Sealant adaptation and penetration into occlusal fissures

BARBARA KANE, BS, JORDAN KARREN, BS, CRISTINA GARCIA-GODOY, DDS & FRANKLIN GARCIA-GODOY, DDS, MS

ABSTRACT: Purpose: To evaluate the adaptation and penetration into occlusal fissures of two different types of fissure sealants, Methods: Extracted third molars (n=10) with evident occlusal fissures were cleaned with a pumice/water slurry and randomly divided into two groups and sealed following the manufacturers’ directions as follows: Group 1 - Embrace fissure sealant (Pulpdent). Surfaces were cleaned and dried, then etched for 15 seconds. Excess water was removed leaving the surface slightly moist. Sealant was applied from cusp to cusp without covering marginal ridges and light cured for 20 seconds using a halogen light at 500 mW/cm². Group 2 - ClinPro (3M Espe). Surfaces were cleaned and dried then etched for 15 seconds. The etched surface was rinsed and thoroughly dried. Dried surfaces appeared frosty white. Sealant was placed making sure not to go beyond etched area, and light cured for 20 seconds. Teeth were thermocycled (500x) and sectioned with an Isomet in a mesio-distal direction (4 slices per tooth). The sections were examined under the SEM. The marginal adaptation of the sealants was evaluated under the SEM using the following criteria: 1 = Smooth adaptation. Sealant flows with enamel. No ledges; 2 = Sealant is not well adapted. Ledge may be present. The penetration ability of the sealants was evaluated under the SEM using the following criteria: 1 = Sealant penetrated 1/3 the total length of the fissure; 2 = Sealant penetrated 1/2 the total length of the fissure; 3 = Sealant penetrated the total length of the fissure. The results were statistically analyzed using a t-test. Results: Embrace showed consistently more intimate marginal adaptation than ClinPro in fissures of the same approximate width and depth (P< 0.05). (Am J Dent 2009;22:89-91).

CLINICAL SIGNIFICANCE: Embrace showed consistently more intimate marginal adaptation than ClinPro in fissures of the same approximate width and depth. The superior adaptation and penetration of Embrace may produce longer lasting sealants.

Introduction
Occlusal surfaces remain areas of higher caries incidence and prevalence both in children and young adults. Additionally, occlusal caries involving pits and fissures are responsible for over 80% of all carious lesions in young permanent teeth. The preventive benefits of pit and fissure sealants are only guaranteed when the sealant remains completely retained with an adequate adaptation to the enamel. Otherwise, microleakage occurs and recurrent caries may develop underneath the sealant.

A problem with the fissure penetration ability of sealants is the type or shape of the fissure. Therefore, a sealant that could adapt well to wide or narrow as well as deep or shallow fissures would probably provide a superior sealant to prevent secondary caries.

This study evaluated the marginal adaptation and penetration ability of a di-, tri- and multi-functional acrylate monomer-based sealant (Embrace) compared to a conventional Bis-GMA-based sealant (ClinPro). The null-hypothesis for the present study was that Embrace sealant placed over a slightly moist enamel produced a more intimate adaptation to enamel than a conventional Bis-GMA-based sealant.

Materials and Methods

Extracted third molars (n=10) with evident occlusal fissures were cleaned with a pumice/water slurry and randomly divided into two groups and sealed following the manufacturers’ directions as follows: Group 1 - Embrace fissure sealant - Surfaces were cleaned and dried, then etched for 15 seconds. Excess water was removed leaving the surface slightly moist. Sealant was applied from cusp to cusp without covering marginal ridges and light cured for 20 seconds using a halogen light at 500 mW/cm². Group 2 - ClinPro fissure sealant - Surfaces were cleaned and dried then etched for 15 seconds. The etched surface was rinsed and thoroughly dried. Dried surfaces appeared frosty white. Sealant was placed making sure not to go beyond etched area, and light cured for 20 seconds. Teeth were thermocycled (x500, 5-55°C) and sectioned with an Isomet diamond saw in a mesio-distal direction (four slices per tooth). The sections were examined under the SEM (Quanta 200®).

The marginal adaptation of the sealants was evaluated under the SEM using the following criteria:
1 = Smooth adaptation. Sealant flows with enamel. No ledges; 2 = Sealant is not well adapted. Ledge may be present.

