Sealing of XeraCem™, and controls using a bacterial leakage model

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Objective: To determine the marginal sealing properties of XeraCem™ for cementation of complete crowns by means of a bacterial leakage model test. The efficacy of the self-sealing properties of XeraCem™ was compared to two other commercially available cements.

Introduction: It has been well established that the chemical composition and the type of luting agent used for cementing cast gold crowns has a bearing on fluid and/or bacterial microleakage [7-8]. The role of microorganisms and exposure to fluids at crown margins and the effect on the luting material and dentin have been demonstrated to be important factors involved in secondary dental decay as well as pulpal and/or gingival inflammation [1-5]. The use of conventional dyes has provided useful information concerning the properties of various cements [4, 6-7 & 9]. For this study, an in vitro method for studying the penetration of microorganisms was developed. The methodology is a modification of bacterial leakage tests that have been used in endodontic research.

Materials and method: Teeth and crown preparation
30 extracted human teeth (upper and lower bicuspid) were prepared for full coverage using a high speed hand piece with copious water cooling and a diamond bur. The occlusal surface was reduced perpendicular to the long axis and penetrated the dentin by at least 1-1.5mm. The crown preparations had a chamfer finish line. Total angle of convergence was 10-12 degrees. All margins were on dentin. The height of the preparations was approximately 5 mm. Copings were waxed with a flat occlusal surface not more than 0.5mm thick. Using conventional laboratory techniques the wax patterns were invested and cast in Type III gold. The internal finishing surface was sandblasted (50 μm particles). The teeth were stored in a Sterile Phosphate Buffer (SPB) solution, except when worked on.

The teeth and matching castings were bagged individually and autoclaved according to standard sterilization procedures. After sterilization 10 samples were randomly assigned to three groups (n=10), see table 1. Cementation was carried out according to the manufacturer’s instructions, using sterile gloves and instruments. One operator did all cementations with the help of a dental assistant making every effort to work under aseptic conditions.

Bacterial leakage setup
For this experiment a slight modification of the dual chamber test apparatus described by Imura et al. (1997) was used. The tip of a 1.5-ml Eppendorf plastic tubes (upper chamber) was cut and the sample was inverted and then pushed through the opening until approximately one half of the crown protruded through the end of the tubes. The junction between the teeth and the tubes was sealed with sticky wax making sure the crown margin was situated in the upper chamber. The tubes were put into glass vials (lower chamber) containing 10 ml of sterile trypticase soy broth (TSS; Difco Laboratory, Detroit, MI) in such a way that the occlusal dentin/cement interface was submerged in the broth.

Results:
One sample in the XeraCem group had to be discarded due to a faulty cementation procedure. Sample turbidity was checked daily and Table 2 summarizes the results in 20-day intervals. The presence of E. faecalis was verified in all chambers showing turbidity. According to the statistical analysis XeraCem and RelyX Luting Plus showed significantly lower bacterial leakage compared to KetacCem. No difference between XeraCem and RelyX Luting Plus was observed.

Conclusions:
Within the limitations of this study, the following conclusions can be drawn:
1. The method described here appeared to be a suitable procedure for testing the sealing ability of luting materials against bacterial microleakage when used for cementation of full crowns. The method may also be suitable for testing marginal bacterial leakage of dental restorations.
2. Cast crowns cemented with XeraCem or Rely X Luting Plus provided an acceptable marginal seal up to 60 days and showed significantly lower bacterial leakage compared to Ketac Cem.
3. The stability and the sealing properties of the tested materials at the restoration/tooth interface after more than 60 days needs to be further investigated.

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Table 1. Test groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
<th>n=10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>XeraCem (Doxa Dental)</td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>Ketac Cem (3M ESPE)</td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>Rely X Luting Plus (3M ESPE)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Samples showing turbidity per 20-day interval

<table>
<thead>
<tr>
<th>Group</th>
<th>n=10</th>
<th>1-20 days</th>
<th>21-40 days</th>
<th>41-60 days</th>
<th>No leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>XeraCem</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>8 (88.9%)</td>
</tr>
<tr>
<td>Ketac Cem</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>4 (40%)</td>
</tr>
<tr>
<td>Rely X Luting Plus</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>8 (80%)</td>
</tr>
</tbody>
</table>

References: