Assessment of shear bond strength between composite resin and enamel surface after treating with acid etching and laser etching: A comparative study

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Abstract:

Background: to contrast the shear bond strength between acid and laser etching on the enamel surface. **Materials and methods:** 100 recently extracted maxillary canines were employed in this experiment. These were then primarily split into two groups: Group 1 received acid etching, followed by enamel bonding, whereas Group 2 received laser etching, followed by enamel bonding. Composite bonding to the enamel surface was done in accordance with the methods used by each group. **Results:** Group I was found to have mean shear bond strength of 63.29 MPa whereas group II was found to have mean shear bond strength of 37.84 MPa. After statistical analysis, it was observed that the samples of acid etching group had significantly greater mean shear bond strength when compared with the laser etching group. **Conclusion:** In comparison to composites bonded after laser etching, the mean shear bond strength of composites was greater after acid etching.

Keywords: Composite resin, acid etching, laser etching

Introduction:

Adhesive technology has developed rapidly since Buonocore introduced the acid etching technique in 1955.[1] The main challenge for dental adhesive is to provide effective bonding to enamel and dentin, which have different characteristics. Enamel bonding is based on micromechanical interlocking between the resin and etched enamel, which has been proven to be reliable and durable. On the other hand, bonding to dentin is far more complex due to the inherent characteristics of dentin, such as variable tubular structure, high organic content and positive dentinal fluid flow.[2-4]

Traditionally, complicated and time-consuming multistep adhesive systems have been used to achieve successful dentin bonding. Although multi-step adhesives can provide high bond strength, they are considered to be highly technique-sensitive, and many procedural errors can occur. As a consequence, clinicians have demanded simpler, more user-friendly and less technique sensitive adhesives. According to the clinicians' demand, dental material manufacturers have developed new simple-step systems.

On the other hand, there have been two concerns regarding simple step adhesive systems. In many studies, several authors have reported that selective enamel etching is effective in terms of the bond strength when using self-etch adhesives, but additional acid etching has adverse effects on the dentin bond strength, resulting in decreased bond strength.[5-8] Therefore, they suggested that prior acid etching should be limited to the enamel when using self-etch adhesives.

Hence; the present study was conducted for assessing and comparing the shear bond strength of composite resin to enamel surface with laser etching and acid etching.

Materials and methods:

100 recently extracted maxillary canines were employed in this experiment. These were then primarily split into two groups: Group I received acid etching, followed by enamel bonding, whereas Group II received laser etching, followed by enamel bonding. Composite bonding to the enamel surface was done in accordance with the methods used by each group. The teeth were dried following the etching technique, and a light cure bonding

chemical was then applied. Using a universal force testing machine, the shear bond strengths of all specimens were compared. The results were analysed with SPSS software after being saved in Microsoft Excel sheets.

Results:

Table 1: Mean shear bond strength among specimens of both the study groups

Group	Mean shear bond strength (MPa)	p- value
Group I	63.29	0.003 (Significant)
Group II	37.84	

Group I was found to have mean shear bond strength of 63.29 MPa whereas group II was found to have mean shear bond strength of 37.84 MPa. After statistical analysis, it was observed that the samples of acid etching group had significantly greater mean shear bond strength when compared with the laser etching group.

Discussion:

Laminate technique or sandwich restoration is one of the methods used in dental composite restoration,[9] in which two different materials namely glass-ionomer cement (GIc) and composite resin are used. In this technique, the GIc or resin-modified glass-ionomer cement (RMGIc) is placed between the dentin gingival margins and occlusal composite restoration.[10] The proper bond between GIc and resin composite is necessary for successful restoration. This method is mainly applied to benefit from both the physical and aesthetic properties of these materials. GIc presents two interesting features in restorations by bonding spontaneously to the dentin and releasing fluoride. Some disadvantages of these materials include poor physical-mechanical properties and aesthetics which can be compensated by the overlying composite resin.[11,12] Etching the GIC is effective to obtain the favourable bond of composite.[13] Using 35% phosphoric acid as surface treatment of GIC may increase the shear bond strength of this cement to composite resin.[14] The bond strength between the conventional GIC and composite resin is due to the porosity in the etched surface of GIC.[15] It has been found that in etching procedure, a 0.5 mm thickness of GIC and 20 seconds of etching is necessary to provide a proper bonding surface.[16]

Hence; the present study was conducted for assessing and comparing the shear bond strength of composite resin to enamel surface with laser etching and acid etching.

In this study, Group I was found to have mean shear bond strength of 63.29 MPa whereas group II was found to have mean shear bond strength of 37.84 MPa. After statistical analysis, it was observed that the samples of acid etching group had significantly greater mean shear bond strength when compared with the laser etching group.

Bahrololoomi Z et al[17] evaluated the effect of tooth preparation with bur and Er:YAG laser on shear bond strength of composite to enamel and dentin of primary teeth. Seventy-five primary molar teeth were collected and 150 specimens were obtained by mesiodistal sectioning of each tooth. In each of the enamel and dentin groups, the teeth were randomly assigned to 3 subgroups with the following preparations: bur preparation + etching (37% H3PO4), laser preparation + etching, and laser preparation without etching. Single Bond adhesive and Z250 composite were applied to all samples. The bond strength of enamel specimens was significantly higher than that of dentin specimens, except for the laser-non-etched groups. The enamel and dentin laser-non-etched groups had no significant difference in bond strength. In both enamel and dentin groups, bur preparation + etching yielded the highest bond strength, followed by laser preparation + etching, and the laser preparation without etching yielded the lowest bond strength ($P < 0.001$). In both enamel and dentin groups, laser preparation caused lower shear bond strength compared to bur preparation.

Kandaswamy et al.reported that the mild self-etch bonding provided higher shear bond strength.[18] This might be due to the lower acidity of the mild self-etch adhesive compared with the strong and intermediate self-etch adhesives. According to organic chemistry, when a weak acid invades something, it induces a minimum excitation in the ions, and hence the salt crumps formation will be minimal.[19] Cations such as Ca2+ and Na+ that are not excited and are present in large amounts for effective interaction, especially in a conductive reaction medium like GIc, instigate strong ionic reaction with the bonding agents.[20,21] It seems that the lower acidity of mild self-etch adhesive leads to the higher shear bond strength.

Conclusion:

The mean shear bond strength of composite was higher after acid etching as compared to composite bonded after laser etching.

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