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Chapter 1

Fissure Sealing in Occlusal Caries Prevention

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Additional information is available at the end of the chapter

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1. Introduction

In the modern world there is still a problem of dental caries. Dental caries is still the most common chronic childhood disease and the primary cause of tooth loss. Over the past 30 years, significant progress has been made in the prevention of dental caries in children and adolescents. While caries has decreased on interproximal surfaces, occlusal pit and fissure caries have increased [1, 2]. In general, research has demonstrated that caries on occlusal and buccal/lingual surfaces account for almost 90% of caries experienced in children and adolescents [3]. The caries process in the first and second molars usually starts soon after eruption. The occlusal surfaces of lateral teeth, especially molars have complicated morphology with many grooves (fissures) and pits on the occlusal surface and on the buccal and palatal surfaces (Figure 1). These molar teeth are considered the most susceptible teeth to dental caries due to the anatomy of the chewing surfaces of these teeth, which unfortunately inhibits protection from saliva and fluoride and instead favours plaque accumulation [4]. Pits and fissures don't cause caries process. They permit the entrance of microorganisms and food into this sheltered warm moist richly provided incubator and the dental plaque can be expected to form here. They instead provide a sanctuary to those agents, which cause caries. When carbohydrates in food come in contact with the plaque, acidogenic bacteria in the plaque create acid. This acid damages the enamel walls of the pits and fissures and caries results. Therefore, the most decay is concentrated on the occlusal surfaces of posterior molars.

Pits and fissures have variations in their appearance in cross section. They were described based on the alphabetical description of shape. According to Nango (1960) there were 4 types of pits and fissures: V&U type: self cleansing and somewhat caries resistant; U type: narrow slit like opening with a larger base-susceptible to caries and a number of different ranches K type: also very susceptible to caries [5]. These are the sites most susceptible to developing decay [6].

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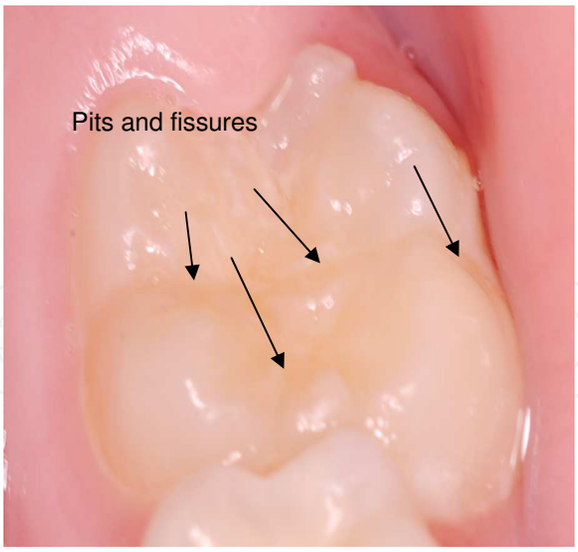


Figure 1. Occlusal morphology of molar teeth

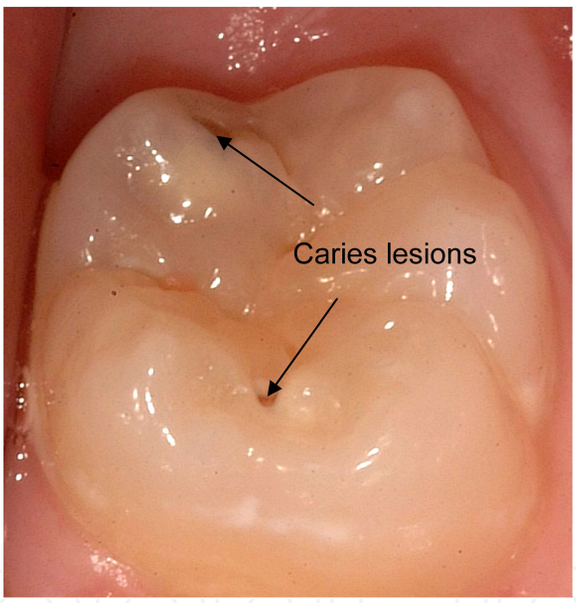


Figure 2. Caries lesions on the occlusal surface of molar tooth

In most cases the shape of the pit or fissure is such that it is impossible to clean, explaining the high susceptibility of pits and fissures to dental caries (Figure 2 and 3). Caries in the pits and fissures follows the direction of enamel rods and characteristically forms a triangular or cone shaped lesion with its apex at the outer surface and its base towards DEJ. Pits and fissures provide greater cavitations than smooth surface caries. Preventive measures for tooth decay include daily tooth brushing, topical fluoride application, chewing gums with xylitol and sealing of fissures which are applied by dental clinicians [7-10].

