COMPARATIVE EVALUATION OF MARGINAL MICROLEAKAGE IN AMALGAM RESTORATIONS OF PERMANENT AND PRIMARY TEETH- A STEREOMICROSCOPIC STUDY

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ABSTRACT
Microleakage and lack of adhesion to the tooth structure are shortcomings that have limited dental amalgam’s use in certain clinical conditions. Studies have shown that the use of adhesive resins as liners under amalgam will create greater retention than mechanical undercuts. The objective of this study is to evaluate the sealing ability of a dentin bonding agent when used as a liner around dental amalgam restorations of both the permanent and the primary teeth.

KEYWORDS: - Dental amalgam, Dentin bonding agent, Varnish, Marginal leakage.

INTRODUCTION
Dental Amalgam has survived for nearly two centuries enduring a pattern of rises and falls with the dental profession and the public. Amalgam has many advantages including ease of manipulation, good wear resistance, long clinical service life and reasonable cost to the patient. However, lack of adhesion and early microleakage are significant disadvantages to its use as a restorative material. Microleakage is defined as the passage of fluid, bacteria, molecules or ions and air between a restorative material and a prepared cavity wall of a tooth. Microleakage of amalgam restorations can lead to tooth discoloration, marginal breakdown, dentinal sensitivity, secondary caries and pulpal irritation. This microleakage poses a particular problem in the child patient in whom the floor of the cavity preparation may be close to the pulp. The use of cavity varnish to help control initial microleakage is an age old technique, but the solubility of varnish in oral fluids limits its effectiveness to about six months. Since the mid-1980s adhesive resin systems have been advocated for use in bonding amalgam to tooth structure. Dentin adhesives, used as liners in amalgam restorations reduce microleakage, improve retention and strengthen restored teeth.

This in-vitro study was undertaken to evaluate the sealing ability of a dentin bonding agent (3M Scotchbond™) and a fluoride varnish (Duraflur®) between cavity walls and amalgam restorations in both the permanent and primary teeth.

MATERIALS and METHOD (Fig. 1)
This study comprises of 30 non-carious human premolars and 30 non-caries human primary molars that were extracted. All the teeth were stored in normal saline at 37°C till the day experiment began. Class 1 cavities were prepared on the occlusal surfaces of all the teeth and the cavosurface walls were prepared to a butt joint. The prepared samples were randomly divided into 6 groups of 10 teeth each. Groups 1 and 2 cavities were lined with Dentine Bonding agent. Groups 3 and 4 were lined with fluoride varnish. Group 5 and 6 received no liner. Silver amalgam restorations were placed in all teeth. The restorations were left unburnished and unpolished since burnishing and polishing leads to a clear reduction of marginal leakage.

The specimens were thermally stressed for 3000 cycles between 5°C and 55°C. Dwell time in each bath was 30 seconds. After thermocycling, teeth were dried followed by two coats of nail polish to within 1mm of the margin of the restorations. Root
Apices were sealed with sticky wax and the teeth were kept in 2% methylene blue dye in a plastic tray at \(37^\circ\)C for 24 hours. After 48 hours, teeth were removed from 2% methylene blue dye and washed under tap water. Nail polish was removed and each tooth was sectioned buccolingually and each section was then viewed under a stereomicroscope at 10X magnification and scored for microleakage by two examiners. Microleakage scores were based on the degree of dye penetration according to the following scale:

0 = No leakage
1 = Dye penetration less than halfway to the axial wall
2 = Dye penetration greater than halfway to the axial wall
3 = Dye penetration along the wall including the pulpal wall

**RESULTS**

Pair-wise comparisons between groups were made with student’s t-test. To test whether the mean of 6 groups differ significantly or not f-test or analysis of variance has to be applied. Since the computed f – ratio > than the table f- ratio (critical ratio), the mean leakage of 6 groups differ significantly.

### Table 1 – Pair wise Comparison between the groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>D.F</th>
<th>“t” Value</th>
<th>“p” Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2</td>
<td>18</td>
<td>0.5</td>
<td>&gt;0.1</td>
<td>NS</td>
</tr>
<tr>
<td>3 and 4</td>
<td>18</td>
<td>0.51</td>
<td>&gt;0.1</td>
<td>NS</td>
</tr>
<tr>
<td>5 and 6</td>
<td>18</td>
<td>0.6</td>
<td>&gt;0.1</td>
<td>NS</td>
</tr>
<tr>
<td>1 and 5</td>
<td>18</td>
<td>13.9</td>
<td>&lt;0.001</td>
<td>HS</td>
</tr>
<tr>
<td>3 and 5</td>
<td>18</td>
<td>8.36</td>
<td>&lt;0.001</td>
<td>HS</td>
</tr>
<tr>
<td>1 and 3</td>
<td>18</td>
<td>2.51</td>
<td>&lt;0.05</td>
<td>S</td>
</tr>
<tr>
<td>2 and 6</td>
<td>18</td>
<td>14.2</td>
<td>&lt;0.001</td>
<td>HS</td>
</tr>
<tr>
<td>4 and 6</td>
<td>18</td>
<td>5.47</td>
<td>&lt;0.001</td>
<td>HS</td>
</tr>
<tr>
<td>2 and 4</td>
<td>18</td>
<td>1.91</td>
<td>0.05</td>
<td>S</td>
</tr>
</tbody>
</table>

DF – Degree of Freedom
HS – Highly Significant
S – Significant
NS – Not Significant

### Table 2 - Analysis of Variance

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Sum of Squares</th>
<th>F. Ratio</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between the Groups</td>
<td>5</td>
<td>73.53</td>
<td>14.71</td>
<td>40.11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>With in the Groups</td>
<td>54</td>
<td>19.8</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 1. Materials and Equipments used in the study

Fig. 2. Stereomicroscopic picture of Group 1 cavity- lined with Dentin Bonding Agent.

Fig. 3. Stereomicroscopic picture of Group 6 cavity- No liner.
Successful sealing with a dentin bonding agent can be explained by adhesive bond formation to the calcium ions in the dentin and to the calcium ions in the dentin smear layer surface.\textsuperscript{13} Fluoride varnish does not bond to the tooth or amalgam which can explain differential sealing ability of these two materials. Results from this study demonstrate the effectiveness of dentin bonding agent in sealing the cavity walls of the amalgam restorations in comparison to either fluoride varnish or no liner in both the permanent and primary teeth.\textsuperscript{14} However, many variables influence the microleakage. Stresses as a result of thermocycling and amalgam shrinkage may cause separation of the amalgam from the liner. The type of alloy selected, method of trituration, method of cavity preparation, amalgam finishing, technique of application of varnish, the type of cavity, the type of liner used and the technique sensitivity are some of the many variables that influence the study. This study does not address the above mentioned variables. Further investigation of the mechanical properties of the amalgam-resin layer and its clinical implications are warranted. Clinical trials are also required to evaluate the long term in-vivo performance of resin lined amalgam restorations in the oral environment.\textsuperscript{15}

CONCLUSION

The results showed that the dentin bonding agent reduced microleakage significantly in both the permanent and primary teeth than either the fluoride varnish or the unlined restorations. When comparing the permanent and the deciduous teeth, a higher degree of microleakage was seen in the deciduous teeth than in the permanent teeth. However, statistically no significant differences in leakage patterns between the permanent and primary teeth was observed. Eventhough in-vitro studies provide evidence for the sealing ability of dentin adhesive liners around amalgam restorations, clinical trials are required to document long term clinical performance.

REFERENCES


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