Glass Ionomer Sealant for Proactive Intervention

By **Fay Goldstep** DDS, FIADFE, FASDA

Occlusal decay and its consequences have a major impact on the dental health of our patients. It is the single most common chronic childhood disease worldwide[1] and its results affect our patients throughout their lives. Molars and premolars are vulnerable, especially during their eruption phase. Deep pits and fissures provide an ideal environment for bacteria to thrive, digesting carbohydrates and creating acid which leads to the demineralisation of susceptible immature dental surfaces.

Purpose of placing pit and fissure sealants

The most efficient way to prevent pit and fissure caries is through the sealing of the vulnerable tooth surfaces, from the cariogenic bacteria and fermentable carbohydrate substrates left on the teeth during mastication. This is best achieved by placing a physical barrier in the form of a seal on the pits and fissures.[2]

Dentists have been attempting to find conservative, minimally invasive ways to treat pit and fissure areas for many years. In 1955, Dr. Michael Buonocore suggested that it would be possible to prevent caries by sealing pits and fissures with a bonded resin material. The appropriate materials became available only later, and he published a further paper on the use of pit and fissure sealants in 1967.[3]

The first permanent molars are a cornerstone in the development of the adult dentition. First permanent molars often erupt before the patient and/or the parent is even aware of their existence. The partially erupted permanent first molar is very difficult to keep caries-free during its eruption phase. Therefore, it requires between 12 and 18 months to fully erupt into occlusion with the existing teeth in the arch.[4] On the other hand, bicuspids only need three to six months to reach full occlusal height.

During this time, the patient experiences difficulty in cleaning and reaching the first molar due to its reduced height unless major effort is made by the patient to achieve contact. However, this is not likely possible in a young child. Hence, the occlusal surface of the first permanent molar is rarely brushed and is often covered with plaque and food debris in a low pH environment.[5] This is further exacerbated if the tooth remains under an operculum (gum flap covering an erupting tooth) for a long period of time. These factors lead to an erupting tooth that can easily become carious on its occlusal surface by the time it fully erupts.[5]

Materials to use

The objectives for the pit and fissure sealant material are: to seal the area, to make the tooth surface caries resistant and to be easy to use.[6] Evidence regarding the efficacy of sealants in reducing occlusal caries is well established.[7] Composite resin is the most commonly used sealant material. It seals the pits and fissures through micro mechanical means. Micro mechanical retention is created through tags after enamel etching. However, these tags are easily destroyed by contamination with saliva and this leads to the eventual failure of the resin sealant.[8] Glass ionomer (GI) sealant material is hydrophilic. Hence, it is not as moisture sensitive as hydrophobic resin materials and it offers an alternative treatment for the wet conditions in the oral cavity.[9]

Resin sealants have higher retention to pits and fissures than GI sealants. However, resin-based sealants have been shown to lose almost all of their protective effect once retention is lost.[10-11] In contrast to resin, even when the GI sealant appears clinically as partially or totally lost, small amounts of the material remain. The GI material stays within the depths of the fissure since it bonds chemically to the tooth and consequently the sealing effect continues.[6] This remaining material provides a barrier to the bacteria and also promotes remineralisation through the release of fluoride.[10-11]

Most studies have used 'retention of the sealant' as the end point for fissure sealant effectiveness. In addition, many studies have assumed that only a totally intact sealant (as opposed to a lost or partially retained sealant) is the criterion for effective caries prevention and clinical success.[12] But systematic reviews have not found that the sealant retention rate is a valid predictor of clinical outcomes.[12] Hence, it should not be used to measure sealant success in preventing caries.

Two systematic reviews[10-11] found that neither resin nor GI sealants were superior in the prevention of dental caries in children. Therefore, the choice of which material to use may have more to do with ease of use, moisture control, and patient compliance.[13]

Hydrophobic resin sealants do not provide the best solution for sealing permanent first molars since they are only partially erupted for a prolonged period of time and adequate isolation is not attainable.[5] Moreover, it has been shown that improperly placed resin sealants can leak and allow caries to develop unnoticed under the leaking sealants.[14] Therefore, many dentists have stopped using resin fissure sealants: too many surprises when opening up carious lesions under failed resin sealants, and finding very extensive decay that has been left undisturbed for a prolonged period of time.