There have been many efforts made within past decades to prevent the development of caries, in particular occlusal caries as it was once generally accepted that pits and fissures of teeth

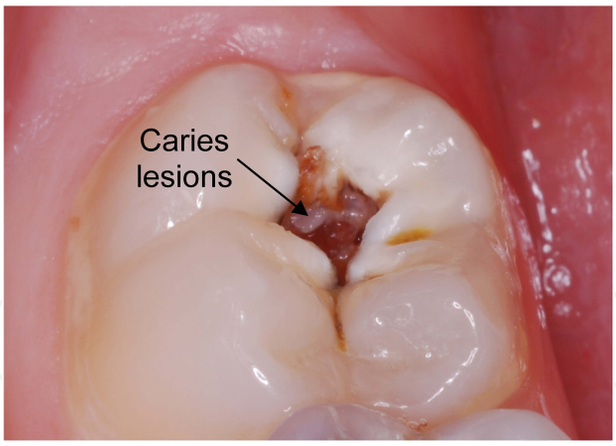


Figure 3. Caries lesion in the fissure of molar tooth

would become infected with bacteria within 10 years of erupting into the mouth [7-10]. G.V. Black, the creator of modern dentistry, informed that more than 40% of caries incidences in permanent teeth occurred in pits and fissures due to being able to retain food and plaque [9].There were many attempts to prevent occlusal caries. Willoughby D. Miller, a pioneer of dentistry, was applying silver nitrate with its antibacterial functions to surfaces of teeth to prevent occlusal caries in early 1905. It was chemically treating the biofilm against both Streptococcus mutans and Actinomyces naeslundii, which are both carious pathogens [7-9, 11]. Silver nitrate, which was also being practiced by H. Klein and J.W. Knutson in the 1940s, was being used in attempt to prevent and arrest occlusal caries [9,12].

In 1955, M.G. Buonocore gave insight to the benefits of etching enamel with phosphoric acid. [7-9] His studies demonstrated that resin could be bonded to enamel through acid etching, increasing adhesion whilst also creating an improved marginal integrity of resin restorative material [7,9]. Later, this bonding system leads to the future successful creation of fissure sealants [8-13].

By the late 1970s and early 1980s the clinical data on sealants and caries prevention was very positive. Studies have continued to demonstrate sealant success. One 4-year study showed an overall 43% decrease in the prevalence of caries effectiveness with significantly better sealant retention on premolars (84%) than molars (30%) [5]. A 7-year study reported 66% complete sealant retention and 14% partial retention [9]. Sealant loss was 20% while there was a 55% reduction in caries rate for the sealed teeth versus the unsealed teeth. One 10-year study showed that for over 8,000 sealants placed on permanent first molars, there was 41% complete sealant retention at 10 years and a 58%–63% retention rate over 7 to 9 years [10].

2. Sealants materials

Pit and fissure sealants proved to be an effective clinical intervention to prevent occlusal caries [13-15]. The aim of fissure sealants is to prevent or arrest the development of dental caries [15].

Preventing tooth decay from the pits and fissures of the teeth is achieved by the fissure sealants blocking these surfaces and therefore stopping food and bacteria from getting stuck in these grooves and fissures [15]. Fissure sealants also provide a smooth surface that is easily accessible for both our natural protective factor, saliva and the toothbrush bristles when cleaning our teeth. Fissure sealing prevents the growth of bacteria in fissures that cause tooth decay. There are several types of materials for fissure sealing.



Figure 4. Fissure sealed with resin based sealant material

Caries in pits and fissures has responded less to routine preventive methods than caries on smooth surfaces. Pit and fissure sealant use is an effective clinical regime available for preventing occlusal caries. The most widely used pit and fissure sealants are based on bis-glycidyl methacrylate (Bis-GMA) resins. These resins were introduced in 1963 as restorative materials. The main types in use are resin-based sealants and glass ionomer cements [16, 17]. Cueto and Buonocore suggested the sealing of pits and fissures with an adhesive resin in 1967 [18,19]. E.I. Cueto created the first sealant material, which was methyl cyanoacrylate [7, 11,19]. However, this material was susceptible to bacterial breakdown over time, therefore was not an acceptable sealing material [18]. Bunonocore made further advances in 1970 by developing bisphenol-a glycidyl dimethacrylate, which is a viscous resin commonly known as BIS-GMA [13]. This material was used as the basis for many resin-based sealant/composite material developments in dentistry, as it is resistant to bacterial breakdown and forms a steady bond with etched enamel [13,19, 30].

A second group of materials used as fissure sealants are the glass ionomer cements (Figure 5). Glass ionomer cement is also the material of choice for fissure sealing. In 1974, glass ionomer cement fissure sealants (GIC) were introduced by J.W. McLean and A.D. Wilson [15,38]. GIC materials bond both to enamel and dentine after being cleaned with polyacrylic acid conditioner [15]. Some other advantages GIC's have is that they contain fluoride and are less moisture sensitive, with suggestions being made that despite having poor retention, they may prevent occlusal caries even after the sealant has fallen out due to their ability to release fluoride[7,13,14-16].

