Evaluation of bonding durability to CAD/CAM crowns

**INTRODUCTION**

CAD/CAM restorations are predicted to become mainstream. Various manufacturers have launched new types of hybrid resin block materials for CAD/CAM crown into the market. Previously, effect of thermal cycle test to bonding durability has been reported. However, there are no reports that evaluated the relationship between cement film thickness and bonding durability considering the adaptation accuracy of CAD/CAM crowns. In this study, effect of cement film thickness on bonding durability of resin cement to CAD/CAM crown was evaluated using a cyclic loading test with thermal cycle assuming an occlusal load.

**METHODS**

**Materials**

Table 1. Materials

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Hybrid resin Block</th>
<th>Resin Cement</th>
<th>Primer for the block</th>
<th>Primer for the abutment</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC CERASMART</td>
<td>G-CERASMART (A3LT #111551)</td>
<td>ResiCem Ceramic Primer E (TR #111551)</td>
<td>Porcelain Primer (W3552)</td>
<td>ML Primer (W111551)</td>
</tr>
<tr>
<td>SHOFU</td>
<td>SHOFU (A3LT #111551)</td>
<td>ResiCem Ceramic Primer E (TR #111551)</td>
<td>Porcelain Primer (W3552)</td>
<td>ML Primer (W111551)</td>
</tr>
<tr>
<td>3M ESPE</td>
<td>LAVA Ultimate (A3LT #1408061)</td>
<td>LAVA Ultimate (TR #130747)</td>
<td>Scamic Universal Adhesive (V0941-E)</td>
<td></td>
</tr>
<tr>
<td>VITA</td>
<td>VITA (1408061)</td>
<td>LAVA Ultimate (TR #130747)</td>
<td>Scamic Universal Adhesive (V0941-E)</td>
<td></td>
</tr>
</tbody>
</table>

**RESULTS & DISCUSSION**

**Tensile bond strength after cyclic loading test**

The results were analyzed by one-way ANOVA and Tukey test, and results & discussion of each item are summarized below.

- **< No-load >** Bond strength of each CAD/CAM block decreased by increasing cement film thickness as noted below.
  1. When cement volume is increased, the cement layer largely strain with accumulation of tensile force using tensile bond strength test because the cement layer has lower strength and elastic modulus compared to abutment teeth and crown. This lead to cohesive failure during the test.
  2. Thicker cement layer lead to higher polymerization shrinkage and this provides higher stress on adhesion interface.

- **< Loaded >** When cement film thickness was 300 or 600μm, no significant difference in the bond strength of CERASMART/G-CERASMART was observed statistically between No-load and Loaded group as noted below.
  1. Both block and cement have higher compressive strength, which leads to higher durability on cyclic loading.
  2. By similar compressive elastic modulus between block and cement, impact to adhesion interface by strain and stress during cyclic loading was lower.

- **< 5,000 Thermal cycling & Loaded >** When cement layer was 100μm, no significant difference in the bond strength of CERASMART/G-CERASMART was observed statistically between each testing group (No-load, Loaded and 5,000 Thermal cycling & Loaded), which indicates the higher bonding durability.

This result shows that combination of G-CERASMART and Ceramic primer II has sufficient chemical adhesion against thermal stress.

**CONCLUSION**

This study supports that cement film thickness has an affect on bonding durability of resin cement to CAD/CAM crowns. Therefore, proper abutment tooth preparation to make accurate CAD/CAM crowns and reliable bonding steps are important for long-term clinical stability.