COMPARISON OF MICROLEAKAGE BETWEEN GLASS Ionomer and Flowable Composite Resin RESTORATIONS — AN IN-VITRO STUDY

Narendra Varma Penumatsa

Department of pedodontics, Division Of Preventive Dental Sciences, College of Dentistry, Salman Bin Abdul Aziz University, Alkharj, Kingdom of Saudi Arabia

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*Corresponding Author: Dr. Narendra Varma Penumatsa.
Department of Pedodontics - Division Of Preventive Dental Sciences, College of Dentistry,
Salman Bin Abdul Aziz University, Post Box No- 153, Alkharj. Kingdom of Saudi Arabia Tel: 00966-505877003

ABSTRACT

 Aim: The aim of the present study was made to evaluate the micro leakage of a Glass ionomer (FUJI VII) and micro hybrid flowable composite resin (Tetric flow) in enamel of both deciduous and permanent teeth.

 Methodology: The study has been done on total of 32 teeth in which 16 permanent teeth were orthodontically extracted and 16 over retained deciduous teeth were extracted. Teeth were randomly divided into four groups of 8 teeth in each group. Standard class I cavities of 1.5 mm depth and 1 mm depth were made on occlusal surfaces of all the teeth. The samples were divided into four groups of which 8 deciduous teeth are for Fuji VII and 8 deciduous teeth for Tetric flow composite and 8 permanent teeth for Fuji VII and 8 permanent teeth for Tetric flow composite. Samples were immersed into 5% Methylene blue dye for 24 hours after restoration with the respective materials. The teeth were sectioned vertically into two halves and observed under the reflected light microscope under 50 x magnifications to observe the level of dye penetration.

 Results: while computing the “T” test between the deciduous and permanent teeth for Tetric flow and Fuji VII it was found that there exists no significant difference in the micro leakage. But surprisingly it was found that micro leakage of Tetric flow was least in the permanent group.

 Conclusion: There is no much significant difference in the micro leakage was observed among all groups.

 Keywords: Micro Leakage, Tetric Flow, Fuji VII, T Test, 5% Methylene Blue, Deciduous Teeth, Permanent Teeth.

INTRODUCTION

Restoring carious teeth is one of the major treatment needs of young children. A restoration in the primary dentition is different from a restoration in the permanent dentition due to the limited lifespan of the teeth and the lower biting forces of children. The glass-ionomer cements provide adhesion to both enamel and dentin through an ion exchange with the additional benefit of a continuing fluoride release throughout the life of the restoration. Solubility is low, abrasion resistance is high, and biocompatibility is excellent. As a water-based material, they have an excellent chance of survival in the hostile environment of the oral cavity and adhere to dental hard tissues. Less processing time is an additional advantage when treating young children.

Composite resins are highly popular as dental restoratives. When used correctly, they provide excellent aesthetics and good physical properties. In an attempt to improve the adaptability a new type of composite resin was developed. These new composites have low viscosity and high flowability. This allows the material to adapt closely to the microstructural and macrostructural defects in the floor and walls of the cavity, resulting in an improvement of the tooth/restoration union resistance.

One of the concerns about the clinical longevity of composite resins is the great possibility of microleakage at the tooth/restoration interface. This lack of adaptation may occur partly due to polymerization contraction and extreme temperatures in the oral cavity, which may break the adhesion between the adhesive system and the cavity walls, forming microgaps. Such gaps allow the penetration of microorganisms, fluids and chemical substances from the oral environment along the tooth/restoration interface, which may result in postoperative sensitivity, marginal deterioration, recurrent caries and pulp injury.
Flow able materials are being used in many clinical applications, dentists need comparative information so that they can select the materials with the most appropriate properties for any particular use. Studies have demonstrated conclusively that no restorative material developed to-date is adhesive to tooth structure. This lack of bond between the restorative material and the tooth structure alerts the clinician to the fact that marginal leakage is an inherent shortcoming of commonly used restorative materials. Hence, an attempt has been made, to evaluate the micro leakage of a glass ionomer (FUJI VII) and microhybrid flowable composite resin (Tetric flow) in enamel, deciduous and permanent teeth.

MATERIALS AND METHODS

The present in-vitro study was done in the Department of Pedodontics and preventive Dentistry, Rajah Muthiah Dental College and Hospital, Annamalai University.

SAMPLE SELECTION

For this study we have collected total of 32 teeth in which, 16 Orthodontically extracted teeth and 16 over retained deciduous teeth. They were collected and stored in distilled water at room temperature (23°C). These teeth were scrubbed, cleaned and checked for any developmental defects or caries. They were then mounted in a self-cure acrylic resin until the cemento-enamel junction (Fig.1). During the process the block was immersed in water to dissipate the heat liberated during polymerization. After mounting, the teeth were stored in distilled water, until further use.

We have used GC Fuji VII and Tetric Flow (Vivadent) for GIC and Composite respectively. All the relevant materials which are necessary to carry out study and procedure were performed carefully.

TOOTH PREPARATION

Teeth were randomly divided into four groups of 8 teeth each. Standard class I cavities were prepared on the occlusal surfaces of all the teeth using a straight fissure bur and contra-angle high-speed airotor hand piece with water coolant. The depth of the cavity was standardized as 1.5 mm by the markings on the bur. The width of the cavity was limited to the diameter of the bur i.e. 1mm.

The samples were divided into the following groups.

Group 1-8: Deciduous molar teeth to be restored with Fuji VII.

Group 2-8: Premolar teeth to be restored with Fuji VII.

Group 3-8: Deciduous molar teeth to be restored with Tetric flow.

Group 4-8: Premolar teeth to be restored with Tetric flow.

In each group, the cavity was restored with its respective material according to the manufacturer’s instructions by principal investigator.

ASSESSMENT OF MICROLEAKAGE

After the samples were restored with the respective restorative materials, they were immersed into the 5% methylene blue dye for 24 hours. After 24 hours they were removed from the dye and sectioned vertically into two equal halves by the diamond disc bur (Fig.2). They were polished using the Arkansan stone before seeing under microscope. They were observed under the reflected light microscope under 50x magnification to observe the level of dye penetration (Fig. 3, 4, 5, 6). The scoring and criteria used for the study was as follows

0- No microleakage.
1- Microleakage less than half of the restoration.
2- Microleakage more than half but not upto the floor of the cavity.
3- Microleakage to the floor and beyond.

RESULTS

The scores were tabulated, interpreted and the resultant findings were statistically analyzed by (Student’s ‘t’ test) to compare the microleakage between the groups.

Table 1 explains that there is no significant difference in the microleakage between Fuji VII and Tetric Flow in enamel but definitely it is appreciable that tetric flow showed least microleakage. Same results was observed when compare micro leakage of Fuji VII or Tetric Flow in deciduous teeth (Table 2). We were surprised to see the same result in another comparison of microleakage of Fuji VII or Tetric Flow in permanent teeth (Table 3).

But when the ‘t’ test was applied between deciduous and permanent teeth for Fuji VII, it was found that there is a significant difference in the microleakage. Also by comparing the mean values of the microleakage, it was found that the mean value of permanent is 1.375, which was lesser than the deciduous value of 2.500. From this value, it can be inferred that the microleakage of Fuji VII was least in the permanent teeth group (Table 4).

While computing the ‘t’ test between deciduous and permanent teeth for Tetric Flow, it was found that there exists no significant difference in the microleakage. But here also It was surprised that the result was found the microleakage of Tetric Flow was least in the permanent teeth group (Table 5).
Figure 3: Score “0” No microleakage

Figure 4: Score “1” Microleakage less than half of the restoration

Figure 5: Score “2” Microleakage more than half but not upto the floor of the cavity

Figure 6: Score “3” Microleakage to the floor and beyond

### Table 1: Comparison of micro leakage of Fuji VII and Tetric Flow in enamel

<table>
<thead>
<tr>
<th>Treatment type</th>
<th>No. of samples</th>
<th>Mean ‘T’ score</th>
<th>‘T’ score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuji VII</td>
<td>16</td>
<td>1.93</td>
<td>1.80</td>
</tr>
<tr>
<td>Tetric Flow</td>
<td>16</td>
<td>1.12</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Comparison of micro leakage of Fuji VII or Tetric Flow in deciduous teeth

