COMPARATIVE EVALUATION OF THREE DIFFERENT COMPOSITE PLACEMENT TECHNIQUE USING DIFFERENT MODES OF CURING LIGHT ON PRIMARY TEETH: AN IN-VITRO STUDY

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Abstract
Background: For the past several years, different techniques and materials have been examined to reduce microleakage in class V restorations. Thus both the quantity and quality of polymerization can be improved with proper selection of light curing modes and clinical placement techniques.
Aim: The aim of the present study was to evaluate and compare which is one of the best placement technique and mode of curing to reduce microleakage.
Material and method: Class V cavities were prepared in 135 teeth. Teeth were divided into 3 groups of 45 each using three different placement technique with two different composite. Each group was further subdivided into 15 teeth cured by different curing modes.
Results: The ‘p’ value of the mean scores of all the groups when cured with high intensity mode is 0.004 (< 0.05) indicating that the results are statistically significant. But the ‘p’ value of the mean scores of all the groups when cured with pulse delay and ramped mode is 0.603 and 2.167 (> 0.05) indicating that the results are not statistically significant. The ‘p’ value of the mean scores of group I and group II when cured with different mode is 0.065 and 0.085 (> 0.05) indicating that the results are not statistically significant. But the ‘p’ value of the mean scores of the group III when cured with different mode is 0.001 (< 0.05) indicating that the results are statistically significant.
Conclusion: Split increment horizontal technique showed least microleakage despite of curing modes. Although curing modes did not show statistically significant results but high intensity showed least microleakage.

Keywords: composite, G.V Black Classification, polymerization shrinkage, curing modes

INTRODUCTION:
For the past several years, different techniques and materials have been examined to reduce microleakage in class V restorations. These efforts were directed toward improving composite resin formulation, photocuring methods, and restorative placement techniques. Bulk and incremental placement techniques are used for composite restorations. Incremental placement techniques are widely recognized as a major factor in the reduction of shrinkage stresses. Type of curing lights and modes of curing have been shown to affect the degree of polymerization and related shrinkage on resin based composite. Thus both the quantity and quality of polymerization can be improved with proper selection of light curing units and clinical curing techniques.

The aim of the present study was to evaluate and compare which is the best placement technique and mode of curing to reduce microleakage.
Material and method:

The study was conducted in the institution on 135 extracted primary teeth.

Inclusion criteria: Extracted primary teeth with no cracks, decay, fracture, abrasion, previous restorations, or structural deformities were considered for the study.

135 teeth were collected and stored in normal saline after scaling. The class V cavities were prepared with dimensions 3mm mesiodistally, 2mm cervicoocclusally and 2mm deep (Figure 1).

Evaluation of microleakage using dye penetration method was done, the sectioned sample was randomly selected and observed under a stereomicroscope (Olympus SZX7) at 30x magnification. The depth of the dye penetration was evaluated and scored according to the criteria followed by Dr. Vijay Singh et al by a single examiner. (Table 1)

Table 1: Scoring criteria for Dye Penetration Method

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No leakage.</td>
</tr>
<tr>
<td>1</td>
<td>Dye penetration extended for less than or up to 1/3 of preparation depth.</td>
</tr>
<tr>
<td>2</td>
<td>Dye penetration greater than 1/3 of preparation depth, but not extending to the entire axial wall.</td>
</tr>
<tr>
<td>3</td>
<td>Dye penetration extending to the axial wall.</td>
</tr>
<tr>
<td>4</td>
<td>Dye penetration past the axial wall.</td>
</tr>
</tbody>
</table>

The results of the present study were subjected to statistical analysis. Kruskal wallis Test, Mann Whitney tests were used. The data were analyzed using statistical package for Social Sciences Version (SPSS) 17.0 for Windows. The level of statistical significance was set at 95% (p=0.05).

- If p-value > 0.05 then NS Not Significant
- If p-value < 0.05 then S Significant

Results:

Table 2 - The ‘p’ value of the mean scores of all the groups when cured with high intensity mode was 0.004 (≤0.05) indicating that the results were statistically significant. But the ‘p’ value of the mean
scores of all the groups when cured with pulse delay and ramped mode was 0.603 and 2.167(≥0.05) indicating that the results were not statistically significant.

Table 2: Comparison of mean microleakage scores between group I, group II and group III

<table>
<thead>
<tr>
<th>Type</th>
<th>Group</th>
<th>Mean</th>
<th>S.D.</th>
<th>Median</th>
<th>Kruskal-Wallis Chi-Square</th>
<th>P-value</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>A high intensity</td>
<td>Group I (Bulk Placement technique)</td>
<td>1.60</td>
<td>0.83</td>
<td>2.00</td>
<td>10.858</td>
<td>0.004</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Group II (Oblique technique)</td>
<td>1.33</td>
<td>0.98</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group III (Split Increment horizontal technique)</td>
<td>0.60</td>
<td>0.51</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B pulse delay</td>
<td>Group I (Bulk Placement technique)</td>
<td>1.87</td>
<td>0.92</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group II (Oblique technique)</td>
<td>1.60</td>
<td>0.99</td>
<td>2.00</td>
<td>0.603</td>
<td>0.740</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Group III (Split Increment horizontal technique)</td>
<td>1.60</td>
<td>0.83</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C ramped</td>
<td>Group I (Bulk Placement technique)</td>
<td>2.33</td>
<td>0.90</td>
<td>3.00</td>
<td>2.167</td>
<td>0.338</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Group II (Oblique technique)</td>
<td>2.07</td>
<td>0.80</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group III (Split Increment horizontal technique)</td>
<td>1.87</td>
<td>1.06</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: It represents that the ‘p’ value of the mean scores of group I and group II when cured with different modes was 0.065 and 0.085(≥0.05) indicating that the results were not statistically significant. But the ‘p’ value of the mean scores of the group III when cured with different modes was 0.001(≤0.05) indicating that the results were statistically significant.

