Bonding of high-strength ceramics to dentin using acrylic adhesive cements

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Objectives

There has been an increasing interest in high-strength ceramics in prosthetic dentistry. Many researches on the bonding behaviors to them have been reported. However, there are few reports on the bonding behaviors of these high-strength ceramics to tooth structures, especially to dentin. The purpose of this study was to evaluate the shear bond strengths (SBS) of high-strength ceramics to dentin when they were bonded with acrylic adhesive resin cements.

Materials and Methods

Materials

Resin cements and ceramic primers

<table>
<thead>
<tr>
<th>Super-Bond (SB) SUN MEDICAL</th>
<th>Super-Bond Quick (SB-Q) SUN MEDICAL</th>
<th>MULTIBOND (MB) Tokuyama Dental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentin activator : Lot. FL6</td>
<td>Quick Monomer : Lot. 021220-2</td>
<td>Primer A : Lot. 101</td>
</tr>
<tr>
<td>Polymer (Clear) : Lot. FE1</td>
<td>Polymer (Clear) : Lot. FE1</td>
<td>Primer B : Lot. 202</td>
</tr>
<tr>
<td>Catalyst : Lot. FL43</td>
<td>Liquid : Lot. 314B</td>
<td>Liquid : Lot. 009</td>
</tr>
<tr>
<td>Porcelain Liner M</td>
<td>Ceramic Primer</td>
<td>Powder : Lot. S2E72</td>
</tr>
<tr>
<td>Liquid A : Lot. VK2</td>
<td>Liquid A : Lot. VK2</td>
<td></td>
</tr>
<tr>
<td>Liquid B : Lot. VK2</td>
<td>Liquid B : Lot. 009</td>
<td></td>
</tr>
</tbody>
</table>

Methods

1. Preparation of ceramic rod surface

- In-Ceram Al₂O₃ rod
- Empress II rod (6mm x 6mm)
- ground with 1000-grit SiC Paper
- Sandblasted with Al₂O₃ (90µm x 0.3MPa)
- Silane-coupling treatment with the each attached ceramic primer

2. Preparation of dentin surface

- Caries free human Molar
- ground to dentin with 180-grit SC Paper
- pre-treated according to the each cement instruction

3. Post-treatment and SBS test

- immersed in 37°C water for 24 Hours
- thermocycling 1000 times (5/55°C, dwelling time 55s)
- SBS test (crosshead speed : 2.0mm/min)

4. Data treatment and failure mode evaluation

The data of SBS were statistically analyzed by ANOVA and Fisher’s test (p<0.05, n=7)

Discussion

Although the cements tested in this study are all the acrylic based resin cements, a significant difference of bonding performance is found between SB, SB-Q groups with MB group. The most important reason of this difference is considered resulted from the polymerization initiating system between SB, SB-Q groups with MB group.

In SB and SB-Q groups, the initiating system is the well-known partially oxidized tributylborane (TBB). As it has been reported that the polymerization initiated by TBB can be accelerated in the presence of a small quantity of water and oxygen, a condition similar to the dentin surface to be bonded. The polymerization in the dentin/resin interface of SB and SB-Q groups is therefore considered faster than the other part of resin, and the polymerization shrinkage stress can be released far away from the dentin/resin interface.

In MB group, the initiating system is basically a BPO-amine redoxy system, although it is claimed containing a tetra-aromatic borate compound, which can transfer into tri-aromatic boron when mixed with acid. However, it has been reported that tri-aromatic boron has almost not polymerization initiating ability comparing with the other tri-alkyl boron.

The “oriented stress releasing” polymerization initiated by TBB results in a high bonding performance of SB and SB-Q to dentin.

Conclusions

The bond strength between the high-strength ceramics tested and dentin was depended on the adhesive cement used. The TBB curing initiating acrylic adhesive cements, Super-Bond and Super-Bond Quick, showed a significant high bonding performance than the other cement tested.