Comparison of Two Different Bonding Agents on Clinical Performance of Fissure Sealants

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Abstract:
Objective: Considering the fact that several bonding agents are available in market, clinical evaluations are required to find the durability of the sealants after using bonding agents. The purpose of this study was to compare the durability of the fissure sealant after applying two kinds of dentin bonding materials, AdheSE and Excite.

Materials and Methods: In this clinical study sample group consisted of hundred permanent first molars teeth of forty two children. Convenience sampling method has been applied. After three, six and twelve month follow-up, marginal integrity, retention rate and caries in experimental groups were examined. Data were analyzed according to Fisher's Exact, Chi-Square and Mann-Whitney statistical tests.

Results: There was no statistical significant difference between the two examined groups, considering marginal integrity, retention rate and caries. In AdheSE group, maxillary teeth had a better retention than mandibular ones.

Conclusion: It seems that in pediatric dentistry use of Excite as a bonding agent before the placement of fissure sealant is preferable.

Key Words: Dental bonding; Dental Prosthesis Retention; Pit and Fissure Sealants; Molar; Child

INTRODUCTION
The occlusal surface is at a high risk for caries. This is especially true for newly erupted molars, where anatomic characteristics cause difficult access for cleaning procedures and incomplete maturation of enamel adds to caries susceptibility. The complex morphology of the occlusal surface also reduces the effectiveness of the fluorides in remineralization phases [1]. Fifty percent of the first permanent molars are decayed by the age of 12 because of the lack of information for protecting them and occlusal morphology. The best way to protect the occlusal surfaces from the carious process is to seal them [2]. Pit-and-fissure sealants have become the most effective noninvasive treatment to prevent occlusal caries [1]. Several studies have shown the effectiveness of fissure sealants in decreasing caries on occlusal surfaces. However, problems in sealant application can cause leakage, partial or total loss, leading to sealant failure at a rate of 5% to 10% a year. The efficacy of sealants depends on many factors such as isolation, use of bonding agent, enameloplasty, and maintenance that may affect sealant retention [3]. Hitt and Feigel [4]; and also Borem and Feigel [5] have shown improved results when an inter-
mediate bonding layer is applied between enamel and sealant after etched enamel contaminated with saliva [4,5]. Several researches have shown that application of bonding agents before fissure sealant improves bond strength, decrease microleakage and increase flow of resin into fissures [5-10]. Higher failure rates of sealant in buccal and lingual fissures could be because of moisture contamination. Feigal reported that the use of bonding agent before sealant improved bond strength in moisture contaminated conditions [11].

Current adhesive systems are total-etch technique or the self-etch (SE) technique. Total-etch adhesive include a phosphoric acid gel that demineralizes dentin and enamel simultaneously but self-etch adhesive does not need a separate acid-etch step. SE adhesive conditions and primes enamel and dentin simultaneously without rinsing. It is based on their ability to partially dissolve hydroxyapatite to cause resin-infiltrated zone with minerals incorporated. SE adhesives include aqueous mixtures of acidic functional monomers, generally phosphoric acid esters or carboxylates, with a PH higher than that of phosphoric acid gels. SE adhesives cause shallow enamel demineralization compared to phosphoric acid due to their higher PH [12].

Hannig et al [13] showed self-etching primers can be an effective alternative to conventional phosphoric acid etchants in conditioning the enamel surface to guarantee a constant bonding and marginal seal of composite resin restorations. Self-etching systems are less technique sensitive than total-etch systems. They seem to eliminate factors such as over-etching, over-drying and over-wetting [14], but a recent clinical study showed that enamel etching prior to the use of an SE adhesive is essential for composite restorations, especially in class IV and V lesions [15].

Considering the variety of dentin bonding materials in Iranian market and announcement of manufacturers about the related higher efficacy compared to other dentin bonding materials, more clinical researches should be done. Since Excite and AdheSE are common dentin bonding materials used in pediatric department of Mashhad Dental School and due to importance of first permanent molars in occlusion and function, recognition of the more efficacious dentin bonding before fissure sealant is necessary.

The purpose of this study was to compare the clinical evaluation of the fissure sealant after applying two types of dentin bonding materials, AdheSE and Excite, on the permanent first molars in children referring to Pediatric Department of Mashhad Dental School.