Table 3: Comparison of mean microleakage scores between subgroup A, B, C of each groups I, II, and III

<table>
<thead>
<tr>
<th>Group</th>
<th>Type</th>
<th>Mean</th>
<th>S.D.</th>
<th>Median</th>
<th>Kruskal-Wallis Chi-Square</th>
<th>P-value</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I Bulk Placement technique</td>
<td>A (high intensity)</td>
<td>1.60</td>
<td>0.83</td>
<td>2.00</td>
<td>5.482</td>
<td>0.065</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>B (pulse delay)</td>
<td>1.87</td>
<td>0.92</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C (ramped)</td>
<td>2.33</td>
<td>0.90</td>
<td>3.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group II Oblique technique</td>
<td>A (high intensity)</td>
<td>1.33</td>
<td>0.98</td>
<td>1.00</td>
<td>4.937</td>
<td>0.085</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>B (pulse delay)</td>
<td>1.60</td>
<td>0.99</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C (ramped)</td>
<td>2.07</td>
<td>0.80</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group III Split Increment Horizontal technique</td>
<td>A (high intensity)</td>
<td>0.60</td>
<td>0.51</td>
<td>1.00</td>
<td>14.431</td>
<td>0.001</td>
<td>S</td>
</tr>
</tbody>
</table>
Discussion:

The results of present study showed regardless of the technique used, microleakage was present. Bulk technique resulted in more polymerization shrinkage and microleakage than incremental technique. The reasons could be increased polymerization contraction stress due to great volume of composite and decreased effectiveness of polymerization at deeper portions of the composite\(^7\).

The least amount of microleakage was observed in split increment horizontal technique than oblique and bulk placement technique despite of different curing modes. Thus could be due to reduced volume of the resin and the stress generated on the cavity walls and also due to more uniform and efficient polymerization of resin composite through its entire thickness\(^7,8\). According to Khamis Hassan et al\(^9,10\), the split-increment technique proposed for restoring large carious cervical cavities with composite resins would be helpful to minimize the development of polymerization shrinkage stresses on the adhesive interfaces at such cavity walls, especially the gingival dentinal wall.

A number of studies propose application of the oblique technique from the gingival aspect for class V cavity restorations\(^8,11\). Puckett et al\(^11\), found no significant difference between oblique incremental and bulk techniques, while according to Tjan et al\(^9\), and M. Moeyyadehr et al\(^12\), this difference was significant. Versluis A. et al. (1996)\(^13\) recognized incremental placement techniques as a major factor in reducing polymerization shrinkage. Incremental techniques ensured the complete polymerization of the composite resin. Studies by Sillas Duarte(2008), Lawrence W Stockhon, Sussan T Tang observed that all the incremental techniques showed decrease in microleakage in comparison to bulk placement techniques. Among the incremental techniques, split technique showed least microleakage scores.

Many studies have demonstrated that even with the light cured composites, slower polymerization of the first increment results in a well- adapted restoration, a technique called “soft-start” polymerization. This method is to reduce polymerization shrinkage-associated stresses and microleakage by providing an initial low rate of polymerization\(^14\). This may reduce the stress build-up by supplying extended time for stress relaxation before reaching the gel phase. This can be accomplished by using a soft-start curing technique in which the curing begins with a low intensity and finishes with a high intensity\(^15\). This causes the maximal possible conversion to occur only after much of the stress has been relieved. Soft-start polymerization is divided- into three techniques: stepped, ramped, and pulse-delay\(^16\).

In present study no statistically significant difference was found in different modes of curing this is an agreement with the study done by Neeraj Malhotra et al\(^17\) which reports no statistically significant difference in microleakage of nanofilled and microhybrid Resin Bond Composites(RBCs) cured with different soft-start polymerization modes. Yap et al\(^18\) also observed no significant reduction in polymerization shrinkage with soft-start curing modes. Özden Özel Bektas et al\(^19\) also studied the effects of each curing mode on two composite resins were compared and no significant difference was observed.

Thus the manipulation of composite materials is highly technique sensitive and is markedly increased by the presence of moisture, cavity surface treatment, incremental layering technique, depth of cure and adequate time of cure. All these factors were taken into consideration while manipulating the materials as per the manufacturer’s instructions.

Conclusion:

Within the limits of this study, the following conclusions were drawn:

All composite placement technique under the study exhibited a certain amount of microleakage despite of different curing modes.

- Bulk placement technique showed the most microleakage among the three placement techniques, the oblique placement technique showed less microleakage than bulk placement but more microleakage than split increment horizontal placement technique despite of the curing modes.

- Although split increment horizontal placement technique showed least microleakage which was not
Statistically significant results was found when high intensity mode was used.

- Bulk and oblique placement technique showed no statistically significant results in different curing modes although high intensity showed least microleakage.
- Split increment horizontal technique showed statistically significant results. High intensity mode showed least microleakage than pulse delay. Pulse delay showed more microleakage than high intensity and less than ramped mode. Ramped mode showed most microleakage.

Importance of this study:

- Class V cavities are more prone in anteriors in pediatric patients.
- Microleakage is one of the main drawbacks.
- Of composite restorations.
- Curing modes helps in reducing microleakage.

References: