Evaluation Of Gingival Microleakage Of Composite Restorations With Glass Fiber Inserts, Polyethylene Fiber Inserts And Prepolymerized Composite Inserts: An In Vitro Study

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Abstract : Aim : The aim of this study was to evaluate the effect of glass and polyethylene fiber inserts and prepolymerized composite on the microleakage of Class II composite restorations on gingival margins of root surfaces.

Materials and Methods: In the present study thirty freshly extracted intact premolars were divided into three groups based on the type of fiber inserts used, mesio-occlusal cavities were made on the proximal sides of premolar. As a liner flowable composite (Filtek Z350 was used and the rest of the cavities were filled with Filtek P-60 (3M/ESPE) posterior composite. Specimens were stained with 2% Basic Fuchsin dye after thermocycling. Dye penetration was evaluated under stereomicroscope after sectioning the samples. Statistical analysis was done using Kruskalwallis test and Mann whitney U test.

Results: The results of this study showed that no statistical difference was observed between glass fibre inserts and prepolymerised composite fiber inserts groups, and also between prepolymerised composite fiber inserts group and polyethylene fiber inserts groups. But statistical significance was observed between glass fiber inserts and polyethylene fiber inserts.

Keywords: Glass fiber inserts; polyethylene fiber inserts; prepolymerized composite fibre inserts.

1. “Introduction”

The fiber inserts like Glass and polyethylene fibers are used as reinforcing agent in composite restorations [1-2]. Light cure resin composites are commonly used to restore posterior teeth due to their improved esthetic properties and their micro mechanical adhesion to tooth structures [3].

The most important problem faced while using the composite resin restorative materials is the susceptibility for marginal leakage due to polymerization shrinkage [4-5]. The wear rate has been reduced in newest posterior resin composites [6]. But in the proximal boxes the marginal adaptation of posterior restorations has remained unacceptable. Composite resin materials may experience a volumetric polymerization contraction of at least 2.0% which can lead to gap formation [7]. So to overcome this problem various fiber inserts have been tried, these includes new dental materials containing glass, polyethylene, quartz, carbon or other fibers. Now megafillers are being used to decrease the polymerization shrinkage, in recent years. Megafillers are inserts that were designed to fill as much of cavity as possible and to reduce the composite volume needed for restorations (50-70%) [8-9]. Reduction in composite material leads the restorations to exhibit less overall shrinkage and smaller marginal gaps.

2. “Material and Methods”

Freshly extracted thirty intact premolars (for orthodontic reasons) were collected. They were stored in distilled water. Class II mesio-occlusal cavities were prepared on the proximal sides of premolar using a #245 tungsten carbide bur (SS White, USA) in a water-cooled high-speed air turbine handpiece. The dimensions of the cavities in the proximal box were as follows: occlusally=2mm; occlusogingivally=4mm, axially=3mm, buccolingual width=4mm, 1mm below the cementoenamel junction. Thirty teeth with prepared cavities were
randomly divided into three groups. In the present study, custom made megafillers were fabricated which is cost effective and is easy to prepare, here the silicone moulds were used to fabricate the megafillers. It is prepared by packing the composite in to silicone moulds and cured for 40 seconds.

“Table 1. The groups were divided as follows”.

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Groups</th>
<th>Materials used</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Group 1</td>
<td>Packable composite, flowable composite with glass fiber inserts (ever stick net, Stick Tech, Finland)</td>
</tr>
<tr>
<td>02</td>
<td>Group 2</td>
<td>Packable composite, flowable composite, prepolymerized composite;</td>
</tr>
<tr>
<td>03</td>
<td>Group 3</td>
<td>Packable composite, flowable composite with polyethylene fiber inserts (Ribbond THM);</td>
</tr>
</tbody>
</table>

“Table 2. Details of the materials used in this study”.

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Products</th>
<th>Composition</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Glass fibers</td>
<td>E-glass, PMMA, Bis-GMA, Resin-Perimpergnated continuous unidirectional FRC.</td>
<td>Ever stick, Stick tech ltd, Turku, Finland.</td>
</tr>
<tr>
<td>02</td>
<td>Polyethylene fibers</td>
<td>Ultra high strength polyethylene (USHPE) fibers, Leno woven spectra fibers.</td>
<td>Ribbond-THM, Seattle, WA, USA.</td>
</tr>
<tr>
<td>03</td>
<td>Flowable composite (Filtek Z350)</td>
<td>Bis-GMA, TEGDMA, Bis-EMA, Silane treated ceramic silica, Zirconium oxide.</td>
<td>3M ESPE</td>
</tr>
<tr>
<td>04</td>
<td>Packable composite (Filtek p60)</td>
<td>Triethyleneglycol dimethacrylate, urethane dimethacrylate, silica, zirconium bisphenylethylenemethacrylate 84.5%, 0.6 mm</td>
<td>3M ESPE</td>
</tr>
<tr>
<td>05</td>
<td>Bonding agent (Prime bond)</td>
<td>One step self-primer; Etchant: Caulk 34% tooth-conditioner gel. Adhesive: di-and trimethacrylate resins, functionalized amorphous silica, PENTA, Photoinitiators, Cetylaminehydrofluor ide acetone.</td>
<td>Dentsply</td>
</tr>
</tbody>
</table>

