Microleakage evaluation of class II composite restoration with incremental and bulk fill technique

Mohammed Abdul Kader, Abdullah Altheeb¹, Abdul Aziz Al-Asmry¹, Master Luqman²

ABSTRACT

Introduction: Microleakage has been regarded as a primary concern of use of composites in class II cavity restorations. Many products have attempted to minimize the interfacing gap between the tooth and restoration, the main pathway of microleakage. The aim of this in-vitro study is to quantitatively evaluate the microleakage of class II composite restoration done with incremental and bulk fill technique. Materials and Methods: In an in-vitro study, a total of 40 sound extracted molars were used for class II preparations and restoration with incremental (Group I, 20 teeth) and bulk fill technique (Group II, 20 teeth). Samples were accessed for dye penetration and pairwise comparison was done using Wilcoxon rank test. Results: Both the composite insertion techniques were not able to completely eliminate the microleakage. Two specimens of bulk filling technique show microleakage, extending to the axial wall. There is no statistically significant difference in microleakage irrespective of the insertion technique used. Conclusion: It can be concluded from the results that there is no significant difference in microleakage for composite restorations done by a bulk layering technique using the newer generation composites and the conventional incremental layering technique.

KEY WORDS: Bulk fill, class II restoration, incremental fill, microleakage

Microleakage, defined as passage of bacteria, fluids, molecules, or ions between a cavity wall and restorative material applied to it, may be responsible for percolation.¹ Traditional posterior composites have never been ideal amalgam alternatives because they: (1) More handling time required; (2) polymerization shrinkage; (3) microleakage with age; (4) questionable durability; and (5) cannot be condensed or packed into the preparations, which makes establishing adequate proximal contact difficult. However, the evolution of composites has recently introduced packable composites as a possible alternative to amalgam restorations. These materials have been referred to as high density, condensable, or packable composites.² Thus, aim of this in-vitro study is to quantitatively evaluate the microleakage of class II composite restoration done with incremental and bulk fill technique.

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**Materials and Methods**

An *in-vitro* study was done to access the microleakage from different restoration techniques of composites.

**Sample preparation**

In total, 40 sound molars, with neither carious lesion nor restoration, recently extracted from college clinic (King Khalid University, Abha) were selected for this *in-vitro* study. After extraction, teeth were cleaned with ultrasonic cleaning and immersed in 3% sodium hypochlorite. Using a number 56 straight fissure bur under air water cooling high-speed handpiece two class II box only cavities were prepared on mesial and distal aspect with dimensions of 5 mm occluso gingivally, 2 mm axially, and 3 mm buccolingually. The margins of the cavities are finished with hand cutting instrument.

**Restorative procedure**

The adhesive used was single bottle self-etching (Adper Single Bond 3M Espe). The enamel alone was etched for 15 s and rinsed with water and surface dried with absorbent points. The adhesive applied for all samples according to manufacturers’ instruction, and light curing was done. Tofflemire matrix was applied for all the teeth. Then the samples were divided into two groups of 20 each

- **Group I:** Packing of composite done by incremental technique using nanohybrid composite (Filtek Z250, 3M Espe)
- **Group II:** Packing of composite done by bulk fill technique and composite used is (Filtek Bulk Fill 3 M Espe).

LED lamp was used for photoactivation. The restoration was finished with fine grit diamond and polished using the polishing disc (Soflex). Restored teeth were stored in distilled water at 37°C for 7 days. The occlusal surface and the apical third of the tooth was covered with pink wax, and the smooth surfaces were sealed with nail polish, leaving 1 mm window around the four cavity margins.

**Microleakage analysis**

Manual thermocycling of the specimens was done according to ISO standard. 5°C for 30 s and 55°C for 30 s time elapsed for transferring the tooth is 3–4 s. After 500 thermocycles, the specimens were placed in 1% methylene blue for 24 h. The teeth were cleaned of the dye by means of brushes and polishing paste. The samples were sectioned with a diamond disc at 1 mm above the gingival seat perpendicular to the long axis of the tooth. Evaluation of the dye penetration was done under a stereomicroscope at ×10. The depth of the penetration was analyzed based on the graded scale used in the previous studies.[6]

- **0** - No dye penetration into the filling material or along the filling tooth interface
- **1** - Dye penetration along the filling tooth interface up to half of the buccal or lingual wall
- **2** - Dye penetration along the filling tooth interface to complete extension of the buccal or lingual wall
- **3** - Dye penetration along the filling tooth interface to complete extension of the buccal or lingual wall and extending to axial wall