Resin sealants also cover the immature under mineralised tooth surface, not allowing fluoride, calcium, phosphate and other minerals from the saliva to contact the tooth surface and mineralise the tooth.[5] Enamel requires almost three years to reach full mature mineralisation. During this time, the enamel is incompletely formed and becomes more susceptible to demineralisation under low pH.[15]

Advantages of Glass Ionomer sealants

Glass ionomer fissure sealants offer several major advantages over resin sealants especially in partially erupted teeth. A summary follows:[5]

1. GI sealants are hydrophilic and they can chemically bond to tooth structure in a moist environment. This is especially advantageous when placing sealants in young children where isolation due to location and/or behaviour can be challenging. Resin sealants only bond mechanically to tooth surfaces. This requires a completely dry, isolated environment.
2. GI sealants release and recharge fluoride. Resin sealants only provide a barrier to bacterial infiltration while GIs provide a barrier to bacteria, and also release and recharge fluoride. GIs adhere to enamel and dentin via ionic and polar bonding.[16] This creates intimate contact and the fluoride is exchanged with the hydroxyl ions in the adjacent enamel hydroxyapatite, forming fluorapatite which is a stronger, more acid resistant structure (Diagram).
3. GI sealants allow for an easy diffusion of calcium and phosphate ions (in addition to the fluoride ions) from the saliva into the tooth. This helps to achieve faster, more complete mineralisation and maturation of the enamel surface. Resin sealants consist of a solid material that seals the tooth and does not allow for the ionic exchange of minerals. GIs are porous and have large spaces to allow the diffusion of calcium, phosphate, fluoride, etc and this assists enamel in the maturation process.[5] Newly erupting enamel is immature as it is composed of carbonate apatite that is easily dissolved. GI sealants can be applied as a thin film over the exposed enamel as well as under the operculum of a partially erupted tooth. The GI sealant has a semi-permeable membrane or "skin" that allows calcium and phosphate from saliva to diffuse through it, into the enamel, and react with the released fluoride to form mineralised fluorapatite enamel. This mature mineralised enamel is more caries resistant (Diagram).
4. A study has shown that GI sealants penetrate more deeply into enamel fissures and occlusal convolutions than resins.[17] As a result, sometimes the GI is not visible on clinical examination. However, when the teeth were sectioned for this study, the GI sealant was present deep in the fissure, providing maximum protection where it is most needed.

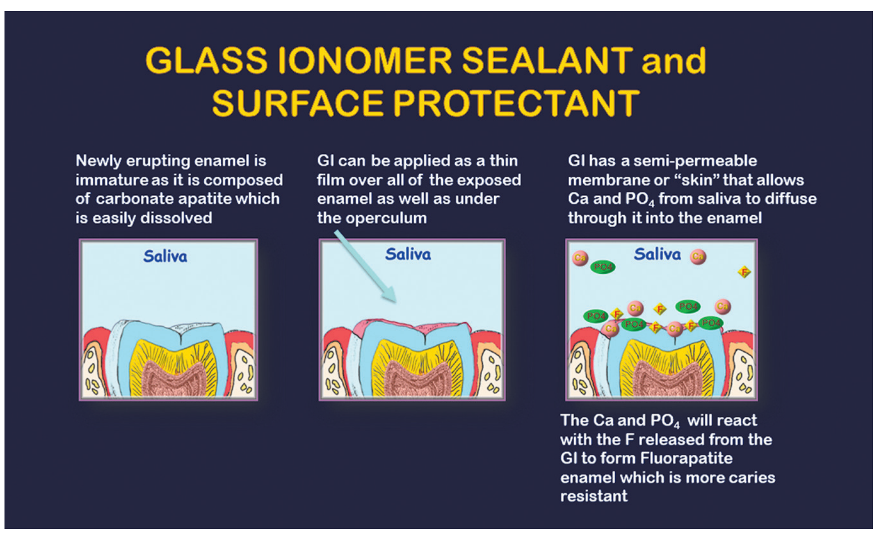
Clinical application

A young patient presented at his 6th month recare appointment with erupting first permanent molars in all quadrants. In view of the child's history of decay and deep pits and fissures on the occlusal surfaces, all the erupting teeth were sealed with self curing glass ionomer fissure sealants.

GC Fuji Triage, white shade (GC America) was applied on the lower molars (Case 1) and Riva Protect, pink shade was applied on the upper molars (Case 2). Different materials were used in this case to illustrate the technique for this article and for further educational purposes - both materials come in white and pink shades.

Step-by-step procedure for case 1 & 2:

1. To prepare the newly emerged molars for treatment, prophylaxis is performed using pumice and then thoroughly rinsed.
2. Cotton rolls and a triangular shield are placed to retract the cheek and tongue and to control excess moisture.
3. Either a 20% polyacrylic acid cavity conditioner (for 10 seconds) or 37% phosphoric acid etch (for five seconds) is applied and thoroughly rinsed. This optimises adhesion of the glass ionomer to tooth structure. Excess moisture is removed. The tooth should have a moist shiny surface.
4. The capsule of the glass ionomer material is tapped on a hard surface to loosen the its contents. The



The mechanism of enamel mineralisation and maturation that occurs with glass ionomer sealants plunger is pushed into the capsule to activate it. (The GC Fuji Triage capsule must be further activated by one click in the applicator).

5. The capsule is placed into the triturator and mixed for 10 seconds.
6. The capsule is removed and loaded into the applicator and the trigger is clicked until paste extrudes.
7. The GI fissure sealant paste is dispensed onto the prepared tooth. A micro brush can be used to ensure the material gets into all the pits and fissures.
8. Once the material has lost its gloss, one drop of the “coat” (GC Fuji Coat or SDI Riva Coat) is dispensed and applied to the treated area and cured.
9. The sealant is inspected for complete coverage and absence of voids.

Fig. 1.1: An erupting mandibular first molar is sealed with GC Fuji TRIAGE. Erupting mandibular first molar prior to treatment.

Fig. 1.2: Prophylaxis with pumice is performed and then thoroughly rinsed.

Fig. 1.3: 37% phosphoric acid etch is applied for 5 seconds.

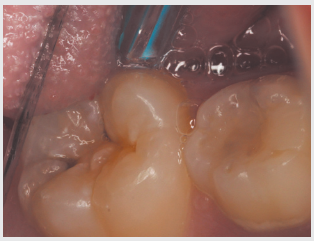


Fig. 1.4: The tooth is thoroughly rinsed. Excess moisture is removed. The tooth is kept moist not desiccated.

Fig. 1.5: The capsule of the glass ionomer material is tapped on a hard surface to loosen its contents.

Fig. 1.6: The plunger is pushed into the capsule to activate it.

Fig. 1.7: The capsule is put into the applicator which is then clicked once for further activation.

Fig. 1.8: The capsule is placed into the triturator and mixed for 10 seconds.

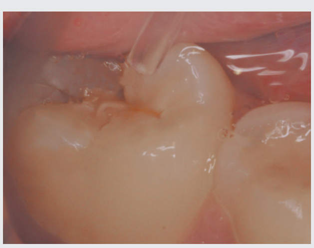


Fig. 1.9: The capsule is loaded into the applicator, the trigger clicked until the paste extrudes, and paste is dispensed onto the prepared tooth.

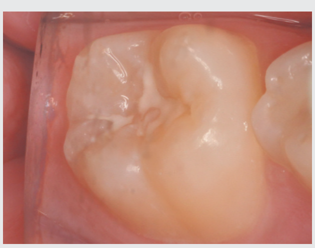


Fig. 1.10: Once the material has lost its gloss, one drop of GC Fuji Coat is applied and cured. The completed restoration is inspected.

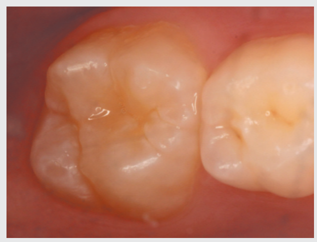


Fig. 2.1: An erupting maxillary first molar is sealed with Riva Protect. Erupting maxillary first molar prior to treatment.

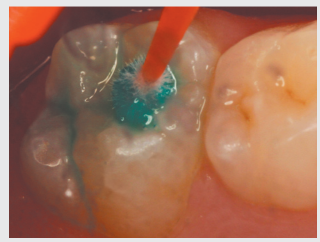


Fig. 2.2: After prophylaxis with pumice and thorough rinsing, Riva Cavity Conditioner is applied for 10 seconds with a micro brush and then thoroughly rinsed. Excess moisture is removed. The tooth is kept moist not desiccated.

Fig. 2.3: The capsule of glass ionomer is tapped on a hard surface to loosen the contents inside.

Fig. 2.4: The plunger is pushed into the capsule to activate it. There is no need to put the capsule into the applicator for further activation when using the Riva Protect system.

Fig. 2.5: After the capsule has been mixed in the triturator for 10 seconds, it is loaded into the applicator, the trigger clicked until the paste extrudes, and the extruded paste dispensed onto the prepared tooth.

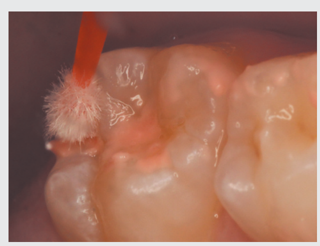


Fig. 2.6: A micro brush is used to ensure that the material gets into all the pits and fissures.

