Comparison of Mean Shear Bond Strength of Light Cure, Self-Cure Composite Resins, Self-Etching and Moisture-Insensitive Primers: An in vitro Study

Chandresh Shukla, Gurmukh Singh, Upendra Jain, Karthik Swamy

ABSTRACT

Objectives: This study was aimed to compare the mean shear bond strength of four orthodontic bonding materials used for bonding orthodontic brackets. Self-cure composite adhesive (Reliance orthodontics), light cure composite adhesive (Transbond XT, 3M Unitek), light cure with self-etching primer (SEP), Transbond XT and Transbond Plus, 3M Unitek and light cure with moisture-insensitive primer (MIP) (Transbond XT and Transbond MIP) were used.

Materials and methods: One hundred and twenty maxillary premolar teeth were collected and divided into four groups. Thirty separate maxillary premolar brackets were bonded to the teeth for each of the bonding agents. Debonding were carried out by using Instron universal testing machine.

Results: Light cure composite adhesive (Transbond XT, 3M Unitek) had the highest shear bond strength followed by light cure and SEP (Transbond Plus and Transbond XT, 3M Unitek) followed by light cure and MIP (Transbond MIP and Transbond XT, 3M Unitek) and the lowest was self-cure composite adhesive (Rely-a-Bond, Reliance orthodontics).

Conclusion: All the materials had the minimal shear bond strength required for orthodontic bonding as proposed by Reynolds and they can be used clinically.

Keywords: Shear bond strength, Self-etching primer, Moisture-insensitive primer.

INTRODUCTION

In the evolution of fixed orthodontic appliances, esthetic is one of the prime concern in the acceptance of any appliance by the patient. This time consuming and unesthetic procedure has been virtually discarded after the introduction of acid-etch direct bonding technique in 1955 by Buonocore. First bonding of orthodontics bracket was reported by Newman in 1965. Over the past 2 decades, the evolution of adhesive techniques has transformed the scope of dental practice. The development of light cured composite has become increasingly popular for bonding orthodontic attachment. The unlimited working time of the adhesive allows the orthodontist to manipulate the bracket position until polymerization is initiated by visible light source.

Bis-GMA or Bowen’s resin, which is a self-cure resin, provides good bond strength, but has few inherent flaws. It is extremely technique sensitive. Having a short setting time, it permitted limited working time for accurate bracket positioning.

The sixth generation self-etching primer system [self-etching primer (SEP)] consists of etchant and primer dispersed as a single unit. Hence, the etching and priming are merged as a single-step stage in bonding procedure, resulting in time saving for the clinician, which has cost implications.

Seventh generation bonding agent [moisture-insensitive primer (MIP)] is the latest entrant and the first no mix bonding adhesive which sets in presence of moisture giving effective bond strength. This is totally insensitive to moisture. Moisture-free oral environment during bonding is often difficult to achieve clinically.

AIMS AND OBJECTIVES

The aim of this study was to compare the shear bond strength of orthodontic brackets bonded with a self-cure bonding material (Rely-a-Bond), light cure bonding material (Transbond XT) and sixth generation SEP system (Transbond Plus) and seventh generation MIP system (Transbond MIP).
MATERIALS AND METHODS

Total 120 extracted human maxillary permanent premolars were collected; the teeth were rinsed with water to clean blood and soft tissue debris and then decontaminated with 0.5% thymol. Further, the teeth were stored in distilled water at 37°C for 2 weeks. Each tooth was placed in a mould and roots were embedded in self-curing acrylic resin block (diameter = 15 mm; height = 20 mm) up to 1 mm apical to CE junction. The long axis of the tooth was kept parallel to the long axis of the acrylic block. Crowns were kept exposed to facilitate surface treatment and adhesive bonding on buccal surfaces. The acrylic resin blocks were color-coded to differentiate four groups of 30 teeth as follows.

1. **Group A**: Teeth were embedded in green-colored acrylic resin blocks for bonding using self-cure resin (Rely-a-bond, Reliance orthodontics products, Itasca.III; Fig. 1).

2. **Group B**: Teeth were embedded in pink-colored acrylic resin blocks for bonding using light cure composite (Transbond XT, 3M Unitek, Monrovia, Calif; Fig. 2).

3. **Group C**: Teeth were embedded in yellow-colored acrylic resin blocks for bonding using self-etching primer (SEP) and light cure composite (Transbond Plus and Transbond XT, 3M Unitek, Monrovia, Calif; Fig. 3).

4. **Group D**: Teeth were embedded in black-colored acrylic resin blocks for bonding using MIP and light cure composite (Transbond MIP and Transbond XT, 3M Unitek, Monrovia, Calif; Fig. 4).

