Comparative Evaluation of the Bonding Efficacy of Seventh Generation Bonding Agent and Peak Universal Bond: An In-Vitro Study

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Abstract

Aim: To compare the shear bond strength of seventh generation bonding agent and Peak Universal bond to dentin.

Materials and Methods: Twenty extracted human maxillary third molars were reduced to expose flat surface of dentin and divided into two equal groups, which were bonded using following bonding agents: Group 1: Peak universal bond (self-etch with 0.2% chlorhexidine incorporated in it) & Group 2: Seventh generation bonding agent (self-etch without chlorhexidine). Composite cylinders were built using a plastic mould on these prepared dentinal surfaces. Samples were stored in distilled water for 24 hours and tested for shear bond strength with universal testing machine. Shear force was applied perpendicular to the long axis of composite cylinder at adhesive-tooth interface until debonding occurred. The data so obtained were tabulated and analyzed statistically using independent-samples t test.

Results: There is no statistically significant difference between seventh generation bonding agent and Peak universal bond.

Conclusion: Use of Peak universal bond (self-etch adhesive with 0.2% CHX incorporated in it) has no adverse effect on immediate resin dentin bond strength and it is comparable with that of seventh generation bonding agent (self-etch adhesive without chlorhexidine), suggesting that antimicrobial may be safely incorporated into the resin monomers contained in the adhesive.

Keywords: Bond strength; Peak universal bond; Chlorhexidine; Universal testing machine

Introduction

Adhesive resin-dentin interfaces still deteriorate over time despite improvement made in the chemistry of contemporary dentin adhesives [1-3]. A correlation between the presence of active endogenous matrix metalloproteinase’s (MMPs) in dentin matrices and premature degradation of hybrid layers has been demonstrated [4,5]. In dentin different forms of MMPs has been identified with MMP-2 and MMP-9 being the most relevant [4,6,7]. When exposed to acidic environment, such as the one created by the application of acidic adhesive resins, these enzymes, initially secreted as pro-enzymes, become active proteinases [8]. These host derived MMPs have been shown to degrade sub-optimally infiltrated collagen fibers once they have been activated through bonding procedures [5,9].

Bonding to dentin currently can be achieved through etch-and-rinse (ER) or a self-etch (SE) approach. pH of etch and rinse adhesives is high (2.5-4.5) to etch through smear layer and underlying dentin, hence separate acid etching step with 32%-37% phosphoric acid is required. Incomplete infiltration of demineralized dentin matrix with resin monomers apically leaves collagen incompletely encapsulated to the bottom of the hybrid layer [10], which is then susceptible to proteolytic degradation by host-derived MMPs. Self-etch adhesives, with a higher pH (2.0-2.7), can still etch through the smear layer. Despite the shallow etching pattern, optimal hybrid-action and high bond strengths have been reported with these formulations [11]. Activation of precursor MMP forms has been demonstrated with ER [8] and SE [8,12] adhesive systems.

Chlorhexidine digluconate (CHX), a cationic antimicrobial agent which is effective against Gram-positive and Gram-negative microbes has been demonstrated successful inhibition of dentin MMP collagenolytic activity when used in concentrations of 0.2% and 2.0% [12-14]. Peak Universal Bond is a novel self-etch adhesive containing chlorhexidine in it.

Therefore the aim of the present study was to compare the bonding efficacy of a novel SE adhesive system containing 0.2% CHX (Peak Universal Bond) and SE adhesive system (seventh generation bonding agent) without CHX to dentin.

Materials and Methods

Twenty freshly extracted non-carious, intact human maxillary third molar teeth were selected for this study. The collected teeth were cleaned of debris stored in saline solution. The specimen teeth were utilized within three months of extraction. These teeth were embedded in cold cure acrylic till cement to enamel junction with the help of plastic moulds (Figure 1). The occlusal surface of each tooth was reduced in order to expose flat surface of dentin with a high speed...
handpiece using #245 carbide bur under constant water spray (Figure 2). The prepared specimens were randomly divided into two experimental groups with 10 specimens in each group depending upon the bonding agent used:

1. Group 1: Peak Universal bond (Ultradent)
2. Group 2: Seventh generation bonding agent (Adper SE, 3M ESPE)

Tooth surface was rinsed and blotted dry. Bonding agents were applied with a microbrush on exposed surface of dentin and light cured for 20 seconds. Then, the composite resin Z 350 (3M ESPE) was placed in a 2 layer increment using plastic mould (2 x 2.5 mm) on exposed dentin surface and was light cured for 40 seconds (Figures 3 and 4). All the specimens were stored in distilled water for 24 hours prior to shear bond testing. Specimens were mounted on the universal testing machine (Unitek, 9450 PC, FIE, INDIA), and force applied by a machine on each specimen was at a crosshead speed of 1 mm/min using a blade parallel to the adhesive-dentin interface. The specimens were positioned horizontally, so that the shearing blade is perpendicular at composite-dentin interface (Figure 5). Each specimen was loaded until failure. Shear force required to debond the specimen was recorded in pounds and converted into megapascals (MPa). The data so obtained were tabulated and analyzed statistically using independent-samples t test.

