

RESEARCH & APPLICATIONS

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current investigations.*

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A Moisture-Tolerant Resin-Based Pit-and-Fissure Sealant: Research Results

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Many clinical studies have supported the efficacy of sealants in the prevention of dental caries.¹⁻⁴ There is, however, a dilemma—dentists and dental hygienists want to provide patients with the most conservative, minimally invasive treatment of pits and fissures. Minimally invasive (also referred to as minimal intervention) dentistry for pit-and-fissure caries prevention involves the placement of a sealant as soon as the tooth erupts. This period of early eruption, however, presents the great challenge of isolating the tooth and maintaining a clean, dry, and etched enamel surface. The typical resin sealants used in the past required a completely dry field to ensure success. Thus, when isolation is very difficult or impossible, the clinician would need to wait until the tooth was more fully erupted. Timing of sealant placement is critical. In many cases, when the child returns for his or her next recall appointment, caries has invaded the at-risk pits and fissures. The treatment then requires an invasive tooth preparation and placement of an adhesive composite resin restoration.

Recently there has been a significant advancement in resin-based sealants with the development of moisture-tolerant chem-

istry. Traditional sealants are hydrophobic. Embrace™ WetBond™ (Pulpdent, Watertown, MA) is an example of a hydrophilic, moisture-tolerant resin-based sealant that does not require an additional bonding agent. Upon light-curing, Embrace WetBond has physical properties similar to other commercially available sealants.⁵⁻⁷

As part of a practice-based, 2-year clinical research study, Embrace WetBond moisture-tolerant, etch-and-rinse resin sealant was evaluated in the prevention of pit-and-fissure occlusal caries. The protocol for the placement of the sealant followed the manufacturer's instructions.

PROTOCOL

The teeth to be sealed were cleaned with a water-pumice paste and a prophylaxis cup in a slow-speed handpiece. The tooth surfaces were rinsed and dried. Isolation was accomplished with cotton rolls. After drying, the teeth were etched for 15 seconds with a phosphoric-acid etchant (Etch-Rite™, Pulpdent), which was then rinsed from the teeth for 10 seconds. Unlike traditional resin sealants, the Embrace WetBond sealant is not placed on dry-etched enamel. The teeth to be sealed were air-dried, but not desiccated. Rather, the teeth were slightly moist with a glossy appearance and no visible water. In some cases, the etched enamel surface was blotted with a cotton pellet to achieve a slightly moist status. The sealant was then applied to the occlusal surfaces from the syringe using the supplied cannula tip or by means of a ball burnisher dipped into a light-protected well containing the sealant material. The sealant was spread over the entire occlusal surface to the cusp ridges to include all pits and fissures. The sealant was then light-cured for 10 seconds. After light-curing, the sealant was evaluated for retention and seal of the occlusal surfaces.

RESULTS

Sealants were placed in the author's pediatric dental practice for 1,102 posterior teeth. There was no prescreening of pa-

tients. Even difficult patients and children with poor oral hygiene and dietary habits were included in the study. At the 2-year recall it was found that none of the teeth evaluated had developed occlusal caries. It was noted that during the 2-year period sealants placed on 1,047 teeth remained intact with good marginal integrity while 55 of the sealed teeth needed the sealant to be repaired or replaced at some time during the 2-year period. This clinical study began in May 2002, and cases are currently being reviewed at recall visits to provide additional data on Embrace WetBond sealants collected over a longer recall period (Figure 1). This data will be reported in a future article.

DISCUSSION

Based on clinical studies, teeth can be classified as sound or incipient/at risk. Heller and colleagues evaluated teeth that were sound and at risk for caries progression by comparing sealed and unsealed teeth in the same mouth.⁸ Teeth that were initially sound had a caries rate of 13% at 5 years when unsealed and 8% when sealed. Teeth

that were classified as incipient/at risk had a caries rate of 52% at 5 years when unsealed, compared with only 11% when sealed. While the benefit of sealing sound teeth (a difference of 13% to 8%) may not be significant, there is no doubt that sealing teeth at risk has a substantial benefit.

Using a dental mirror and explorer during a clinical examination, a clinician makes the observation that there are pits, fissures, and grooves on the surfaces of teeth. The diagnosis of carious pits and fissures, however, can often be daunting especially with recent changes in the diagnosis and treatment of caries.^{9,10} The concept of using a sharp explorer for the detection of pit-and-fissure caries has been discarded in favor of the visual appearance of enamel, radiographic diagnosis, and new types of devices.¹¹ Even with newer technologies for caries diagnosis, it is still difficult to chart the progression of the disease¹²⁻¹⁵ because considerable variation is noted when this type of caries is examined microscopically.¹⁶

Pits and fissures can be classified according to their appearance in cross-section, namely: V-type, U-type, and I-type

Table 1: Considerations for Premature Sealant Failure

- Partially erupted tooth
- Poor isolation
- Occlusal parafunctional habits (wear of sealant)
- Patient behavioral problems
- Age of patient (very young patients, difficult adequate isolation, and patient behavioral issues)
- Enamel structural defects (amelogenesis imperfecta, dentinogenesis imperfecta)



Figure 1 A 5.5-year recall of a moisture-tolerant resin-based sealant (Embrace WetBond sealant).

pits and fissures.¹⁷ In most cases, the shape of the pit or fissure is such that it is impossible to clean. Food and bacteria are compacted into the invaginations of occlusal surfaces, explaining the high susceptibility of occlusal pits and fissures to dental caries when compared with a lower caries rate of buccal pits with the same morphology.

The earliest sealants were resins placed with an acid-etch technique that sealed caries-susceptible pits and fissures.^{18,19} Clinical research trials with sealants demonstrated that effectiveness. A 4-year clinical evaluation of sealant retention comparing sealed with non-sealed teeth demonstrated an overall 43% decrease in the prevalence of caries with significantly better sealant retention on premolars (84%) than molars (30%).¹ A later, 7-year study by Mertz-Fairhurst and co-workers reported 66% complete sealant retention and 14% partial retention.² Sealant loss was 20% while there was a 55% reduction in the caries rate for the sealed teeth vs the unsealed teeth. In a more comprehensive 10-year observation of over 8,000 sealants placed on permanent first molars, there was 41% complete sealant retention at 10 years and a 58% to 63% retention rate over 7 to 9 years.³

Simonsen has reported on the retention and effectiveness of a single application of sealant to permanent first molars at both 10 and 15 years.^{20,21} The results indicated that at 10 years, 56.7% of the sealants were completely retained and 20.8% were partially retained. In the sealed group, 84.4% of the pit-and-fissure surfaces of the first molars were caries-free. Of the unsealed, matched-pair group, only 31.7% of the first molars were caries-free. At 15 years, 27.6% of the teeth still had complete sealant retention with a further 35.4% maintaining partial retention. Of those teeth sealed, 68.7% were caries-free when compared to the matched pair of unsealed first molars, of which only 17.2% were caries-free. Also, sealant success is multifactorial. Technique, fissure morphology, and characteristics of the sealant are all factors that contribute to clinical success.²²

After a review of published sealant data,²³ one can conclude that a 5% to 10%

loss of sealants per year can be expected. This data reveals the importance of periodic reevaluation of teeth with sealants and reapplication if necessary. If one were to find a negative aspect of sealants in the realm of dental prevention it would be the failure of clinicians to reevaluate and reapply sealants when they are lost or failing. Table 1 lists considerations for early sealant failure. Based on the data reported in the aforementioned clinical research reports, it is important that patients with sealants have periodic re-evaluations and reapplication of sealant if necessary. When a sealant needs to be repaired or reapplied, the tooth should be treated as if an initial sealant is to be placed.²⁴

When sealants are placed on the occlusal surfaces of posterior teeth, they can interfere with the occlusion. For the child with a transitional dentition this is not problematic, but for the adolescent and young adult with a fully erupted dentition, it can be problematic for retention. To avoid any problems and to increase the retention of the sealant it is important to perform the following for fully erupted dentitions:

- check the occlusion with articulating ribbon to evaluate any potential occlusal interference. If the tooth has occlusion in the areas where the sealant placement and retention is desired, it is recommended that a fissurotomy be performed to create additional space for thickness of the sealant and thus increase retention²⁵⁻²⁷
- sealant should be applied to cover the cusp ridges to a thickness of at least 0.3 mm.^{25,26,28}

CONCLUSION

An innovative and unique moisture-tolerant resin-based sealant was evaluated for the prevention of pit-and-fissure caries on the occlusal surfaces of permanent teeth. There were not exclusionary criteria for patients. At the 2-year recall, this sealant was demonstrated to be a highly effective at preventing pit-and-fissure caries. Because moisture contamination is a significant risk factor to sealant retention, the introduction of a moisture-tolerant resin-

based sealant that is clinically successful provides clinicians with an additional choice in their preventive regimen.

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COMMENTARY

Sealants have been shown to be an effective clinical technique in preventing pit-and-fissure caries on those teeth most at-risk of occlusal caries. One problem has been the timing of the intervention—when do you seal the occlusal surface of an erupting first or second permanent molar? To best prevent pit-and-fissure caries it is advantageous to place a sealant as soon as an at-risk tooth erupts; unfortunately, there are anatomic restrictions that limit sealant success when the tooth first erupts. When permanent molars erupt there is typically a gingival operculum over the distal surfaces of these teeth, which leads to difficulty in controlling moisture during sealant placement and significantly lowers retention of the sealant. One solution has been to use moisture-tolerant glass ionomer cements, eg, GC Fuji TRIAGE® (GC America, Alsip, IL), as sealants. Unfortunately, the research has shown these to be less durable than resin-based sealants.

This practice-based research study provides the preventive-oriented clinician with an alternative to a “watchful waiting” approach to sealant placement. With Embrace WetBond sealant, the dentist and dental hygienist now have a water-tolerant, resin-based sealant that can be successfully used for early-erupting permanent first and second molars and all sealant placement. In fact, the manufacturer’s instructions require that the tooth be moistened before sealant placement. While this report only provides 2-year data, the fact that all children were included in the study regardless of whether or not it was easy to attain isolation for placement demonstrates the importance of the data collected.

Practice-based studies are becoming more important in providing clinically relevant information on the performance of dental procedures and materials in a busy dental practice rather than a controlled study where time and cost is not an issue. The moisture-tolerant Embrace WetBond sealant had a 95% success after 2 years, which is comparable to other sealant studies where teeth that were difficult to isolate were excluded. From a personal conversation with the author, the longer-term recalls of over 4 years and 5 years are demonstrating similar clinical success.—Howard E. Strassler, DMD

DISCLOSURE

Dr. Strassler has received grant/research support from Pulpdent.