It has certain advantages over composite resins: less susceptible to moisture, easy handling and long-term release of fluoride ions [20,21]. These are all essential characteristics for materials handled in paediatric dentistry. However, various studies have shown a significantly lower level of retention compared with composite resins [22-25]. Mechanical properties of glass ionomer are significantly weaker than composite resin. Question about preventive effect of glass ionomer still gets controversial answers: Different studies have shown different preventive effects [22, 24, 21,26, 27].

Glass ionomer materials release fluoride over time and have the advantage of being less sensitive to moisture contamination than resin-based materials, making them a potential alternative to resin-based sealants when moisture control is an issue [28,29]. Hybrid materials which incorporate features of both resin and glass ionomer, e.g. polyacid-modified resins (compomers) and resin-modified glass ionomers, have also been developed and used as pit and fissure sealants [30].

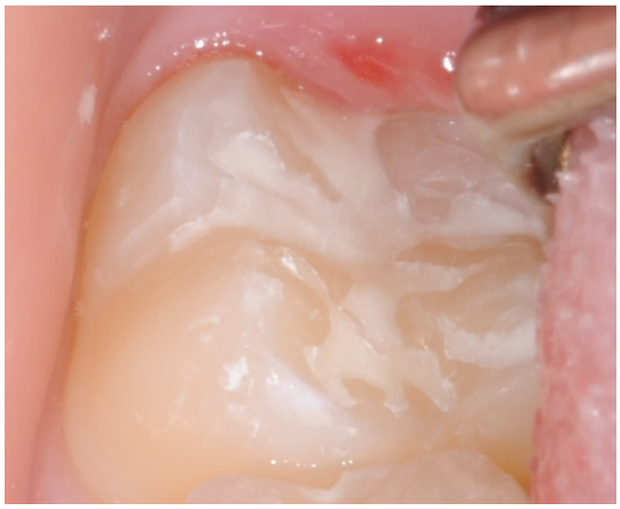


Figure 5. Fissure sealed with glass ionomer sealant material

3. Properties of fissure sealing materials

Resin-based fissure sealants are effective at preventing caries on pit and fissure surfaces in children and adolescents. A Cochrane systematic review of 16 trials found that first permanent molar teeth sealed with resin-based sealant had 78% less caries on occlusal surfaces after 2 years and 60% less after 4–4.5 years compared to unsealed molars [31]. Sealant retention is critical to the effectiveness of resin-based sealants and retention has become an important measure of sealant effectiveness. The Cochrane systematic review reported complete sealant retention rates and it ranged from 79% to 92% at 12 months, 71% to 85% at 24 months, 61% to 80% at 36 months, 52% at 48 months, 72% at 54 months and 39% at 9 years [31]. There was evidence of a clear trend for decreasing sealant retention with time. Some other systematic review on sealant effectiveness reported that the caries-preventive effect of sealants was

influenced by sealant replacement, with relatively high reductions in caries risk found in those studies in which a sealant replacement strategy had been used [32].

To achieve effective caries prevention on occlusal surfaces, dental sealants should have several properties. Adhesion of material should be perfect during all kind of function and thermal challenges. Dimensional changes of material during setting should be minimal. Complete retention of sealant material in the occlusal fissures depends on the dimensional changes and resistance to wear and fracture. Good preventive effect today means substantial release of fluoride ions.

Glass ionomer cements (GICs) are also proposed for pit and fissure sealant materials. They have several advantages compared to classic resin sealant materials: easy handling, fluoride releasing at a continuous rate and they are not moisture sensitive.

For the best caries preventive effect in the fissures of lateral teeth, material for sealing should have the following properties:

1. Ideal adhesion of material should be maintained during setting and function, including the challenges of both thermal and mechanical cycling.
2. Complete retention of the sealant material in the occlusal fissures
3. Resistance to wear and fracture
4. Ease to handling and placement
5. Caries preventive effects
6. Biocompatibility.

Inclusion of fluoride ions in the material may be beneficial on the prevention of developing carious lesions, and the remineralization of any demineralized enamel adjacent to the sealant [33-37].

Some studies introduced additional treatment to improve mechanical properties of glass ionomer materials. So a few years ago a method of heating the glass ionomer was introduced. Material was heated with 60-70oC metal plates in order to improve the mechanical properties of materials [39]. Sidhu and colleagues have linked the contraction of the material and the loss of water from glass ionomer cement as a reason to improve the properties of materials[40]. Some studies have shown enhanced adhesion of glass ionomer for hard tissues [95].

Another study tried to increase the level of retention of glass ionomer sealants with heating during setting time of materials [41]. The results obtained for the resin sealing group as a control group in this study are consistent with previously published studies and their results [41-44]. Glass ionomer (Fuji VII) on the basis of the results obtained by monitoring of patient showed a relatively low percentage of retention after 12 months. The results did not differ when compared with the results obtained for the retention of classical (chemical) treated glass ionomer cement [45-50].