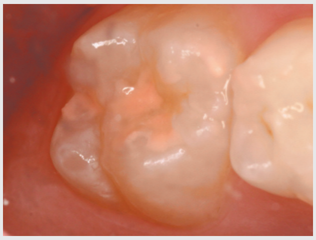


Fig. 2.7: Once the material has lost its gloss, one drop of SDI Riva Coat is applied and cured. The completed restoration is inspected.

Conclusion

Fissure sealant application is an excellent proactive dental treatment. It is an underutilised treatment because of the difficulties in isolation with resin sealants and the unwelcome surprises of advanced decay that is sometimes found under failed resin sealants. Glass ionomer sealants offer the advantages of easier isolation and the ionic exchange of fluoride and other minerals to help in the mineralisation of the immature tooth surface. It is time to bring fissure sealants back out, as proactive intervention treatments for our young patients, this time with patient friendly glass ionomer materials. **DA**

References:

1. Muthu MS, Sivakumar N. Pediatric dentistry. Principles and Practice. 1st ed. New Delhi: Elsevier; 2009
2. Gore DR. The use of dental sealants in adults: a long-neglected preventive measure. Int J Dent Hyg 2010; 8: 198-203
3. Cueto EI, Buonocore MG. Sealing of pits and fissures with an adhesive resin: its use in caries prevention. J Am Dent Assoc 1967; 75(1):121-8
4. Ekstrand KR, Christiansen J, Christiansen ME. Time and duration of eruption of first and second permanent molars: a longitudinal investigation. Community Dent Oral Epidemiol. 2003 Oct; 31(5):344-50
5. Antonson DE. Imagine a world without occlusal caries: are glass ionomer sealants the answer? Oral Health Journal 2012 Dec; 31-36
6. Berg JH. Glass ionomer cements. Pediatric Dent 2002; 24(5):430-438
7. Ahovuo-Saloranta A, Hiri A, Nordblad A, Makela M, Worthington HV. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. Cochrane Database Syst Rev 2008; 4:CD001830
8. Bishara SE, Oosombat C, Ajlouni R, Denehy G. The effect of saliva contamination on shear bond strength of orthodontic brackets when using a self-etch primer. Angle Orthod 2002; 72:554-557
9. Smith DC. Development of glass-ionomer cement systems. Biomaterials 1998; 19:467-478
10. Yengopal V, Mickenautsch S, Benzerra AC, Leal SC. Caries-preventive effect of glass ionomer and resin-based fissure sealants on permanent teeth – a meta analysis. J Oral Sci 2009; 51:373-382
11. Mickenautsch S, Yengopal V. Caries-preventive effect of glass ionomer and resin-based fissure sealants on permanent teeth: an update of systematic review evidence. BMC Research Notes 2011; 4:22
12. Mickenautsch S, Yengopal V. Retention loss of resin-based fissure sealants – a valid predictor for clinical outcome? The Open Dentistry Journal 2013; 7:102-108
13. Niederman R. Glass ionomer and resin-based fissure sealants: equally effective? Evid Based Dent 2010; 11(1):10
14. Edwina A. M. Kidd. Essentials of Dental Caries: The Disease and its Management. Oxford University Press p 170, June 30, 2005
15. Edwina A. M. Kidd. Dental Caries: The Disease and its Clinical Management. John Wiley & Sons. P299, Apr 11, 2008
16. Sachin S. Glass ionomer cement and resin-based fissure sealants are equally effective in caries prevention: a critical summary of Yengopal V, Mickenautsch S, Benzerra AC, Leal SC. Caries-preventive effect of glass ionomer and resin-based fissure sealants on permanent teeth – a meta analysis. J Oral Sci 2009; 51:373-382. JADA 2011 May; 142(5):551-552
17. Antonson, SA, Kilinc E, Antonson, DE. Depth of Penetration of Fissure Sealants on Contaminated Enamel Surface. J Dent Res 2006; 85(Spec Iss B):1580

About the author

Dr. Fay Goldstep is a clinician, author and educator. Dr. Goldstep has lectured nationally and internationally on proactive/minimal intervention dentistry, soft-tissue lasers, electronic caries detection, healing dentistry, and innovations in hygiene. Dr. Goldstep has served on the teaching faculties of the post-graduate programs in aesthetic dentistry at SUNY Buffalo and the Universities of Florida (Gainesville), Minnesota (Minneapolis), and UMKC (Kansas City). She sits on several editorial boards, has been a contributing author for four textbooks, and has published more than 100 articles. Dr. Goldstep is a consultant to a number of dental companies, and practices in Toronto, Canada.