<table>
<thead>
<tr>
<th>Treatment type</th>
<th>No. of samples</th>
<th>Mean ‘T’ score</th>
<th>‘T’ score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuji VII</td>
<td>8</td>
<td>2.50</td>
<td>1.88</td>
</tr>
<tr>
<td>Tetric Flow</td>
<td>8</td>
<td>1.37</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Comparison of microleakage of Fuji VII or Tetric Flow in permanent teeth

<table>
<thead>
<tr>
<th>Treatment type</th>
<th>No. of samples</th>
<th>Mean ‘T’ score</th>
<th>‘T’ score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuji VII</td>
<td>8</td>
<td>1.375</td>
<td>0.784</td>
</tr>
<tr>
<td>Tetric Flow</td>
<td>8</td>
<td>0.875</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4: Comparison of microleakage of Fuji VII in deciduous and permanent teeth

<table>
<thead>
<tr>
<th>Teeth type</th>
<th>No. of samples</th>
<th>Mean ‘T’ score</th>
<th>‘T’ score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciduous</td>
<td>8</td>
<td>2.500</td>
<td>2.260</td>
</tr>
<tr>
<td>Permanent</td>
<td>8</td>
<td>1.375</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5: Comparison of microleakage of Tetric Flow in deciduous and permanent teeth

<table>
<thead>
<tr>
<th>Teeth type</th>
<th>No. of samples</th>
<th>Mean ‘T’ score</th>
<th>‘T’ score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciduous</td>
<td>8</td>
<td>1.375</td>
<td>0.698</td>
</tr>
<tr>
<td>Permanent</td>
<td>8</td>
<td>0.875</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

It was Michael Buonocore who focused the attention of the profession on adhesion in the oral cavity. The problem has been solved through the glass-ionomer cements rather than with resins, but sadly, he did not live to see them ripe. According to Munksgaard (1987) one of the factors that contribute to marginal microleakage in restorations with composite resins is the contraction that the material suffers during polymerization. Q. Vist stated that mastication had a greater influence on the marginal integrity of composite restorations than did thermal stress. Versluis said contraction and expansion of the tooth and the restoration are because they have different coefficients of thermal expansion, the adhesion between them may be broken. The results obtained in the present study shows that Tetric Flow showed least microleakage in all the comparisons. This was in accordance with study done by Zyskind D, Frenkel A and Hirschfeld Z (1991). Polymerization shrinkage and thermal changes of the composite resin can also create a gap in the tooth – restoration interface that encourages leakage. Various studies have demonstrated that etched enamel and bonded composite resin from a strong micromechanical bond that resists leakage. Conversely, Glass Ionomers exhibit limited shrinkage during setting and their coefficient of thermal expansion is similar to that of dentin, so their leakage cannot be explained by the same reasons. Their inability to seal may be attributed to two factors: (1) the material is sensitive to moisture during placement and early set and (2) dehydration after the set may result in crazing and cracking. Loss of water may cause the restoration to crack or shrink and stress newly forming ionic bonds, possibly leading to loss of adhesion. In the present study, the microleakage in the deciduous and the permanent teeth group was least, when restored with Tetric.

Bayne et al stated that the modulus of elasticity of Flowable composite is low, thereby, it has the ability to undergo plastic deformation to flex and absorb polymerization shrinkage stress. On the other hand Bayne et al and Chuang et al stated that since Flowable composite has less filler content, the coefficient of thermal expansion of flowable composites is close to that of the tooth structure. Researchers like Payne et al., Leevailoj et al. have used flowable composites as lining materials and have obtained favorable results in reducing microleakage.

In another study, Ferderianakis compared the microleakage performance of flowable resin composite with that of hybrid resin composite and found significantly less leakage in cavities restored with flowables. Swift et al. have shown that bonding of restorative material to enamel is adequate. In this investigation, all restorations completely resisted microleakage at the occlusal margins, proving the effectiveness of the acid-etch technique in sealing cavity margins in enamel.

CONCLUSION

The inter group among the groups was small and hence, the choice of restorative material also depends on their other inherent properties like ease of manipulation, reduced clinical working time, ability to withstand masticatory forces and dissolution in oral fluids and their ability to release fluorides. Further, there is a strong need to standardize in-vitro tests for the identification of microleakage under clinical environment to determine the success of the restorative materials. However, further in-depth research is recommended since the sample size was small in the present study.

REFERENCES


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