4. Caries preventive effect

There is good evidence that teeth sealed very early after eruption require more frequent reapplication of the FS than teeth sealed later [51,52]. Therefore, FS placement may be delayed until the teeth are fully erupted, unless high caries activity is present. Placement of FS even in the absence of regular follow-up is beneficial [53, 54].

Caries prevalence is relatively low in high-income and relatively high in low-and middle-income countries. Children from high-income countries have benefited from the available established caries preventive measures; such as the use of fluoride-containing products and awareness among their parents and caretakers of the importance of keeping tooth surfaces free from plaque [55].

The studies show that sealants work if applied correctly. Sealant success is multifactorial [56, 57]. Technique, fissure morphology, and the characteristics of the sealant contribute to clinical success [58]. When one reviews published sealant data, a basic concept of 5%–10% of sealant loss per year has been seen demonstrated [31, 32]. This data reveal the importance of re-evaluating teeth with sealants on a periodic basis and to reapply if necessary.

Discussion about caries preventive effect of glass ionomer sealants is still controversial: different studies have shown different preventive effects. It was reported that some material remnants in the fissures can maintain caries prevention. The treatment of glass ionomer material with thermo-curing was recently introduced and showed increase of the mechanical properties. Gorseta et al. showed increased bond strength of glass ionomers to hard dental tissues after thermo-curing during material setting [58]. Skrinjaric et al. investigated the retention rate of glass ionomer sealant material thermo-cured during setting time after 1-year clinical trial [41]. Some authors have pointed to the fact that the remains of SIC in the fissures may have some preventive effect in the development of caries [59, 60]. Skrinjaric et al. did not determine SIC remains in fissures. Increased cariostatic effect can be achieved by regular reapplication, but it increases the cost of such preventing procedure [61-64]. The Database Cochane Review could not find a conclusion on a comparison of glass ionomer sealants and resin sealants [63]. Therefore, it is an area that needs further investigation in order to obtain relevant conclusions.

Primary objective of the most studies is to evaluate the effectiveness of pit and fissure sealants in children and adolescents. It is very important that a different background level of caries in the population is related to obtained results. The diagnosis of the surface to be sealed was based on clinical examination in nine studies, one further study used also a DIAGNOdent device [65-68].

Studies which compare the retention of two or more nearly similar type of sealant materials and report the caries rates only on the sealed occlusal surfaces are not relevant. It is important to report on individual level. Information on the caries risk in the study population, the use of fluoridated water, toothpaste and general preventive methods as well as other preventive interventions should be reported in order to facilitate multivariate analysis of risk factors [69].

Comparing glass ionomers to resin sealants, where less than 10% of tooth surfaces had a small dentine caries lesion and most tooth surfaces were reported to be sound. Caries diagnosis of occlusal surfaces can be challenging. In general, using conventional visual, tactile and radiographic methods in occlusal caries lesion diagnosis, it is not accurate enough to identify whether a lesion extends into the dentine or not [70].

New technologies such as DIAGNOdent laser fluorescence devices may be more sensitive in detecting occlusal dentinal caries [71, 72]. However, the likelihood of false-positive diagnoses may increase when using laser-fluorescence compared with visual methods [71]. Regardless of the caries diagnostic method used, the condition of an occlusal surface to be sealed remains, however, in any case somewhat unclear.

5. Indications and contraindications

Post eruption period of the tooth is most caries susceptible. According to EAPD guidelines, fissure sealant should be placed as soon as possible if there is an indication for placement. However, teeth can be sealed at any age depending on assessment of caries risk factors. [15].

Indications for the use of dental sealants are individual and it depends on patients or teeth that are at high risk of dental caries.

This includes patients with:

- Patients with high risk of dental caries
- Poor oral hygiene
- Deep pits and fissures
- Enamel defects or hypomineralisation or hypoplasia
- Initial lesion of dental caries
- Orthodontics appliances.[73]

Contraindications for the use of dental sealants are individual patients or teeth that are at a low risk of dental caries:

This includes patients with:

- Teeth with shallow, self-cleansing fissures
- Adequate oral hygiene
- A balanced diet with low carbohydrates intake
- Partially erupted teeth without adequate moisture control (operators may choose to use GIC in these cases)
- Teeth with previously restored pits and fissures.[73]

6. Clinical procedure for fissure sealing

It includes:

1. **Tooth selection** (Figure 6) and cleaning the occlusal surface (Figure 7).

Visual dental examination is the starting point for dental assessment and treatment planning. The assessment of occlusal surfaces is particularly challenging, due to their complex morphology. The basic prerequisites for visual caries detection are clean, dry teeth and good illumination [72, 74, 75].

The difficulty in detecting and correctly assessing occlusal caries by visual examination alone has led to the development of various caries detection methods to refine the diagnostic process, and to enhance the identification of early caries lesions [68, 71, 73]. These methods include dental radiography, light-based technologies e.g. fibre-optic transillumination, quantitative laser fluorescence (DIAGNOdent) or light induced fluorescence (QLF). Given the importance of the visual examination, a system for detailed visual examination of teeth – the International Caries Detection and Assessment System (ICDAS) – has been developed, which promotes the recording of the earliest changes in enamel as well as dentinal caries [76].