**Table 1: Comparison of frequency and percentage between two group**

<table>
<thead>
<tr>
<th>Score</th>
<th>Group I n</th>
<th>Percentage</th>
<th>Cumulative percentage</th>
<th>Group II n</th>
<th>Percentage</th>
<th>Cumulative percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8</td>
<td>40.0</td>
<td>40.0</td>
<td>7</td>
<td>35</td>
<td>35.0</td>
</tr>
<tr>
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<td>7</td>
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<td>70.0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>20.0</td>
<td>100.0</td>
<td>4</td>
<td>20</td>
<td>90.0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>2</td>
<td>10</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Table 2: Pairwise comparison between Groups I and II**

<table>
<thead>
<tr>
<th>Group I − Group II</th>
<th>n</th>
<th>Mean rank</th>
<th>Sum of ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative ranks</td>
<td>6</td>
<td>8.33</td>
<td>50.00</td>
</tr>
<tr>
<td>Positive ranks</td>
<td>9</td>
<td>7.78</td>
<td>70.00</td>
</tr>
<tr>
<td>Ties</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results**

A total of 40 teeth were divided into two groups (20 each group). Scores obtained for both groups are shown in Table 1. Both the composite insertion techniques were not able to completely eliminate the microleakage. Two specimens of bulk filling technique show microleakage extending to the axial wall. The outcomes of the data analysis are depicted in Table 2. There was no statistically significant difference in microleakage irrespective of the insertion technique used.

**Discussion**

Tooth-colored posterior restorations are now the first choice of many patients. One of the most popular is the composite restoration. However, microleakage is one of the important problems at the margins of the proximal box of class II cavities restored with resin composites.[7,8] It is likely that this cervical microleakage contributes to the high incidence of secondary caries in this region and accounts for many clinically failed restorations.[9]

The microleakage process is a phenomenon of diffusion of substances, organic or inorganic, into the tooth through the interface between the restorative material and the tooth structure. Many commercially available dental composite are based on methacrylate chemistry. Because of free radical polymerization of methacrylate-based composite, monomer molecules come closer to each other during the polymerization process.

**Table 2: Pairwise comparison between Groups I and II**
process, which results in polymerization shrinkage and leads to microleakage. Class II preparations were selected for the study, to make deep cavities of 5 mm without involving pulp. Methylene blue was used for dye penetration as it was simple, inexpensive and does not require complex laboratory procedure. Furthermore, utilizing methylene blue provides easy visualization of the prepared cavity in the digital images, providing the evaluators with a clear reference point from which to score. The dye also provides an excellent contrast with the surrounding environment.

This study used aging by thermocycling to simulate degradation of bond over a period due to changes of temperature in the oral cavity.[10] Observed that there were wide variations in the thermocycling regimens in different studies and indicated that the choice of the regimen adopted must be arbitrary. Varying authors have used different dwell times, ranging from as low as 4 s in each bath, to as high as 180 s without any justification for the same from his study concluded that the dwell time should be clinically relevant and recommended dwell time of 10 s or less. All the teeth were thermally cycled between 5°C and 55°C with a dwell time of 30 s and a transfer time of 3–4 s.[11]

The shrinkage stress greatly weakens the longevity and performance of dental composites; numerous approaches have been designed to decrease the shrinkage stress through different placement techniques and curing protocols. The use of oblique layering technique reduces the development of contraction forces between opposing walls, which could be result in stress build-up, gap formation, and cuspal fissures.[10] Hence, in this study the oblique and horizontal layering techniques were used. The oblique layering technique was found to show less microleakage than bulk or other incremental technique as in different studies.[12,13] The results obtained in our study are contradictory to the above-mentioned studies as no statistically significant difference was observed in microleakage between both the techniques. However, similar results were obtained in a study conducted by Relhan et al.[14] It can be attributed to the variations in the chemical composition of the composite resin used for the bulk layering technique. The volumetric shrinkage of the Filtek Bulk Fill is <1.5% according to the manufactures.

**Conclusion**

It can be concluded from the results that there is no significant difference in microleakage for composite restorations done by a bulk layering technique using the newer generation composites and the conventional incremental layering technique. However, further studies have to be done with larger samples and clinical trials.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**