Results

The results of SBS along with the results of the statistical analysis are summarized in Table 1. The statistical analysis revealed that at 24 hours, there was no significant difference between SBS of Group1: Peak Universal bond (self etch adhesive with 0.2% chlorhexidine incorporated) and Group2: Seventh generation bonding agent (self-etch without chlorhexidine).

<table>
<thead>
<tr>
<th>Group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUB (Group 1)</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Mpa</td>
<td>23.05</td>
</tr>
<tr>
<td>p &gt; 0.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: The mean in Peak universal bond (PUB) was no significant difference than 7th generation bonding system (p > 0.05).
Discussion

One of the problems affecting adhesive restorations is premature loss of adhesion [15] and has been primarily attributed to hybrid layer degradation at tooth restoration interface [16].

Self etch adhesives are selected in the study, that this approach eliminates the rinsing phase, which not only decreases the clinical application time, but also significantly reduces the technique-sensitivity or the risk of making errors during application. Regarding user friendliness and technique-sensitivity, this approach seems clinically most promising [17].

Figure 5: Shearing blade perpendicular to composite dentine surface.

Many studies have done on the chlorhexidine application on etched dentin, in association with etch-and rinse adhesives, before primer and bonding application [14-18]. No studies have been conducted on the chlorhexidine incorporated in the self-etch adhesive.

The present study evaluated the bonding efficacy of seventh generation bonding agent (self-etch without chlorhexidine) and Peak Universal bond (self-etch adhesive with 0.2% chlorhexidine incorporated in it). Chlorhexidine incorporated into the adhesive, did not appear to affect bond strength for adhesive approach at 24 hours, suggesting that the antimicrobial may be safely incorporated into the resin monomers contained in the adhesive. Our results confirm those from previous studies, which have shown that CHX, applied topically [14,19-23], or into adhesive system has no effect on the immediate bond strength.

Chlorhexidine widely used as antimicrobial agent. Previous studies have demonstrated that application of chlorhexidine before or after acid etching has no adverse effects on immediate bond strength of etch and rinse adhesives [24,25]. Recent studies also stated that the initial bond strength of chlorhexidine application after acid etching is comparable with that of controls [21]. The data of present study indicates that peak universal bond (self-etch adhesive with 0.2% chlorhexidine incorporated in it) has no effect on the bond strength of resin to dentin.

It has been reported that chlorhexidine possesses MMP-inhibitory properties at very low concentrations. Chlorhexidine completely inhibit MMP-2 and MMP-9 gelatinase activity at concentrations as low as 0.03% [19].

In recent studies in which 2% chlorhexidine solution is used after acid etching for etch and rinse adhesive systems excess chlorhexidine is blot dried and removed with absorbent paper points before application of adhesive and resin composite [21,26]. It is fact that MMPs can be inactivated by chlorhexidine when applied after acid etching. MMPs activated by the adhesive can further demineralize dentin and activate MMPs by acid-activation mechanism [27]. In our study peak universal bond is used which is a novel self-etch adhesive with 0.2% CHX incorporated in it, when self-etch adhesives demineralize dentin and activate MMPs, chlorhexidine in self etch adhesive can simultaneously inactivate MMPs until adhesive is cured. Therefore we can hypothesize that use of chlorhexidine incorporated self-etch adhesives result in better preservation of resin dentin bonds that of application of 2% chlorhexidine after acid etching for etch and rinse adhesive system.

Further studies should be conducted to evaluate the role of chlorhexidine incorporated self-etch adhesive in stabilizing the bond for long term period.

Conclusion

Under the limitations of the study it can be concluded that the use of Peak universal bond (self-etch adhesive with 0.2% CHX incorporated in it) has no adverse effect on immediate resin dentin bond strength and it is comparable with that of seventh generation bonding agent (self-etch adhesive without chlorhexidine), suggesting that antimicrobial may be safely incorporated into the resin monomers contained in the adhesive.

References