

Preventive Dentistry
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Lec. 11: Pits and Fissure Sealants

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Sealants are systems that can be applied to the occlusal surfaces of teeth to penetrate anatomic surface pits and fissures and form a physical barrier on the tooth surface. It is a **non- invasive technique** applied to deep pits and fissures act as ***mechanical barriers*** between enamel surface and the biofilm (; dental plaque). **Simonsen in 1978** defined it as (a material that is introduced into the occlusal pits and fissures of caries susceptible teeth, thus forming a micro-mechanically bonded, protective layer cutting access of caries-producing bacteria from their source of nutrients).

Rationales for sealants use:

- 1- Dental pits and fissures are susceptible sites for plaque accumulation thus dental caries in children and adolescents.
- 2- Occlusal surface is least protected by systemic fluoride compared to smooth surface.

Development of occlusal caries and related factors: The first type of caries lesion affecting children are mostly in pit and fissures. **Three site-specific risk factors** are associated with the development and progression of occlusal caries:

- 1- Morphology:** initiation and development of caries are strongly correlated to morphology of teeth. Pits and fissures are retentive area for plaque accumulation; predisposing factor for dental caries. The pit and fissure system of the occlusal surface is composed of shallow fissures with occasional deep pits. The high risk for caries is associated in particular with those pits that have narrow openings and a bulbous widening at the base, which is close to the dentino-enamel junction (DEJ) and provides a very short route for a lesions to penetrate into dentine
- 2- Eruption stage:** The duration of period of eruption is a risk to dental caries, teeth with longer eruption time tend to have more occlusal caries.

Molars affected by caries in occlusal surface **more** than **premolar** because of longer eruption time (12 – 18 months for molars and few months for premolar.)

3- Functional use of occlusal surfaces: dental plaque accumulates on occlusal surface of erupting teeth **much more** than a fully erupted tooth, increasing the susceptibility of teeth to caries.

Adequate timing of sealant application is important because the time from tooth emergence in the oral cavity till reaching full occlusion is the most **critical period for caries initiation**. For any patient having one of the above risk factor it is essential to seal all susceptible site for permanent teeth.

Purpose of Sealants: The cariostatic properties of sealants are attributed to;

- 1- The physical obstruction of the pits and fissure grooves (i.e. *physical barrier to seal off dental pits and fissures*).
- 2- Prevents the penetration of fermentable carbohydrates, thus bacteria cannot produce acid in cariogenic concentration (*prevent bacteria and their nutrients from providing environment necessary for initiating caries*).

History:

- In 1895, Wilson suggested the placement of cement in deep pits and fissure to protect teeth and prevent caries.
- In 1929, **Bodecker** advice to broaden fissure by large round bur in order to be easily cleaned; a procedure known as (enameloplasty). However, in this method there will be a loss of sound tooth structure.
- A similar procedure was suggested by **Hyatt** in 1936, but with placement a restoration be for deep pits and fissure before they become affected by caries. A procedure called (prophylactic odontotomy). However, this also require cutting a sound tooth structur.
- In the early 1970's the use of fissure sealants was introduced by a placement of a flowable liquid plastic material over the occlusal surfaces to prevent accumulation of dental plaque. Different types of material were used to seal pits and fissures as ammonia silver nitrate, zinc chloride, copper amalgam. Then different plastic material were applied as (polyurrrthanes, cyanoacrylates).

- Another product was introduced in the late 1955 by **Buonocore**, a resin material adhere to tooth surface following acid etching.
- In 1965, **Bowen** and associated introduced the Bis- GMA(; **Bisphenol A- glycidyl- methyl-acrylate**). 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.
- In 1972, the first commercial sealant was Nuva – seal.

Years	Authors ⁽²⁻⁷⁾	Contribution
1895	Wilson	Placement of zinc phosphate cement in pits and fissures
1923	Hyatt	Prophylactic odontomy
1942	Kline and Knutson	Treatment with ammoniacal silver nitrate
1955	Buonocore	Sealing of pits and fissure with bonded resin material
1971		Pit and fissure sealant recognized by ADA
1978	Simonson	Preventive resin restoration
1986	Garcia-Godoy	Preventive glass ionomer restoration

ADA: American dental association

Types of sealants: There are two main types of materials that can be used as sealants: *unfilled* or *lightly filled* **composite resins** and **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.

Ideal Sealants Materials: the use of sealants are to prevent the establishment and stop the progression of carious lesions. In order to prevent caries on any surface, the technique must provide good retention, a long-term seal and be non-technique sensitive so that it can be applied by both dentists and dental auxiliaries such as hygienists and therapists. The requirements of an ideal material include **biocompatibility, low viscosity, low solubility, esthetically acceptable, and reasonably visible to facilitate reassessment**.

Classification of sealants are according to: filler contents, color and/or generation:

1- Based on filler content: Sealants are classified into **filled** and **unfilled** resin systems in regard to the presence or absence of filler particles in the system. The filled sealants contain microscopic (glass beads, quartz particles), and other fillers used in (composites resins). The fillers make the resin more resistant to abrasion and wear. In contrast, unfilled sealants wear quicker.