Orthodontic preadjusted edgewise appliances (PEA) metal brackets having 0.022 × 0.028 MBT slot for maxillary premolar (Gemini 3M, Unitek Monorovia, Calif) were used for bonding. The surface area of bracket was 10.61 mm². All the brackets were bonded on the buccal surfaces according to the instructions supplied by the manufacturer. All bracket were bonded by a single operator to avoid interoperator variation (Figs 5A to D).

The shear bond strength tests were done using Instron universal testing machine no.3382 at cross head speed of 1 mm/min force passing parallel to buccal surface (Fig. 6). A custom-made rod was locally fabricated for debonding of brackets (Fig. 7). Each block was fixed in a metal jig a force parallel to the tooth surface in an occlusal-apical direction was applied by the machine. The force required to debond each bracket was registered in newtons and converted into megapascals by using the following formula:

\[ \text{Bond strength MPa} = \frac{\text{force in Newtons}}{\text{surface area of bracket in mm}^2}. \]
Statistical Analysis

Mean shear bond strength (SBS) of different groups was determined using student’s t-test. The level of significance (p-value) was kept at 0.05.

RESULTS

Group A (self-cure composite resin) showed a mean SBS of 9.03 ± 1.14 and group B (light cure composite resin) showed a mean SBS of 10.34 ± 2.91 and group C (light cure and SEP) was showing mean SBS of 9.78 ± 0.871 and group D (light cure and MIP) showed a mean SBS of 9.65 ± 0.90. The difference between self-cure and light cure composite resin and self-cure and light cure with SEP and self-cure and light cure and MIP was statistically significant (S). On the other hand, in comparison of light cure composite resin and light cure with SEP and light cure composite resin and light cure and MIP was statistically nonsignificant (NS), the difference between light cure and MIP and light cure with SEP was nonsignificant (NS) as confirmed by paired t-test (Table 1).

DISCUSSION

The findings of this study indicated that in all the three groups, the mean SBS to the tooth was highest with group B light cure composite resin (10.34 ± 2.91 MPa) followed by group C light cure and SEP (9.78 ± 0.871 MPa) and the lowest for group A self-cure composite resin (9.03 ± 1.14). The groups A

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean (SBS ± SD) in MPa</th>
<th>t-value</th>
<th>p-value</th>
<th>Significant (S)/nonsignificant (NS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and B (self-cure and light cure composites)</td>
<td>9.03 ± 1.14, 10.34 ± 2.91</td>
<td>2.01</td>
<td>0.01</td>
<td>S</td>
</tr>
<tr>
<td>B and C (light cure and light cure + SEP)</td>
<td>10.34 ± 2.91, 9.78 ± 0.871</td>
<td>0.95</td>
<td>0.34</td>
<td>NS</td>
</tr>
<tr>
<td>B and D (light cure and light cure + MIP)</td>
<td>10.34 ± 2.91, 9.65 ± 0.90</td>
<td>0.95</td>
<td>0.24</td>
<td>NS</td>
</tr>
<tr>
<td>A and C (self-cure and light cure + SEP)</td>
<td>9.03 ± 1.14, 9.78 ± 0.871</td>
<td>2.68</td>
<td>0.012</td>
<td>S</td>
</tr>
<tr>
<td>A and D (self-cure and light cure + MIP)</td>
<td>9.03 ± 1.14, 9.65 ± 0.90</td>
<td>2.43</td>
<td>0.021</td>
<td>S</td>
</tr>
<tr>
<td>C and D (light cure + SEP and light cure + MIP)</td>
<td>9.78 ± 0.87, 9.65 ± 0.90</td>
<td>0.50</td>
<td>0.61</td>
<td>NS</td>
</tr>
</tbody>
</table>

S: Significant; NS: Nonsignificant
Comparison of Mean Shear Bond Strength of Light Cure, Self-Cure Composite Resins

SELF-CURE VS LIGHT-CURE COMPOSITE ADHESIVE

SELF-CURE COMPOSITE RESIN

1. Licht cure composite adhesive (Transbond XT, 3M Unitek, Monrovia, Calif) followed by light cure and SEP (Transbond Plus and Transbond XT, 3M Unitek, Monrovia, Calif) had the highest SBS followed by light cure and SEP (Transbond MIP and Transbond XT, 3M Unitek, Monrovia, Calif) and the lowest was self-cure composite adhesive (Rely-a-bond, Reliance orthodontic products, Itasca, IL).

2. In the present study, the entire four different bonding agents have shown SBS value of more than 7.8 MPa, hence, all the four materials are suitable for clinical use.

REFERENCES