Banding around each tooth was done with a universal metal matrix band/retainer (Tofflemire) and this was supported externally by applying an impression compound which helped to maintain the adaptation of the band to the cavity margins. Bonding agent (Prime bond, Dentsply) was used for all the samples. Flowable composite (Filtek Z350) was used as a liner on the gingival floor for approximate 2mm thickness and over that a 3 mm piece of fiber inserts were placed, it was light cured for 40 seconds. The rest of the cavity was filled with horizontal placement technique with packable composite. Then the cavities were finished (Shofu Composite Finishing Kit) and polished (Shofu, Super-Snap Rainbow Technique Kit). Then the specimens were then stored in distilled water at a temperature of 37°C for two weeks, then the samples were subjected to 500 thermocycle in water baths between the temperature 5°C and 55°C, with a dwell time of 30 seconds. The teeth were immersed in a 2% basic fuchsin dye for 24 hours at 37°C, after which they were rinsed with tap water for five minutes. Each tooth was then sectioned mesiodistally with diamond discs. The section with the deepest dye penetration was selected to represent the tooth. The extent of dye penetration was determined by examination under the stereo microscope according to a five-point scale, as elaborated below:

0=No dye penetration;
1=Dye penetration less than half of the gingival wall;
2=Dye penetration along the gingival wall;
3=Dye penetration along the gingival wall and less than half of the axial wall;
4=Dye penetration along the gingival and axial wall;
5= Dye penetration along the pulpal floor;

3. “Results”

Data was statistically analyzed with Kruskalwallis test and Mann-Whitney U test.

“Table 3. Shows Mean microleakage score of various group of fiber inserts along with standard deviation”.

Kruskalwallis ANOVA has shown that there is no statistical significant difference between microleakage score of various groups at 5% significance level. (p=0.116)
“Table 4. Shows pair wise comparison with Mann Whitney U Test showing significant difference between Glass Fiber inserts and Polyethylene fiber inserts at 5% significance level (p=0.046).”

<table>
<thead>
<tr>
<th>Mann Whitney U Test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass fiber inserts</td>
<td>Group 1</td>
</tr>
<tr>
<td>Prepolymerized Composite fiber inserts</td>
<td>Polyethylene fiber inserts</td>
</tr>
<tr>
<td>Glass fiber inserts</td>
<td>Polyethylene fiber inserts</td>
</tr>
</tbody>
</table>

4. “Discussion”

Major disadvantage of resin composite restorations is the marginal microleakage which is the result of polymerization shrinkage, fatigue-cycling, thermal changes happening in oral cavity [10]. It has been tried to eliminate this disadvantage through various research processes. According to Bowen RL postulates it was learnt that the amount of polymerization shrinkage would be proportionately reduced, if the total amount of composite material used to restore a Class II cavity could be reduced [11]. Various types of fibers have been added to resin composites to decrease the microleakage by two main ways that is by reducing the total amount of composite required for the restoration and increasing the resistance against pull-away of initial composite increment from the gingival margin toward the light curing unit [12-13].

Ribbond THM consists of cold plasma-treated polyethylene fibers; it is made up of higher concentration of small diameter fibers, glass fiber inserts are silanized E-glass fibers preimpregnated with resin [11]. Kolbeck claimed that the reinforcing effect of glass fibers was stronger than that of polyethylene fibers, because glass fibers are light conducting whereas polyethylene fibers has difficulty in obtaining good adhesion between its fibers and resin matrix [13]. Prepolymerized composite inserts are easy to fabricate and are economical. These fibers inserts not only improves the marginal adaptation but also reinforces the composite.

The results of this study are similar to the findings of Hamza et al. Here the Kruskal wallis ANOVA has shown there is no statistical significant difference between microleakage score of various groups at 5% significance level (p=0.116). But pair wise comparison with Mann Whitney U Test shown significant difference between Glass fibers inserts and Polyethylene fiber inserts at 5% significance level (p=0.046). Flowable composites when placed as a liner in the proximal box below the packable composites exhibits increased elasticity and wettability, low viscosity, low surface tension, and this will help to fill irregular internal surfaces and proximal boxes, thus it improves the final marginal integrity and less leakage and post operative sensitivity [14]. Also when fibers were inserted into the bed of flowable resin, this increased the microtensile bond strength to cavity dentin surface [15].

5. “Conclusions”

With in the limitations of this study it could be concluded that Polyethylene fiber inserts group exhibited less reduction in microleakage when compared to Glass fiber inserts and Prepolymerized Composite fiber inserts.

When Prepolymerized Composite fiber inserts were compared with Glass fiber inserts there was no statistical significant difference between microleakage scores, but the Prepolymerized Composite fiber inserts are much cost effective when compared to Glass fiber inserts and its ease of fabrication.

6. “References”


