A New Therapeutic Pit-and-Fissure Sealant Improves Early Dental Caries Monitoring for Minimally Invasive Dentistry

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Pit-and-fissure sealants are recognized as one of dentistry's more effective techniques of preventing occlusal surface decay.1,2 There are, however, a few complicating issues to be considered. Ease of application is the most clinically relevant of these. Sealants may be underused by some dental practices because of the difficulty in maintaining isolation in application. Salivary contamination remains a problem with a resultant decrease in retention and, therefore, less effectiveness.3 Second, concerns exist regarding contamination within the grooves and pits before application.4 The grooves and pits cannot always be totally debrided without using mechanical cleansing devices. It sometimes requires using a fissurotomy bur in a high-speed handpiece to completely remove the debris from within the pits and grooves, or some type of air/water abrasion.5,6

Moisture itself, however, often remains; Fiegel demonstrated in his research that the bottom sac within the groove remains filled with plaque and moisture.7 The average penetration of the sealant is, on average, only 17% of the depth of the groove.8 To successfully place a hydrophobic sealant, an additional placement step may be necessary, such as the use of a priming and drying agent. Otherwise, hydrophobic sealants do a very nice job of protecting the grooves and pits because they tend to repel any moisture or plaque build-up. Unfortunately, they do not deeply penetrate into the grooves.9,10 In addition, high-viscosity sealants may not be able to fully penetrate even the area of the enamel that has been properly acid-etched. Therefore, some highly filled sealants do not sufficiently infiltrate the etched enamel.11 Because of this limitation, some researchers have recommended using fourth- and fifth-generation dental adhesive products to improve the adhesion and adaptation of sealants to the morphology of molars.12

Another issue would be the occasional failure of the marginal integrity of the pit-and-fissure sealant. This would result in demineralization and finally decay under the leaking sealant. Although this has not been a common problem, when the leakage occurs the result can be very damaging to the sealed tooth. When the failed sealant is removed the tooth structure underneath is quite de-calcified with severe surface breakdown. Therefore, it would be very helpful to have the ability to diagnose sealant leakage before extensive demineralization.

The DIAGNOdent (KaVo Dental, Lake Zurich, IL) operates at a wavelength of 655 nm. At this specific wavelength, clean, healthy tooth structure exhibits little or no fluorescence, resulting in very low scale readings on the display. However, carious tooth structure will exhibit fluorescence proportionate to the degree of caries, resulting in elevated scale readings on the display of the DIAGNOdent.13,14

Shofu Dental Corporation (San Marcos, CA) has introduced a new pit-and-fissure sealant material (ClearCheck™ SLP) that
Figure 3 A semi-gel acid etchant placed and carefully agitation for surface conditioning.

Figure 4 Applying the sealant to the etched enamel surface with the needle-tipped syringe.

Figure 5 Photo-initiation of the pit-and-fissure sealant.

Figure 6 The dental explorer is used to check the surface of the sealant for air voids and to ensure complete tooth coverage.

Figure 7 The completed pit-and-fissure sealant of the second permanent molar.

The ClearCheck sealant is lightly filled with nano particles and should be resistant to occlusal wear. Although occlusal wear is considered the most significant, sealant materials not only wear from occlusal function but also by tooth brushing. All sealants eventually wear down, and the dentist has to decide which sealant to place based on the patient’s needs.

Another clinical consideration is the mineralization condition of the dentition. Some patients requiring sealants may have molar/incisor hypomineralization. This is a genetic condition that is far more common than first believed. Microleakage may also develop over an extended period of time due to water absorption and resultant water softening of the hydrophilic resin matrix of the sealant. The pit-and-fissure sealant may start losing more filler particles as a result of water-induced desilanization and, therefore, develop increased wear.26,27

Pit-and-fissure sealant materials generally do not pull away from the tooth surface because of photo-polymerization shrinkage resulting from the low elastic modulus of the materials and the low C-factor of the “preparation.”28 In a photoelastic study of resin-based composites, the materials with a lower elastic modulus would demonstrate more stress development than the higher-elastic modulus materials because the low-elastic modulus materials would simply dissipate the stress within the material itself instead of pulling on the margin and the enamel.29

Also, hydroscopic materials absorb water, and the material’s expansion from the water absorption may be enough to compensate for the polymerization shrinkage with the stress becoming virtually negligible (for example, with glass-ionomer-based materials). This is perhaps another instance where a hydrophilic material such as ClearCheck has a clinical advantage, because the absorption of water may release the stress induced by the polymerization shrinkage.

CLINICAL TECHNIQUE

The teeth to be sealed should receive a thorough dental prophylaxis, at least with rubber cup, pumice, and water, although the use of a fissurotomy bur or air abrasion would decrease debris deep within the fissures (Figure 1). After prophylaxis, the fissures are scanned with the DIAGNOdent and the values are recorded in the patient’s chart (Figure 2). These recorded values provide baseline data to allow for monitoring the sealant’s preventive effectiveness.

A 32% semi-gel acid etchant is placed and gently agitated (Figure 3). After etching for 30 seconds the etchant is rinsed away with copious amounts of water for 10 seconds. The excessive surface water is removed with high-volume suction and gently dried with air. Isolation is maintained with NEODRYS® (Microcopy, Kennesaw, GA) and a suction mirror (Indigreen Innovations, Greenville, NC). The ClearCheck sealant is applied to the conditioned tooth surface and a microbrush is used to eliminate any air bubbles.
and to achieve the desired thickness (Figure 4). The sealant is photo-initiated for 20 seconds with at least 500 mW output (Figure 5). The surface of the sealants should be carefully examined for any air bubbles or unprotected fissures (Figure 6 and Figure 7). Reapply the sealant as necessary to produce a smooth and continuous surface.

CONCLUSION

This new development of an optically neutral pit-and-fissure sealant allowing for improved diagnosis with the DIAGNOdent is an important adjunct when practicing minimally invasive dentistry with early intervention. Minimally invasive dentistry requires the routine use of pit-and-fissure sealants. Leaking sealants permit undiagnosed decalcification of the tooth surface. This new sealant material further aids the clinician in diagnosing sealant leakage and resultant decalcification. Furthermore, this sealant material is a hydrophilic material, easy to place, and should encourage remineralization. This material should be considered a therapeutic sealant, as it would encourage the repair of early carious lesions. Obviously, this sealant would also require home adjunctive care with remineralization products and would be part of a total minimally invasive dental practice emphasizing preventive care. This requires the routine use of a caries risk-assessment tool for determining the caries risk for each individual patient. Parental history is also important because of the high correlation between the child's caries risk and maternal caries history and level of education.

DISCLOSURE

The author has received an honorarium from Shofu.

REFERENCES