The penetration ability of the sealants was evaluated under the SEM using the following criteria:
1 = Sealant penetrated 1/3 the total length of the fissure; 2 = Sealant penetrated 1/2 the total length of the fissure; 3 = Sealant penetrated the total length of the fissure.

The results were statistically analyzed using a t-test.

Results

Embrace showed consistently more intimate marginal adaptation (Figs. 1-3) than ClinPro (Figs. 4-6) in fissures of the same approximate width and depth (P<0.05). Penetration of both sealants was similar with more complete fissure sealing in wider fissures than narrower ones. Incomplete penetration of the sealants into deep constricted fissures was noticed for both sealants (Figs. 2,6).
The Table shows the results for sealant marginal adaptation and the scores for the penetration ability of both sealants. The marginal adaptation of Embrace was statistically superior (P< 0.05) than for ClinPro. There was no statistically significant difference in the penetration ability into the fissures of both sealants.

**Discussion**

The caries preventive properties of pit and fissure sealants have been documented by many studies,\(^ {14,15}\) including those conducted in a tropical environment.\(^ {10,17}\) Sealants are only effective as long as they remain completely intact and bonded in place.\(^ {18,19}\)

The present study showed that Embrace pit and fissure sealant provided superior adaptation to enamel and excellent penetration into fissures compared to ClinPro Bis-GMA-based sealant. This is of interest because acid etching of enamel fissures does not completely penetrate the entire fissure system.\(^ {6,20}\) and therefore, an intimate adaptation of the sealant per se would be an additional benefit to the procedure to prevent marginal gaps that can induce or enhance bacterial growth in the interfaces, and subsequently, enamel demineralization. Therefore, the null hypothesis of the present study was accepted as Embrace did show superior marginal adaptation than ClinPro. Based on the present results, it may be concluded that Embrace showed consistently more intimate marginal adaptation than ClinPro in fissures of the same approximate width and depth. The superior adaptation and penetration of Embrace may produce longer lasting sealants. Clinical studies should evaluate the long-term performance of Embrace.

An interesting aspect observed was that the Embrace sealant produced an intimate adaptation when placed over a slightly wet enamel surface. This is relevant from a clinical standpoint as it is sometimes very difficult to maintain an absolute dry field before applying an etchant.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Score</th>
</tr>
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<tbody>
<tr>
<td><strong>Marginal adaptation</strong></td>
<td></td>
</tr>
<tr>
<td>Embrace</td>
<td>16*</td>
</tr>
<tr>
<td>ClinPro</td>
<td>8</td>
</tr>
<tr>
<td><strong>Penetration ability</strong></td>
<td></td>
</tr>
<tr>
<td>Embrace</td>
<td>0</td>
</tr>
<tr>
<td>ClinPro</td>
<td>0</td>
</tr>
</tbody>
</table>

* Statistically significant (P< 0.05).
One other aspect that should be pointed out is the release of bisphenol A from sealants, although no major health hazards have been reported. Embrace incorporates di-, tri- and multi-functional acrylate monomers into an acid-integrating network that is activated by moisture and is recommended for use on slightly moist tooth surfaces. When activated, the material is acidic. In the cured state the material is no longer affected by water, and as a result, the cured material has a neutral pH and very low water solubility. Embrace does not contain Bis-GMA, and therefore there is no possibility of bisphenol A release.

Resin penetration into enamel, enhanced by acid etching, is considered the key to successful bonding of the sealant. A previous study showed that even if acid etching gels or solutions were scraped into the fissures with an explorer tine, the gels, solutions or sealants did not penetrate beyond the region of fissure constriction. This may explain the reason why neither fissure sealant showed complete penetration into constricted fissures.

Another consistent observation reported in pit and fissure sealant studies is that even in those few instances in which part or all of the deep pits and fissures were penetrated by the sealant, poor resin adaptation was recorded, possibly due to the lack of enamel conditioning or air entrapment, which was also noticed in this study.

Polymerization shrinkage could also play an important role in sealant adaptation to the enamel surface. Embrace may also show less polymerization shrinkage than conventional pit and fissure sealants. Therefore, further studies should evaluate this aspect of fissure sealants.

a. Pulpdent, Watertown, MA, USA.

b. 3M Espe, St. Paul, MN, USA.

c. Buehler, Lake Bluff, IL, USA.

d. FEI, Hillsboro, OR, USA.

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References