Figure 6. Tooth selected for sealing

There are different approaches for surface cleaning and the way of cleaning pits and fissures before sealing. It may seem to be controversial. Raadal et al. suggested careful removal of pellicle and plaque with pumice in order to achieve optimal acid-etch pattern of the enamel [77]. On the other hand, Harris and Garcia-Godoy keep that the enamel acid etching alone is sufficient for surface cleaning and provided soft plaque removal [78]. The literature is extensive on the effectiveness of different methods for cleaning prior to bonding [15]. Air abrasion also has been suggested for preparation of the occlusal surface before sealant application [79]. In this case a high-speed stream of purified aluminium oxide particles propelled by air pressure is used to clean the tooth surface. They can remove debris and excavate incipient decay in the fissures. A widening of the fissures with rotary instrumentation in order to remove superficial enamel and open the fissure to have the resin penetrate into it has been recommended before



Figure 7. Cleaning the occlusal surface

etching and sealant application by Waggoner and Siegal. This is known as the invasive pit- and fissure technique [80, 81]. However, although cleaning the fissures with a bur has given superior retention in some studies [82, 83]. There is evidence in other studies that it provides no additional benefit [84]. Furthermore, purpose full removal of enamel or enameloplasty just to widen the base of a fissure in a sound occlusal surface is an invasive technique, which disturbs the equilibrium of the fissure system and exposes a child unnecessarily to the use of a handpiece or air abrasion. It is concluded, therefore, that there is a need for removal of most organic substance in order to obtain sufficient bonding, but that the removal of sound tooth tissue by the use of instruments, such as a bur, is unnecessary and undesirable. There is a significant volume of evidence of high fissure sealants retention without the use of a bur. Hydrogen peroxide (3%) also has been suggested for cleaning the occlusal fissures before etching, but there is no evidence that this improves clinical retention [85].

2. Moisture control

Adequate isolation is the most critical aspect of the sealant application process [78]. Achieving good moisture control is one of the greatest challenges to successful sealant application. Salivary contamination of a tooth surface during or after acid etching will have a key effect on the bond quality between enamel and resin. Salivary contamination, also allows the precipitation of glycoprotein onto the enamel surface greatly decreasing bond strength. If the enamel porosity created by the etching procedure is filled by any kind of liquid, the formation of resin tags in the enamel is blocked or reduced [86, 87]. The circumstances that affect the control of moisture will vary from patient to patient, and may relate to the state of eruption of the tooth, the patient's ability to co-operate, the materials and equipment available for isolation, or a combination of these factors. The options considered by the Guideline Group for 'interim' treatment of teeth for which a sealant was indicated but for which adequate isolation could not be achieved were: resin-based sealant, fluoride varnish and glass ionomer sealant [15].

The rubber dam, when properly placed, provides the best, the safest way of moisture control, and for an operator working alone, it ensures properly isolation from start to finish. In young and partially erupted teeth this is usually not practical. There is evidence of difficulty in

securely placing a clamp onto a partially erupted tooth, discomfort during clamp placement and it demands the use of local analgesia in some instances [7, 15]. On the other hand, there is sufficient evidence that careful isolation with cotton rolls gives similar retention results [83]. Cotton roll isolation offers some advantages over rubber dam isolation. No anaesthetic is necessary because no clamps are placed. Cotton rolls can be held in place with either cotton roll holders or fingers. The primary disadvantage to cotton roll isolation is that it is almost a practical necessity that an assistant be used to provide four-handed dentistry [88-90]. The maintenance of a dry field must therefore usually be achieved by the use of cotton rolls and isolation shields, in combination with a thoughtful use of the water spray and evacuation tip. The isolation procedure may frequently be extremely challenging, particularly in the partially erupted teeth or in those children with poor cooperation.

3. Enamel cleaning(Figure 8)

The goal of etching is to produce a dry, uncontaminated and frosted surface [91]. There are various etching materials available, but the most frequently used is orthophosphoric acid, provided that its concentration lies between 30% and 50% by weight. This is available as both a liquid solution and a gel. Small variations in the concentration do not appear to affect the quality of the etched surface [81]. Duggal et al. showed no significant difference in retention of fissure sealant after one year follow-up on second primary and first permanent molars when 15, 30, 45 or 60 seconds etching times were used [92]. Liquid etching, likewise, is often applied by brush or a small cotton pledget. The application of the gel is often done either directly from the gel dispenser with special applicator tips or with a small disposable brush [7].



Figure 8. Etching the occlusal surface

4. Rinsing and drying

Many of the sealant manufacturers recommend rinsing the tooth for 20 to 30 seconds to remove the etchant. The most important is ensuring that the rinse is long enough to remove all of the etchant from the surface. After drying the tooth with compressed air, the tooth exhibits a chalky, frosted appearance but if still no milky white appearance is seen, the tooth should be re-etched for 15 to 20 seconds [7, 81, 91].

5. Sealant application (Figure 9)

During sealant application, all the susceptible pits and fissures should be sealed for maximum caries protection. The long-term clinical success of fissure sealants is closely related to their poor handling [93]. The sealant material can be applied to the tooth in a variety of methods. It may be applied with a small brush or on the tip of an explorer. 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. Many sealant kits have their own dispensers, which directly apply the sealant to the tooth surface. When using a dispenser, the dentist should allow the sealant to flow ahead into the pits and fissures. It reduces air entrapment [7].



Figure 9. Application of glass ionomer fissure sealing material

6. Application of surface gloss for glass ionomer sealants (Figure 10)



Figure 10. Application of surface gloss

7. **Polymerization of resin sealants** or Thermo-curing of glass ionomer sealants (Figure 11)

For light cured sealants, polymerization should be initiated quickly after the sealant is placed on the etched surface to help minimize potential contamination. Some study found that the longer sealants were allowed to sit on the etched surface before being polymerized; the more the sealant penetrated the microporosities, creating longer resin tags, which are critical for micromechanical retention [94]. One of the key factors affecting polymerisation is the light intensity of the dental light curing unit. A Canadian study reported that 12.1% of light curing units tested in a sample of dental practices had intensities that would be considered inadequate (<300 mW/cm^2) [70]. Other factors that may influence polymerisation include curing time, distance of the light guide from the material being cured, and thickness, shade and composition of the material being cured.

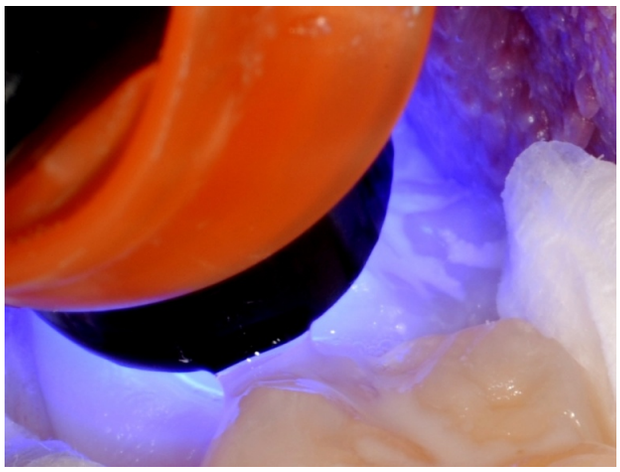


Figure 11. Thermo-curing with dental light

There are some tips for better fissure sealants:

a. Cure each surface on the same tooth separately if more than one surface is being sealed

b. Put the light-curing tip as close as possible to the surface and cure for at least the recommended curing time.

c. Manufacturer's instructions for sealant materials and for curing lights should be available for every operator

d. Check the light output and curing performance of dental curing units in accordance with the manufacturer's instructions

8. **Evaluation of the sealed tooth** (Figure 12)

Sealant retention should be checked with a probe after application, and the sealant re-applied, if necessary, repeating each step of the sealant application procedure.

Regular evaluation of sealants for retention is critical to their success. During routine recall examinations, it is necessary to re-evaluate the sealed tooth surface both visually and tactually

for loss of material, exposure of voids in the material and caries development. The need for reapplication of sealants is usually highest during the first six months after placement [95]. When sealants are partially lost and require repair, the clinician should vigorously attempt to dislodge the remaining sealant material with an explorer. If it remains intact to probing, there is no need to completely remove the old material before placing the new.



Figure 12. Occlusal view of fissure sealed with nano ionomer cement

7. Retention rates for the fissure sealing

One of the major problems when considering the success rates of sealant restorations is the variation in techniques and materials used. Short term studies indicate a high degree of success for sealant restorations [96-105]. However, longer term studies appear to indicate that success is less predictable [106-110].

Recent study by Gorseta et al. investigated retention of Glass Carbomer fissure sealant after six and twelve months of clinical trial [111]. Glass Carbomer is relatively new material developed from glass ionomer (GIC) and contains nano-sized powder particles and fluorapatite. Advantages of Glass Carbomer comparing to GIC are better mechanical properties and command setting through application of heat. Materials included forty eight teeth with well-delineated fissure morphology divided in two groups which were sealed with Glass Carbomer Sealant (Glass Carbomer Products, Netherlands) and Helioseal F (Vivadent, Liechtenstein) using split mouth design. Investigated materials were placed and set according to manufacturer's instruction using dental light Bluephase 16i (Vivadent, Liechtenstein) (Figure 10). Teeth in group A were sealed with Glass Carbomer material and in group B with Helioseal F. Evaluation criteria (Kilpatrick et al.) for retention of sealant was classified as: type 1: intact sealant; type 2: 1/3 of sealant missing; type 3: 2/3 of sealant missing; and type 4: whole sealant missing. Presence of new caries lesions was evaluated in two categories: 1-absent; 2-present.

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Gorseta et al. used replicas for evaluation of fissure sealant retention rate. The impressions with polyvinylxyloxane impression material of Glass Carbomer-sealed teeth were taken in order to obtain replicas of occlusal surfaces (Figure 14). For that purpose, impression was taken and poured in acrylic resin (Citofix Kit, Struers) (Figure 13). The obtained replicas were analysed with SEM (Figure 15, 16).

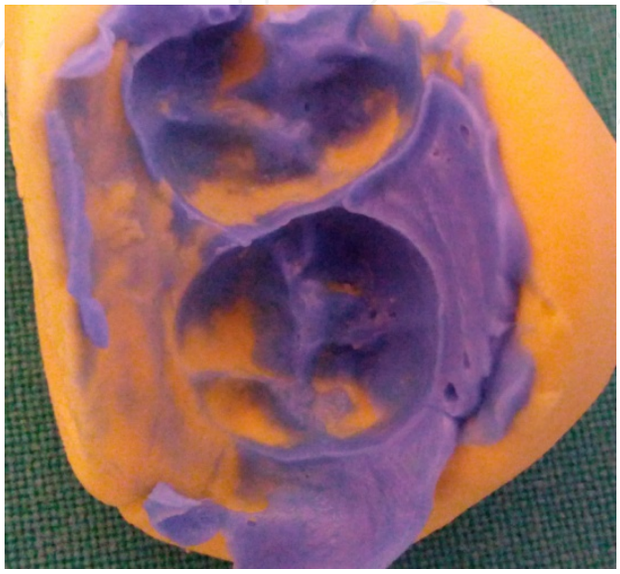


Figure 13. Impression of occlusal surface of molar



Figure 14. Replicas of occlusal surface of molar

Obtained data were statistically analyzed using non-parametric Mann-Whitney test.

Results showed that retention rate in-group A and B were 100% after six months of clinical service. There were no secondary caries lesions in either group. Results showed that complete retention in group A and B were 75% after 12 months of clinical service. There were two new caries lesions in each group. Mann-Whitney U test doesn't reveal significant statistical

difference between groups. Glass Carbomer sealant material showed comparable retention rate to resin based sealant material and can also be recommended for every day practice [111].

In some studies which found statistically significantly more caries in group with glass ionomer sealed teeth at 36-48 months than in group with resin sealed teeth, the complete retention for resin sealants was about 80%, and for glass ionomers was very low (3%) [112, 113, 114].

Studies published by Karlzén-Reuterving and Williams reported similar retention rate did not show a difference between the materials in caries incidence [115, 116]. In next two studies, glass ionomers sealing were reported to be more effective regarding caries prevention [117, 118]. They reported retention of both sealant materials as low (resin-based sealants 28% to 40% and glass ionomers in 21% to 40% after 36 months). Conditioning with 10% polyacrylic acid as well as heating lamp polymerization during curing of cement had no effect on the level of retention of the tested glass ionomer cement (Fuji VII). Similar studies have been done in other parts of Europe, and all with the record of low retention rate of glass ionomer sealants, or the value does not significantly deviate from those of the observed in our study. The two-year Finnish study published the complete retention of polyalcenoic cement at 26% of the sealed teeth compared with 82% fully retained fissure sealants of bis-GMA materials [50].

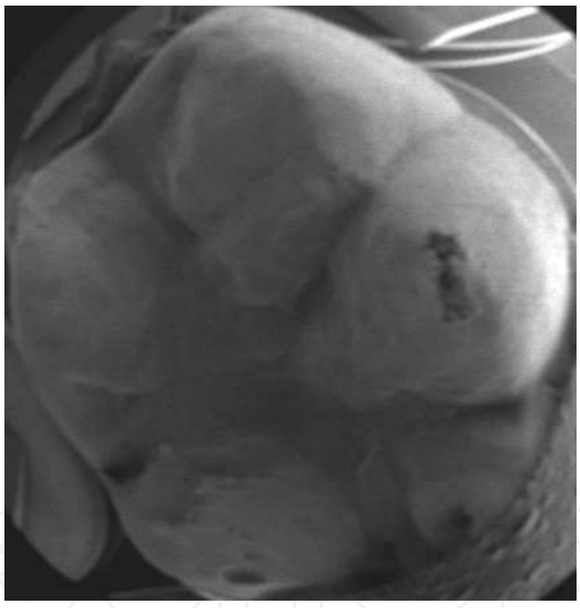


Figure 15. SEM analysis of glass ionomer sealant

After 28 months, Poulsen et al [45] have noted retention of Fuji III of less than 10%, and Pardi et al [46] only 3.5%. After nine months Weerheijm et al. [60] showed an overall retention of Fuji IX in the amount of 51% and only 15% for Fuji III. The incidence of new carious lesions in the group of sealing with glass ionomer cements was not statistically significant. The duration of study is only one year because of the small percentage of retention rate of glass ionomer sealants. Regardless of what is known that the most people prefer chewing on the right side, a control group of sealants (Helioseal F) placed on the right side of the jaw showed a high percentage of retention of 80%.

http://dx.doi.org/10.5772/59325

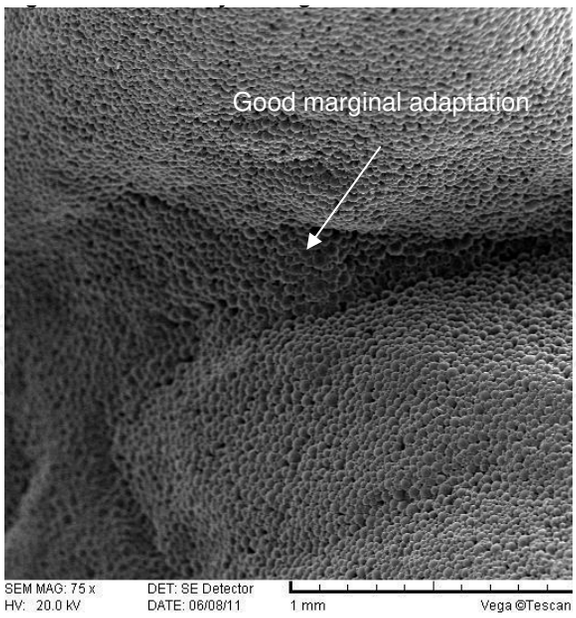


Figure 16. SEM analysis of glass ionomer sealant-higher magnification

Sidhu et al. studied contraction SIC after heating [40]. They concluded that the degree of contraction of the material depends on the porosity within the SIC. These dimensional changes can affect not only the marginal integrity between the enamel and the material, but also compromise the quality of adhesion between the glass ionomer and enamel. As the viscosity of glass ionomers used for sealing fissures greater than the viscosity of the resin sealants, Simonsen, McLean recommend use SIC only fissure having a diameter greater than 100 microns [119]. Also, solutions and gels for fluoridation may affect the surface SIC causing greater roughness [120]. This may induce microfractures on the surface of the material, then the fractures in the material and chained lead to loss of retention of material in the fissure.

The study of Pardi analyzed following sealant materials: flowable resin composite (Revolution), resin-modified glass ionomer (Vitremer) and compomer (DyractFlow) [121]. All occlusal surfaces were conditioned with 37% phosphoric acid. After 2 years, sealants were totally retained on 76% of the teeth sealed with Revolution, on 58% of teeth sealed with Dyract Flow and on 47% of the occlusal surfaces sealed with Vitremer. Recent studies comparing resins to resin-modified glass ionomers at 36 months, reported clearly better complete retention rates for resins (94%) than for resin-modified glass ionomers (5%) [122,123].

There might be many different causes behind the inconsistent results between the studies comparing resin-based materials to glass ionomers as sealants. Therefore, conclusion cannot be drawn based only on retention rate of material as sealants. However, information about caries prevalence in population is very important as diet and oral hygiene [122, 123].

Recent studies showed that the level of retention of glass ionomer sealants treated by heating during setting time is considerably lower than retention of conventional composite resin for sealing. Reduced time manipulation and adhesion of glass ionomer material for the wet surface

of the tooth, unequivocally favours glass ionomer material as the material of choice for sealing partially erupted molars [124-130]. This procedure is especially warranted in high caries risk patients, uncooperative patients and those with special needs [121].

Griffin et al. evaluated the effectiveness of sealants in managing caries lesions in a meta-analysis, and found their effectiveness in preventing dentin caries to be in the range of 62% to 100% (median 74% for all; 83% for non-cavitated and 65% for cavitated lesions). They recommended the placement of sealants to arrest lesions in the early carious stages and also to surfaces where caries status is uncertain. The progression of non-cavitated occlusal lesions was slow also for surfaces that were not sealed indicating that such surfaces could either be monitored or sealed. Invasive treatment methods were not recommended [124, 126-131].

Sealant maintenance is an integrated part of the sealant approach – all sealed surfaces should be regularly monitored clinically and radiographically [132-133]. Bitewing radiographs are suggested to be taken at a frequency consistent with the patient's risk status especially in cases where there has been doubt about the surface caries status prior to sealant application [124]. Defective or lost sealants should be reapplied in order to maintain the marginal integrity of sealants.

8. Conclusion

A fissure sealant is a material that is placed in the pits and fissures of teeth in order to prevent or arrest the development of dental caries. As the integrity and retention of a sealant is considered crucial to the success of sealants in the long-term, resin based is the material of choice. Sealing over incipient caries lesions is both effective and practical – the dental profession should be encouraged to use sealants more in an interceptive manner rather than in a preventive or operative manner.) They recommended the placement of sealants to arrest lesions in the early carious stages and also to surfaces where caries status is uncertain. The progression of non-cavitated occlusal lesions was slow also for surfaces that were not sealed indicating that such surfaces could either be monitored or sealed.

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