fossa (shallow depression) selected for sealant placement is well isolated from another fossa with a restoration.
- The area selected is confined to a fully erupted fossa even though the distal fossa is impossible to seal because of inadequate eruption.
- The selected tooth has an intact occlusal surface when the contralateral tooth surface (surface of tooth in opposite arch) is carious or restored; teeth on opposite sides of the arches usually are equally prone to caries.
- An incipient lesion exists in the pit and fissure area.
- Sealant material can be flowed over a conservative class I composite or amalgam to improve the marginal integrity and into the remaining pits and fissures to prevent further recurrent decay

Concerning the teeth of the adult, the sealant should be placed if there is evidence of existing or impending caries susceptibility as would occur following excessive intake of sugar or as a result of a drug or radiation induced xerostomia.

In all cases it's the disease susceptibility of the tooth should be considered when selecting teeth for sealants, not the age of the individual

A sealant is contraindicated under these circumstances:

- Patient behavior does not permit use of adequate dry field techniques throughout the procedure.
- An open, frank, carious lesion exists on the same tooth.
- Caries exist on other surfaces of the same tooth in which restoration will disrupt an intact sealant.
- A large occlusal restoration is already present

Ideal sealants materials

The desired clinical outcomes from the use of sealants are to prevent the establishment and stop the progression of carious lesions. the technique must provide good retention, a long-term seal and be non-technique sensitive

The requirements of an ideal material include

Biocompatibility low viscosity low solubility esthetically acceptable and visible to facilitate reassessment.

There are two main types of materials that can be used as sealants:

- Unfilled or lightly filled composite resins
- Glass ionomers.

Neither of these can be regarded as ideal so the selection of which material to use will be driven by the requirements of each case

Requisites for Sealant Retention

Placement of pit and fissure sealants is technique sensitive. For sealant retention the surface of the tooth must:

- 1) have a maximum surface area Sealants do not bond directly to the teeth. Instead, they are retained mainly by *adhesive forces*. The surface area is greatly increased by the acid etch, which in turn increases the adhesive potential
- 2) have deep, irregular pits and fissures (Deep, irregular pits and fissures offer a much more favorable surface contour for sealant retention compared with broad, shallow fossae. The deeper fissures protect the resin sealant from the shear forces occurring as a result of masticatory movements. Of parallel importance is the possibility of caries development increasing as the *fissure depth and slope* of the inclined planes increases. ***Thus, as the potential for caries increases, so does the potential for sealant retention.***)
- 3) be clean
- 4) be absolutely dry at the time of sealant placement and uncontaminated with saliva residue.

Sealant Placement Guidelines Step 1: Prepare the Teeth (Surface Cleanliness)

The need and method for cleaning the tooth surface prior to sealant placement are controversial. Usually the acid etching alone is sufficient for surface cleaning, however, it was shown that cleaning teeth with the prophylaxis pastes with or without fluoride did not affect the bond strength of sealants. However all heavy stains, deposits, debris, and plaque should be removed from the occlusal surface before applying the sealant.

Step 2: Isolate the Teeth

Adequate isolation is the most critical aspect of the sealant application process. Salivary contamination of a tooth surface during or after acid etching will have a deleterious effect on the ultimate bond between enamel and resin. A dry field can be maintained in several ways, including use of a rubber dam, employment of

⇒ ***cotton rolls***, and the ***placement of bibulous pads*** over the opening of the parotid duct.

The rubber dam provides an ideal way to maintain dryness for an extended time. Some of the disadvantages of Rubber dam include: discomfort during clamp placement, need for local anesthetic in some instances, difficulty in securely placing a clamp onto a partially erupted tooth, also it is not feasible to apply the dam to the different quadrants of the mouth; instead it is necessary to employ cotton rolls, combined with the use of an effective ***high-volume, low-vacuum aspirator***. Cotton roll holders may be used. If a cotton roll does become *slightly* moist, another short cotton roll can be placed on top of the moist segment and held in place for the duration of the procedure.

In the event that it becomes necessary to replace a wet cotton roll, it is essential that ***no*** saliva contacts the etched tooth surface; if there is *any* doubt, it is necessary to repeat all procedures. This includes a 15-second etch to remove any residual saliva.

Step 3: Dry the Surfaces

⇒ Dry teeth with air for 20–30 seconds, Check to make sure there is no moisture coming out of air syringe tip.

Step 4: Etch the Surfaces (Increasing the Surface Area)

⇒ An etchant of 37% phosphoric acid is applied for 20 seconds on the occlusal surface prior to the placement of the sealant, another 15 seconds of etching is indicated for fluorosed teeth to compensate for the greater acid resistance of the enamel.

One should always apply the etchant onto all the susceptible pits and fissures of the tooth and extend it up the cuspal inclines well beyond (at least 2 millimeters) the anticipated margin of the sealant.

⇒ If any etched areas on the tooth surface are not covered by the sealant or if the sealant is not retained, the normal appearance of the enamel returns to the tooth within 1 hour to a few weeks ***due to a remineralization*** from constituents in the saliva.

The etchant may be either in ***liquid or gel*** form. The former is easier to apply and easier to remove.

- If using a gel: applied with a supplied syringe and left undisturbed for all of time

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- If using a liquid: is placed on the tooth with a small resin sponge or cotton pledget held with cotton pliers. Continue to apply etchant throughout the etchant time. Both are equal in abetting retention

Step 5: Rinsing and Drying the Teeth

⇒ For 10 seconds the water from the triple syringe is flowed over the occlusal surface and hence into the aspirator tip. Then the surface is dried for ***10 seconds***. The air supply needs to be absolutely dry.