2- Based on the color of the sealants: Sealants are rather **clear or colored**. The clear type is esthetic but difficult to detect if any loss by time. Further, it is possible to see under the sealant if there is any active caries lesion ever present. While the colored sealants (tinted and opaque fissure sealants) are easily visible and chair side time is saved at follow-up. Furthermore, parents are reassured when they can see the sealants on their child's teeth. As the sealant is clearly visible to the child, it is of benefit to encourage the child to look periodically for any sealant loss.

3- Based on generation: Depends on type of chemical reaction of sealants or **curing method**

Frist generation: The first sealant material that utilized the acid etch technique and activated with an ultraviolet light source at a wavelength of 365 nm (photo cured via ultraviolet).

Second generation: Sealants are auto polymerizing and set upon mixing with a chemical catalyst - accelerator system. They are generally "self-cured" or "chemically cured" without the need of an external ultraviolet source as BIS-GMA dimethacrylates or urethane dimethacrylates based products.

Third generation sealants: Visible light activated sealants (photo cured by visible light).

Fourth generation sealants: fluoride releasing sealants as Helioseal-F. It was believed that fluoride added to sealants can provide additional anticariogenic effect. Thus fluoride was added to sealants either by adding soluble fluoride to the un-polymerized resin or adding organic fluoride compound that bind chemically to the resin to form an ion exchange resin.

Fifth generation: **glass ionomer cement** (GIC) as pit and fissure sealants, and sealants with bonding agents. The main advantages of the glass-ionomer

cement are ion exchange adhesion to tooth structure, fluoride release, and technique tolerance:

- 1- Ion exchange adhesion: GIC is chemically adhere to the tooth surface with minimal preparation. Polyacrylic acid is needed before application of this material. This diluted acid **does not** etch the enamel but rather prepares it by **increasing surface energy** to improve wetting of the glass-ionomer sealant and improve adhesion.
- 2- Fluoride release: This type of sealant, following external application of fluoride agents allow for a long term fluoride release and recharge. Thus provide an additional anti-cariogenic effect.
- 3- Technique tolerance: Glass ionomer 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, light curing is not available. Glass ionomer is best suited for protecting erupting teeth when it is inserted under the operculum.

NOTE: When a resin sealant is used, moisture control is of utmost importance. The tooth must be fully erupted with the distal operculum below the distal marginal ridge.

Sixth generation: Self- etch light cure fissure sealants.

Indication of use:

Sealants are applied following clinical judgment of the individual. Following good evaluation of risk factors concerning (individual patients) and (individual tooth). In another word, sealants are not recommended for any individual and for any occlusal deep fissures of posterior teeth, or any fossa or lingual pits.

The general recommendation of using fissure sealants in dental practices depend on;

1- Case selection (; patient selection):

Points to be evaluated are related to patients oral hygiene, dietary habits, behaviors and the history of dental caries. Patients selection for sealants placement can be at any age; provided that there is an indicated tooth for fissure sealants.

The selected patient should be:

- Dependable on recall appointments.
- Patient behavior permits the use of adequate dry field.
- Children with medium and high risk to dental caries in their primary dentition. Thus sealants are applied to their permanent teeth.
- Medically compromised patient or with special need.
- Adult with an increase susceptibility dental caries. As cases of xerostomia, intake of medications enhancing dental caries, following radiotherapy.

2- Tooth selection:

- A presence of deep irregular fissures, fossa or pits. Fossa indicated may well be isolated from another fossa present with a restoration in the same tooth.
- The tooth fossa indicated need to be fully erupted even if the adjacent fossa in the same tooth is not fully erupted.
- An intact occlusal surface where the contralateral surface (tooth in the opposite arch) is carious or restored.
- Sealant can be applied to:
 - a- Intact/ caries free tooth surface.
 - b- An incipient lesion exists in the pit and fissure area. This is known as ***an invasive technique***.
 - c- Sealant can be flowed over a restorative material (; amalgam or composite) to improve marginal integrity and preventing recurrent caries.

Sealants are NOT Indicated when:

- Un cooperative patient, when his behavior does not permit having a dry field to place sealants.

- An open frank carious lesion present in the same tooth near the intact fissure or fossa.
- A large dental restoration is already present.

Appendix

- Pit and fissure sealant has been used both as primary and secondary preventive measures against occlusal caries.
- Pit and fissure sealant is now recognized as one of the most effective methods for preventing occlusal caries in children.
- Some suggest that in presence of susceptible area of permanent teeth it is better to (seal and monitor) than (waite for caries to occur). As no harm can occur because of sealing.
- 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.
- Wilson and others (1985) introduced glass-ionomer cements, which exists today as both restorative and preventive materials.
- Different types of occlusal fissure are present: as V shape, or I shape in addition to U, Y and K type.
- Light cure versus self- cured sealants:
 - 1- The light cure sealants are simple to use, less expensive and does not require additional equipment's. The disadvantage of this material however, Once mixing is started it should be continued, and materials should be placed immediately. If any problem should occur a new mix is required. In addition,

the chances for air bubbles formation is increased as the base and catalysts are mixed prior to placement.

- 2- The light cure sealants; provide the control of the operator for the initiation of polymerization, and it requires no mixing as supplies by a single liquid. It is high cost and required an extra- piece of equipment that can break down.