

ORIGINAL RESEARCH

Comparative evaluation of shear bond strength of composite resin to enamel surface with laser etching and acid etching

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ABSTRACT:

Background: Comparison of shear bond strength of composite resin to enamel surface with laser etching and acid etching. **Materials & methods:** 100 freshly extracted permanent maxillary second premolars were included. All the specimens were divided broadly into two study groups as follows: Group 1: Specimens in which enamel bonding was done after acid etching, and Group 2: Specimens in which enamel bonding was done after laser etching. All the specimens were then placed in universal force testing machine for checking the shear bond strength. Assessment of all the results was subjected to statistical analysis using SPSS software. **Results:** Mean shear bond strength among specimens of group 1 and group 2 was found to be 29.12 MPa and 17.43 MPa respectively. While analysing statistically, it was seen that mean shear bond strength specimens of the acid etching group was significantly higher in comparison to the patients of the laser etching group. **Conclusion:** Mean shear bond strength of composite bonded after acid etching was significantly higher.

Key words: Shear Bond Strength, Composite Resin

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INTRODUCTION

In 1955, Buonocore introduced acid etching that resulted in a very significant increase in adhesion on the tooth-restoration interface. Acid etching removes the smear layer generated by cavity preparation. This layer is characterized by a low surface energy that reduces the strength of the bond between biomaterials and enamel or dentin. This bonding mechanism involves micromechanical interlocking of resin tags into the dentinal pores created by acid etching. Composite resin restorations are commonly used to restore dental structures, but they typically illustrate lower bond strength when used on dentin compared with enamel. Progressing to increase the strength of this bond, several adhesive systems have been introduced.¹⁻³ Acid etching of the enamel appears to improve the retention by selectively eroding certain hydroxyapatite formations and facilitating the penetration with the development of resin tags of about 6-12 mm in length. Various procedures for acid etching have been proposed, though the most widely used at present for enamel is 37% phosphoric acid for 15s.⁴⁻⁶ Hence; the present study was undertaken for

assessing and comparing shear bond strength of composite resin to enamel surface with laser etching and acid etching.

MATERIALS & METHODS

100 freshly extracted permanent maxillary second premolars were included. Resin blocks of uniform dimensions were made and all the specimens were embedded in them leaving behind exposed coronal portion. Two study groups were formed:

Group 1: Specimens in which enamel bonding was done after acid etching, and

Group 2: Specimens in which enamel bonding was done after laser etching.

Bonding of composite to enamel surface was done both the study groups according to their respective methods of etching. After completion of etching procedure, drying of the teeth specimens was done, followed by application of light cured bonding agent. Universal force testing machine was used for evaluation of shear bond strength. Assessment of all the results was subjected to statistical analysis using SPSS software.

RESULTS

Mean shear bond strength among specimens of group 1 and group 2 was found to be 29.12 MPa and 17.43 MPa respectively. While analysing statistically, it was

seen that mean shear bond strength specimens of the acid etching group was significantly higher in comparison to the patients of the laser etching group.

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

Group	Mean shear bond strength (MPa)	SD	t- value	p- value
Group 1	29.12	2.75	41.38	0.000 (Significant)
Group 2	17.43	3.95		

DISCUSSION

The bonding of orthodontic brackets is mainly based on the mechanical interlocking of an adhesive to irregularities in the enamel surface created by previous enamel etching. Acid etching has been the conventional method of enamel conditioning since its development in 1955. Enamel acid etching improves retention by hydroxyapatite eroding and subsequently facilitates penetration, via the production of resin tags. However, it can result in unintentional demineralization of the most superficial layer of the enamel surface, initiate caries around the metal bracket, expose the acid to uninvolved enamel, and prolong clinical manipulation.⁷⁻⁹ Hence; the present study was undertaken for assessing and comparing shear bond strength of composite resin to enamel surface with laser etching and acid etching.

Mean shear bond strength among specimens of group 1 and group 2 was found to be 29.12 MPa and 17.43 MPa respectively. While analysing statistically, it was seen that mean shear bond strength specimens of the acid etching group was significantly higher in comparison to the patients of the laser etching group. Türkmen C et al assessed in vitro the shear bond strength of a nanohybrid composite resin bonded with three adhesive systems to enamel surfaces prepared with acid and Er,Cr:YSGG laser etching. Sixty extracted caries- and restoration-free human maxillary central incisors were used. The teeth were sectioned 2 mm below the cemento-enamel junction. The crowns were embedded in autopolymerizing acrylic resin with the labial surfaces facing up. The labial surfaces were prepared with 0.5-mm reduction to receive composite veneers. Thirty specimens were etched with Er,Cr:YSGG laser. This group was also divided into three subgroups, and the following three bonding systems were then applied on the laser groups and the other three unlased groups: (1) 37% phosphoric acid etch + Bond 1 primer/adhesive (Pentron); (2) Nano-bond self-etch primer (Pentron) + Nano-bond adhesive (Pentron); and (3) all-in-one adhesive-single dose (Futurabond NR, Voco). There were no significant differences in shear bond strength between self-etch primer + adhesive and all-in-one adhesive systems for nonetched and laser-etched enamel groups ($P > .05$). However, bond strength values for the laser-etched + Bond 1 primer/adhesive group (48.00 ± 13.86 MPa) were significantly higher than the 37% phosphoric acid + Bond 1 primer/adhesive group (38.95 ± 20.07 MPa) ($P < .05$). The Er, Cr: YSGG

laser-powered hydrokinetic system etched the enamel surface more effectively than 37% phosphoric acid for subsequent attachment of composite material.¹⁰

Al Habdan, et al compared the shear bond strength of enamel or dentin conditioned with either Er, Cr: YSGG (erbium, chromium: yttrium–scandium–gallium–garnet) laser or phosphoric acid to composite resin restoration. Forty posterior human extracted teeth were used. After mesiodistal sectioning of the teeth crowns, the samples were randomly divided into two groups—in the first group (E), bonding was performed on the enamel after roughening and in the second group (D), the enamel was removed and bonding was performed on the dentin. These groups were further randomly divided into two subgroups according to the type of etching ($n = 20$ each). In the acid-etched groups (EA and DA), the surfaces were etched with 37% phosphoric acid. In the laser-conditioned groups (EL and DL), the surfaces were conditioned with Er, Cr: YSGG laser. Total-etch adhesive system was used to bond all the 80 specimens resin composite. The composite was vertically light-cured, and the specimens were subjected to a shear bond strength test. Modes of bond failure were determined with a stereomicroscope. The highest shear bond strength was observed for the DA group (16.25 ± 1.10 MPa, $p < 0.0001$), whereas the lowest was observed for the DL group (8.56 ± 0.67 MPa). The adhesive failure mode was the most frequently observed in all groups. The shear bond strength of composite resin bonded to enamel and dentin etched with phosphoric acid was higher than when conditioned with Er,Cr:YSGG laser.¹¹

CONCLUSION

Under the light of above mentioned data, the authors concluded that in comparison to composite bonded after laser etching, mean shear bond strength of composite bonded after acid etching was significantly higher.

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