Microleakage of Class II composite using different etching techniques

Zainab M. Abdul-Ameer B.D.S., M.Sc. (1)

ABSTRACT

Background: Microleakage in the gingival floor of class II composite restorations can compromise the marginal adaptation of the filling material to the cavity edges. The aim of this study was to evaluate the effect of different etching techniques on Microleakage of class II Composite filling.

Materials and methods: Sixty extracted caries-free human premolars were randomly divided into six groups according to etching technique. In group A and B the dentin of the cavities were etched with 35% phosphoric acid gel, in group C and D the dentin of the cavities were irradiated using a 320 μm Nd: YAG laser beam, in group E and F the dentin surfaces were initially treated with the laser and then etched as in group A and B with 35% phosphoric acid. Proximal class II cavities were prepared in all samples with the gingival floor one millimeter below the CEJ. Cavities were restored according to research protocol. The samples were subjected to 2500 thermal cycles (5-55°C), immersed in 0.5% basic fuchsine solution, embedded in epoxy resin and cut centrally. Microleakage was scored and collected data were statistically analyzed using one way analysis of variance.

Results: More microleakage was detected in group C (p<0.05; variance analysis). The laser beam and acid-etching showed no advantage compared to the acid-etching alone (p>0.05). Using the incremental technique significantly decreased microleakage (P<0.02).

Conclusion: The Nd: YAG laser irradiation in cl II composite does not constitute an alternative to acid-etching. Samples restored with the incremental technique, and cavities etched with 35% phosphoric acid gel had the least dye penetration and microleakage.

Keywords: Acid etching, Nd: YAG laser, resin composite. (J Bagh Coll Dentistry 2009; 21(1): 46-48)

INTRODUCTION

Ever since Maiman developed ruby lasers in 1960, they have been used experimentally and clinically in dentistry. (1) By varying a number of parameters (pulse mode, irradiation time, frequency, and energy outputs), several types of lasers have been suggested for oral soft tissue procedures, curing light activated materials, and treating or cutting dental substrate. (2) Such devices include the CO2 laser, excimer laser, and the Nd: YAG laser. Stern and Sognnaes (3) and Goldman et al. (4) began their studies on hard dental tissues by investigating the use of a ruby laser to reduce subsurface demineralization. A reduction in permeability to acid demineralization of enamel after laser irradiation was found. (1) Bond strength results that were better than those achieved with acid-etching. It is suggested laser treatment might be replaced with acid etching as a pre-treatment procedure for dentin bonding. (5)

Light cure composite resins are being widely used for the restoration of posterior teeth. Several investigations have been conducted in order to analyze various features of photopolymerized composites and subsequently improve their durability and physico-mechanical. (6-8) Shrinkage forces may cause clinical problems like postoperative pain, hypersensitivity, marginal breakdown and marginal opening with microleakage leading to secondary caries. (9) The aim of this study was to evaluate the effect of different etching techniques on Microleakage of class II Composite filling.

MATERIALS AND METHODS

Sixty extracted caries-free human premolars were selected for this in vitro study. The teeth were stored in saline solution until used. Proximal cavities (class II boxes only) were prepared in the mesial surfaces by a No. 245 carbide bur mounted on a high-speed handpiece under copious air-water spray. The dimensions of the cavities in the gingival floor were as follows: mesiodistal width=2mm, buccolingual length = 4mm, gingival floor =1mm lower than CEJ. Each bur was used for four preparations and then replaced. All samples were randomly divided into six groups of ten teeth each. In group A and B the dentin of the cavities were etched with 35% phosphoric acid gel (Scotchbond, 3M Dental Products, USA) for 15 seconds, rinsed with water for 20 seconds, and dried. In group C and D the dentin of the cavities were irradiated using a 320 μm Nd: YAG laser beam (Settings: 2 W, 20 ppS, for 40s). In group E and F the dentin surfaces were initially treated with the laser and then etched as in group A and B with 35% phosphoric acid. This was followed by the application of the dentin bonding agent.
Restorative Dentistry

(138x109 to 252x252)

RESULTS

The mean and standard deviation of microleakage in each study group is shown in Table 1 and figure 2. According to the results of the microleakage evaluation of this study, the specimens in group C (laser + composite) showed the most microleakage. While a statistically significant difference was found between group A and group C and between group B and group D (p<0.05), a statistically significant difference was not found between group C and group E and between group D and group F (p>0.05). Additionally, there was a statistically significant difference between group A and group E and between group B and F (p<0.05). Sections showed that using the incremental technique significantly decreased microleakage (P<0.02).

Table 1: The means values and standard deviation for the microleakage of study groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Means</td>
<td>1.8</td>
<td>1.3</td>
<td>3.7</td>
<td>3.3</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td>SD</td>
<td>0.63</td>
<td>0.82</td>
<td>0.70</td>
<td>0.84</td>
<td>1.03</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Figure 2: Histogram showing the means of study groups.

DISCUSSION

Acid-etch are the accepted preparation method for adhesion of composite materials to enamel or dentin. However, it has some disadvantages:

- Damages to tooth structure (pulp, dentin);
- Clinical manipulation involves drying, wetting, and then drying again;
- Removal of the etchant with a syringe can cause damage to adjacent enamel or soft tissues;
- Its treatment times are relatively long. (10)

Recently, new innovative methods, such as lasers, have been suggested for creating retention areas for resin bonding. (10, 11) Some researchers (10, 11) have also demonstrated laser irradiation or air abrasion to roughen enamel or dentin surfaces produced higher composite bond strengths than

Figure 1: Schematic illustration of section.
acid etching. However, these systems also have some disadvantages. The Nd: YAG laser beam causes an increase in heat. (12) Cox et al. (13) studied the effects of pulsed Nd: YAG laser radiation on enamel and dentin. They observed melted dentin, crazing on the surface, slight debris formation, and modification of dentin tubule structure where the tubule periphery had melted. The laser irradiation group did not produce a dye penetration-resistant interface, and the laser group demonstrated the highest degree of microleakage. This may be the result of the presence of a fused layer in which interfibrillar spaces were lacking. This probably restricted the diffusion of composite resin into the subsurface of the intertubular dentin resulting in more leakage. Ceballo et al. (14) reported similar results using the Er-YAG laser.

According to stereomicroscope observations, dye absorption was different in each layer of composite restorations. This indicates different degrees of polymerization and confirms Hellwig’s theory stating that placing composites in multiple layers can cause differences in the degree of polymerization. (15) Reduced shrinkage may be due to the small bulk of material in each layer. (18)

In restoration of class II cavities, placing the spectral output of the curing unit close to the composite is impossible. Dental tissue or a matrix band could cause light to become opaque or shady. In addition illumination of light from behind a 2 mm layer of composite resin can decrease the amount of transmission. According to Ruyster and Oysaed (16), placing the tip of a curing unit at a 2 mm distance from a detector could cause a 7% decrease in output energy which could be further reduced to 25% when the distance is increased to 4 mm. When restoring class II cavities, the marginal ridges and cusps usually demonstrate a distance of at least 4 mm from the gingival floor. Therefore the exposure time should be increased in order to achieve maximum hardness and durability of the filling material. The recommended distance of a light source from the composite surface is 1 mm. Various methods and instruments have been proposed to transmit light to inaccessible areas of the cavity such as transparent matrix strips, light conducting wedges, mirror matrix bands and transparent cones attached to the tip of the curing unit (17). However, controlling the exact distance of the tip of a curing unit would be problematic in clinical settings. It has been shown that addition of inserts to composite resins can decrease their microleakage, which is due to the lower thermal expansion coefficient of the inserts. (18)

REFERENCES