Effect of beveling with different grid size diamond fissure bur on resin bond strength

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ABSTRACT

Background: Diamond burs are recommended for grinding enamel and they are available in different grid sizes, therefore the aim of this study was to evaluate the effect of beveling with 4 different grid size diamond fissure burs on shear bond strength of light cured composite resin.

Materials and Methods: Forty extracted anterior teeth were sectioned at the level of cervical line. The crowns were embedded in cold cure acrylic resin exposing the labial surface. The specimens were divided into 4 groups according to the grid size of the diamond fissure bur which were used in flattening the labial surface (group I extra fine, group II fine, group III Medium, group IV coarse). Standardized cylinders of composite resin were bonded to the grinded surface, and testing was done with Zwick testing machine.

Results: There is a non significant difference between all the four groups.

Conclusion: The grid size of diamond burs didn’t affect the resin bond strength to enamel.

Keywords: Diamond bur, bond strength, enamel beveling.

INTRODUCTION

One of the basic principles of quality operative dentistry paramount for successful esthetic resin restoration is the cavosurface margin design. Incorrect margin design decreases the survival and longevity of the restoration. Beveling the margin has advantages to the properties of acid etched resin restoration, such as, enhanced resistance to microleakage, increased retention and better abrasion resistance, in addition to beveling the margins exposing greater surface area thus improves the adhesion. (1,2)

Diamond burs are mostly efficient when used to grind brittle material and are superior to other burs for the removal of dental enamel. (3)

Diamond burs are commonly categorized according to the particle size into different grids. The clinical performance of different grid of diamond abrasive instrument is to produce surface scratches and removing more tooth structure depends on the particle size, also produce different surface roughness which may affect the bond strength (5). Therefore the purpose of this study was to evaluate the effect of beveling with four different grid size diamond fissure bur on the shear bond strength of light cure composite resin.

MATERIAL AND METHODS

Forty recently extracted anterior teeth were collected, cleaned with slurry of pumice in rubber cup used in low-speed hand piece, and sectioned at the level of cervical line then the crown of the tooth was embedded in acrylic resin exposing the labial enamel surface. (Figure1)

- Four grid size fissure burs (Mani Inc. Japan) were used in this study which were color coded: coarse; green (125-150µm), medium; blue (106-125µm), fine; red (53-63µm), extra fine; yellow (20-30µm).
- The specimens were divided into 4 groups according to the grid size of the diamond fissure bur being used in flattening the labial enamel surface:
  - Group I: Extra fine diamond fissure burs (10 specimens)
  - Group II: Fine diamond fissure burs (10 specimens)
  - Group III: Medium diamond fissure burs (10 specimens)
  - Group IV: Coarse diamond fissure burs (10 specimens)

A flat enamel surface was obtained with the diamond fissure bur in high-speed hand piece mounted in a surveyor with applied load=100 g.
- The flat labial surface was acid etched with 37% phosphoric acid gel (degufill etchant, degussa dental, GmbH & Co.KG) for 15 seconds, washed for 30 seconds and bonding agent (alpha dent bonding resin, Dental Technology, Inc.USA) applied and light cured for 20 seconds.
- The bonding procedure was done with a standardized translucent plastic straw with an internal diameter of 3mm and 6mm length filled with composite resin (alpha-dent composite, Dental Technology, Inc.USA) and was placed perpendicular on the enamel.
surface and light cured in four directions for 40 seconds.

- The specimens were stored in deionized distilled water for 24 h. in humidifier.
- Testing was done with Zwick testing machine applying shear force with specially designed chisel-shaped rode with cross head speed of 5mm per minute applied at the interface between the enamel surface and the bonded composite resin. The load cell was set at 100 g. The specimens were stressed to failure and the force was recorded in Newton and divided by the surface area to obtain the shear bond strength values calculated in Mpa.

RESULTS
The resulted shear bond strength values in Mpa for the four groups are shown in Table 1 and Figure 2.