**MATERIALS AND METHODS**

Forty two children with a mean age of 8.64 years (range 6-13 years) participated in this non-randomized open clinical trial study. Selection criteria included at least two permanent first molars indicated for fissure sealant in each patient. In this study the convenience sampling method has been applied. After taking parental consent, the fissure sealants were done by one dentist in Pediatric Department of Mashhad Dental School. The treatment was completed under a rubber dam.
After isolation, teeth were cleaned by pumice powder and fissures freshened with taper bur on a high speed engine and gently rinsed with water. 37% phosphoric acid gel was applied with a disposable applicator for 20 seconds in order to condition the enamel surface. Then the teeth were rinsed with water and thoroughly dried with oil free compressed air. Two types of dentin bonding materials that was applied before fissure sealant in this study included AdheSE (Self-etch) and Excite (Total etch). For each child before applying sealant AdheSE was applied on the first right and Excite was used on the first left permanent molars, according to manufacturers' recommendations and then fissure sealant (Helioseal F, Ivoclar, Vivadent, Schaan, Liechtenstein) was used. The patients were scheduled for evaluation visits at three, six and twelve months. Also the patients were given diet advice and brushing instruction. The sealants were evaluated in terms of retention; 1, present; 2, partially present; or 3, lost; and the presence of caries; 1, present; or 2, absent. The marginal integrity of sealants was also evaluated using the USHPS system by Koch et al [16]: Alpha, an excellent margin with no evidence of crevice; Bravo, an acceptable margin with a small crevice detected; and Charlie, unacceptable margins with larger crevice present [16]. After each evaluation visit, only professional tooth cleansing procedures were performed by the operator using slurry of prophylaxis and a rubber cap rotating on a low-speed hand piece. Data were analyzed according to Mann-Whitney and Wilcoxon statistical tests.

**RESULTS**

From 42 children, 40 were ready for recall sessions (100 teeth). Results have shown that there was no statistical significant difference between the two examined groups, considering marginal integrity, retention rate (Tables 1, 2) and caries existence. Mann-Whitney Test was used to compare marginal integrity, retention rate and caries existence between experimental groups. Absence of caries was seen in 91.7%, 91.3% and 87% respectively at 3, 6 and 12 months evaluation in AdheSE group. Rates for the same evaluation periods were 95.9%, 89.6% and 83.3% respectively for Excite group.

There was no statistical significant difference comparing the standards between the different surfaces (i.e. buccal, palatal and occlusal).

Table 3 shows that in the AdheSE group maxillary teeth had significantly better retention rates than mandibular ones in all 3, 6 and 12 month follow ups, but there was not any significant difference regarding retention rates in Excite group between the two arches. Compared to mandibular molars, maxillary molars had significantly better marginal integrity after 6 and 12 months except for 3 months in AdheSE group. Also there was not any significant difference in marginal integrity in Excite group between two arches after 3, 6 and 12 months (Table 4). Wilcoxon test was used to compare retention rate, marginal integrity (Tables 3, 4) of fissure sealant and caries presence in experimental groups in both arches. There were no significant differences between

<table>
<thead>
<tr>
<th>Retention Rate</th>
<th>After 3 months</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>AdheSE (%)</td>
<td>Excite (%)</td>
<td>AdheSE (%)</td>
<td>Excite (%)</td>
<td>AdheSE (%)</td>
<td>Excite (%)</td>
</tr>
<tr>
<td>Present</td>
<td>78.0</td>
<td>68.0</td>
<td>66.0</td>
<td>60.0</td>
<td>56.0</td>
<td>52.0</td>
</tr>
<tr>
<td>Partial</td>
<td>18.0</td>
<td>30.0</td>
<td>26.0</td>
<td>36.0</td>
<td>36.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Lost</td>
<td>4.0</td>
<td>2.0</td>
<td>8.0</td>
<td>4.0</td>
<td>8.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Analysis</td>
<td>Z=1.0 , P=0.3</td>
<td></td>
<td>Z=0.42 , P=0.67</td>
<td></td>
<td>Z=0.18 , P=0.85</td>
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</tr>
</tbody>
</table>
maxillary and mandibular teeth regarding dental caries in experimental groups.

**DISCUSSION**

The present study was designed for clinical evaluation of fissure sealant after applying two types of total etch (Excite) and self-etch (AdheSE) dentin bonding materials. There is not any study just similar to ours in review of literature. In the following, some of nearly similar studies have been mentioned.

Pinar et al [1] showed acceptable marginal integrity rates with using One Coat Bond before sealant (93%, 93%, 83%, and 79% respectively after 3, 6, 12 and 24 months). The retention rates for sealants with One Coat Bond were 75% after 24 months [1]. In our study AdheSE group had 56% total presence and Excite group had 52% total presence after 12 months, which is less than study of Pinar et al [1]. However it is noticed that type of dentin bonding materials are different in two studies. In our study AdheSE group had 69.6% and Excite group had 74.5% excellent marginal integrity after 12 month which is similar to the Pinar's study [1].