⇒ The dried tooth surface should have a white, dull, frosty appearance. If there are areas at or near the opening of the pits and fissures that do not have the frosty look, then etch again



The teeth *must* be dry at the time of sealant placement because sealants are hydrophobic. The presence of saliva on the tooth is even more detrimental than water because its organic components interpose a barrier between the tooth and the sealant.



Whenever the teeth are dried with an air syringe, the air stream should be **checked** to ensure that it is not moisture-laden. A check for moisture can be accomplished by directing the air stream onto a cool mouth mirror; any fogging indicates the presence of moisture. Possibly the omission of this simple step accounts for the inter-operator variability in the retention of fissure sealants. **Step 6: Application**



of Sealant Material

With either the light-cured or autopolymerized sealants, the material should first be placed in the fissures where there is the maximum depth.

At times penetration of the fissure is negated by the **presence of debris, air entrapment, narrow orifices, and excessive viscosity of the sealant**. The sealant should not only fill the fissures but should have some *bulk over the fissure*. After the fissures are adequately covered, the material is then brought to a knife edge approximately *halfway* up the inclined plane. Following polymerization, the sealants should be examined carefully *before* discontinuing the dry field. If any voids are evident, additional sealant can be added *without* the need for any additional etching.



Step 7: Evaluate the Sealant

The finished sealant should be checked for retention without using undue force. In the event that the sealant does not adhere, the placement procedures should be repeated, with only about 15 seconds of etching needed to remove the residual saliva before again flushing, drying, and applying the sealant.

If *two* attempts are unsuccessful, the sealant application should be postponed until remineralization occurs.



The occlusion should be checked visually or, if indicated, with articulating paper. Usually *any minor* discrepancies in occlusion are rapidly removed by normal chewing action. If the premature contact of the occlusal contact is unacceptable, a large *round cutting* bur may be used to rapidly create a broad resin fossa.



- ✓ Resin sealants are retained better on recently erupted teeth than in teeth with a more mature surface
- ✓ They are retained better on first molars than on second molars.
- ✓ They are better retained on mandibular than on maxillary teeth. This latter finding is possibly caused by the lower teeth being **more accessible, direct sight** is also possible; also, **gravity aids the flow of the sealant** into the fissures.

Teeth that have been sealed and then have lost the sealant have had fewer carious lesions. This is possibly due to the presence of tags that are **retained in the enamel** after the bulk of the sealant has been sheared from the tooth surface.

Step 8: Re-evaluation

Because the most rapid fall off of sealants occurs in the early stages(*probably caused by faulty technique in placement*), an initial 3-month recall following placement should be routine for determining if sealants have been lost *then* evaluated on a six months basis as sealant losses probably being due to abnormal *masticatory stresses*. After a year or so, the sealants become very difficult to see or to discern tactilely, especially if they are abraded to the point that they fill only the fissures.

Fluoride-Releasing Sealants

Use of a fluoridated resin-based sealant was thought to possibly provide an additional anticariogenic effect. *Fluoride is added to sealants by two methods.* **The first** method involves adding a soluble fluoride to the unpolymerized resin. **The second** method involves adding an organic fluoride compound that will bind chemically to the resin to form an ion exchange resin. Fluoride-releasing sealants have shown antibacterial properties as well as greater artificial caries resistance compared with a nonfluoridated sealant.

Glass ionomer sealants

The main advantage of the glass-ionomer cement is

- ↗ Its ability to chemically adhere to the tooth surface with minimal preparation as the acid used is, Polyacrylic acid .This diluted version does not etch the enamel but rather prepares it by increasing surface energy to improve wetting of the glass-ionomer sealant and improve adhesion.
- ↗ Anti-caries effect that can be attributed to both long-term fluoride release and recharge
- ↗ Is a water-based material and is more technique tolerant so should be considered when:

- Four-handed dentistry is not available
- Lack of patient's full co-operation
- There is bleeding or gingival fluid seepage
- Moisture control is compromised

Glass ionomer is best suited for protecting erupting teeth when it is inserted under the operculum.

Colored Versus Clear Sealants

Both clear and colored sealants are available. They vary from *translucent* to *white, yellow, and pink*. The selection of a colored versus a clear sealant is a matter of individual preference. The colored products permit a more precise placement of the sealant, with the visual assurance that the periphery extends halfway up the inclined planes. Retention can be more accurately monitored by both the patient and the operator placing the sealant.

On the other hand, a clear sealant may be considered more esthetically acceptable. On the other hand, some clinicians seem to prefer the clear sealants because it is possible to see under the sealant if a carious lesion is active or advancing.

Light-Cured Versus Self-Cured Sealants

type	advantage	disadvantage
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self-cure sealant	Simple to use Less expensive—does not require additional equipment	1-Once mixing has started, the operator must continue mixing and immediately place the sealant, or stop and make a new mix if a problem should occur. 2. The catalyst and base must be mixed prior to placement, increasing the chance of incorporating air bubbles into final product
light- cure sealant	Operator has control over the initiation of polymerization 2. Supplied as single liquid so no mixing	1-Requires extra-piece of equipment that can break down. 2. High cost of curing light and shorter shelf-life of material.