Table 1: The mean and standard deviation of shear bond strength values in Mpa for the four groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>SD±</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>19.5</td>
<td>5.02</td>
<td>18.3-23.7</td>
</tr>
<tr>
<td>II</td>
<td>20.9</td>
<td>5.42</td>
<td>18.8-25.3</td>
</tr>
<tr>
<td>III</td>
<td>19.2</td>
<td>4.75</td>
<td>18.3-25.8</td>
</tr>
<tr>
<td>IV</td>
<td>19.4</td>
<td>2.33</td>
<td>17.7-21.9</td>
</tr>
</tbody>
</table>

Group III (Medium grid diamond fissure bur) showed the lowest mean= 19.155 ± 4.75 while group II (fine grid diamond fissure bur) showed the highest mean=20.86 ± 5.42. However, the statistical analysis of the data using analysis of variance ANOVA test showed no significant difference between the four groups.

DISCUSSION
Adhesive restorative and preventive dentistry began in 1955 when acid etching of the enamel surface was proposed to increase adhesion (6). Beveling the margin has advantages to the properties of acid-etched resin restorations (1), and currently done using diamond burs (3).

The diamond fissure burs as well as the bonding agent and composite resin being used in this study were among the materials introduced to the market in our country with their manufacturers to claim high efficacy of their respective product.

The work load was standardized (100=g) on the head of the high speed handpiece. This important variable has great influence on the cutting effectiveness of the diamond fissure burs and the obtained surface roughness of the cut surface (3).

The specimens were stored in deionized distilled water for 24hrs. before being tested. This second important variable was controlled because bond strength tends to be increased gradually with prolonged storage (9).

The established reliability of the method selected for measuring the shear bond strength (using Zwick testing mash in with specially designed chisel shaped rode) (10) was the main reason for its adoption in the present work.

In this study the results of shear bond test indicated that none of the four different grid size diamond fissure burs had any significant influence on the resulted bond strength of composite resin. These findings could be explained on the fact that grinding the enamel surface with diamond burs produce gross mechanical roughness in the range of 20-150µm but leaves a smear layer of hydroxyl apatite crystals and denaturated collagen that is approximately 1-3 µm thickness. Acid etch dissolves this layer and produces microscopic relief with undercuts on the surface to create a porous layer in the range of 5-50 µm with higher surface energy which can be penetrated easily by bonding resin creating a mechanical lock, thus creating opportunity for mechanical bonding (5,7). The grid size of diamond fissure bur therefore, affects the resin tag length even though it has no influence on resin bond strength to enamel because of the fact that debonding occurs on the neck of the resin tags (5).

In table 1, the means of shear bond strength values calculated in Mpa are in range of 19.155-20.86 and were higher than the 17 MPa that was reported to be sufficient to resist contraction force of polymerization shrinkage of composite resin that provides clinically successful retention and marginal seal of the restoration. Furthermore, this rang was very close the (20 MPa) reported by other studies (5,8) which appear to be clinically very acceptable. In addition, the scatter of data was relatively of narrow range (2.33-5.42 MPa) in comparison to the scatter of the data derived from adhesion testing to enamel in other studies (11-13). This favorable result obtained may be attributed to the control of the variables, the sufficient sample size in the presented work,
and applying shear bond strength test rather than tensile bond strength test that the latest is less reliable for brittle material (14). But still the scattered data derived from any adhesion testing to dental tissue is an on-going problem for researchers in the area of study due to the nature of the dental tissue itself. Controlling the problem scattered of the data is allowing a valid conclusion to be drawn (15).

The non significant difference between the four groups, and the high range of mean shear bond strength values as well as the controlled range of the scattered data, seem to be of particular clinical relevance. As the four different grid size diamond fissure burs can be used in beveling the enamel margin successfully and the dentist can use any available diamond fissure bur in his/her clinic to bevel the enamel margin of the prepared cavity.

REFERENCES