Perdigão et al [12] showed mean bond strengths for AdheSE to be 16.3 (SD=7.2) for intact enamel and 23 (SD=10.3) for roughened enamel, however, Excite showed 37.9 (SD=13.5) for intact enamel and 36.6 (SD=14.2) for roughened enamel. They showed that mean bond strengths in Excite were higher than AdheSE group. Phosphoric etching of enamel creates microporosities on enamel surfaces. Low viscosity enamel bonding agents flow into the irregularities of etched enamel to provide reliable enamel bond strengths, prevent microleakage and reinforce residual tooth structure. The enamel etching capability of self-etchant adhesives has been studied abundantly. One of the disadvantages of SE adhesives is that the depth of etching is less than that of phosphoric acid [12].

It is not recommended to use self-etching bonding systems, Clearfil Liner Bond 2 and Resulcin Aqua Prime, before fissure sealant because of lower sealing ability compared to conventional acid-etching technique [17].

Also Celiberti and Lussi [18] showed lower microleakage when phosphoric acid was used for 60 seconds instead of 40s and when after enamel etching with phosphoric acid (40s and 20s, respectively) Xeno III used for 20s. There is controversy about efficacy of self-etching materials on enamel and dentin [14]. Feigal and Quelhas reported similar results about retention rate of sealant with a self-etching adhesive (Prompt L-Pob®, 3M ESPE, St Paul, MN, USA) compared to conventional etch method over 24 months [19], but their results are questionable because of the small number of sealants.

Venker et al [20] retrospectively compared a self-etching primer (Prompt L-Pop®) and phosphoric acid etches in a school-based sealant program over a one-year period. They found that sealant retention with the use of phosphoric acid was superior to self-etching primer.

Burbridge et al [21,22] compared the retention of fissure sealants placed on occlusal surfaces following the use of a self-etching priming agent (Xeno® III) and traditional acid etch

<table>
<thead>
<tr>
<th>Marginal Integrity</th>
<th>After 3 months (Maxilla, Mandible)</th>
<th>After 6 months (Maxilla, Mandible)</th>
<th>After 12 months (Maxilla, Mandible)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AdheSE (%)</td>
<td>Excite (%)</td>
<td>AdheSE (%)</td>
</tr>
<tr>
<td>Present</td>
<td>87.9, 58.8</td>
<td>72.7, 58.8</td>
<td>78.8, 41.2</td>
</tr>
<tr>
<td>Partial lost</td>
<td>12.1, 29.4</td>
<td>24.2, 41.2</td>
<td>21.2, 35.3</td>
</tr>
<tr>
<td>Lost</td>
<td>0.0, 11.8</td>
<td>3.0, 0.0</td>
<td>0.0, 23.5</td>
</tr>
<tr>
<td>Analysis</td>
<td>P=0.01</td>
<td>P=0.37</td>
<td>P=0.003</td>
</tr>
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</table>
(phosphoric acid etch together with Prime&Bond). The retention rate of the self-etching priming agent was significantly lower (P<0.01), as was the caries preventive effect (P<0.01). 37% of teeth had complete sealant coverage in the Prime&Bond and etch group. However Xeno® III sealants were more likely to completely fail (0.0% complete sealant coverage after 6 months) [21]. Also after 12 months, the retention was significantly better in etch group (P=0.003) [22]. Burbridge et al [21,22] recommended that the best way for the placement of sealants is enamel preparation with acid etch and the use of intermediate bonding layer.

De Munck et al [23] showed that total-etch systems had higher bond strength to enamel than AdheSE. The ability of self-etching systems to demineralize dental tissue depends on the buffering capacity of dental substrate. At times, self-etching agents applied to dental hard tissues show different behavior because of composition of enamel and dentin. Some of these systems have been introduced and their behavior in bonding to enamel is unknown. Lopes et al [24] showed that among several self-etching systems (Adper Prompt self-etch, Opti Bond Solo Plus self-etch, AdheSE, Tyrian, Clearfil SE Bond, Single Bond), Clearfil SE Bond showed similar bond strength compare to total etch system.

Our study showed that there was no statistical significant difference between the two examined groups considering marginal integrity, retention rate and caries. It should be noticed that in AdheSE experimental group, etching was done with H3PO4 (37%) as recommended by Matsuye [15]. Also Pinar et al [1], Perdigão et al [12] and Hannig et al [17] showed more efficacy of Excite in comparison to AdheSE. As a result, reducing working time and eliminating etching which are advantages of self-etchants have not been taken into account. Furthermore, considering the fact that AdheSE has two stages and takes more time, use of Excite in pediatric dentistry could be recommended.

CONCLUSION
Considering that there was no statistical significant difference in marginal integrity, retention rate and caries between the two examined groups and the shorter procedure of Excite (one-bottle) compared to AdheSE after etching enamel, it seems that in pediatric dentistry use of Excite as a bonding agent before the placement of fissure sealant could be preferable.

ACKNOWLEDGMENT
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