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

Dr. Nikhil R. Sathawane[1], Dr. Ritu Sharma[2], Dr.Rohit Wadhwa[3]

[1]Associate Professor, Department of Conservative Dentistry and Endodontics,
Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur.
[2]Assistant professor, Dept. of Conservative Dentistry and Endodontics
School of Dental Sciences, Sharda University, Greater Noida, Uttar Pradesh, India.
[3]Reader Department of Conservative Dentistry and Endodontics Desh Bhagat Dental College Mandi Gobindharh.

Corresponding Author:Dr. Nikhil R. Sathawane

.**Abstract**

Background: To compare the shear bond strength of composite resin to enamel surface with laser etching and acid etching.

Materials and methods: In order to conduct this investigation, 100 recently extracted maxillary canines were used. Then, these were mostly divided into two groups: those in Group 1 received acid etching, then enamel bonding, whereas those in Group 2 underwent laser etching, then enamel bonding. According to each group's methodology, composite bonding to the enamel surface was carried out.

Results: Group 1 was found to have mean shear bond strength of 42.96 MPa whereas group 2 was found to have mean shear bond strength of 27.41 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: The mean shear bond strength of composite was higher after acid etching as compared to composite bonded after laser etching.

Keywords: Composite resin, acid etching, laser etching

Introduction

The current understanding of the adhesion of dental restorative materials is based on two fundamental theories. One theory is based on chemical adhesion, describing intermolecular forces at the interface and the other theory is based on micromechanical retention; attributing

adhesion to the interpenetration of components of the two surfaces.[1] Cavity preparation with rotary instruments or manual scalers leaves a smear layer on the dental surface. The low surface energy of this layer hinders the impregnation of the tissue with the adhesive agent and thus prevents adequate adhesion. Since the report of Buonocuore, the standard approach to this problem has been acid etching.[2]

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.[3] Various procedures for acid etching have been proposed, though the most widely used at present for enamel is 37% phosphoric acid for 15 seconds.[4]

Composite resin restorations are commonly used to restore dental structures, but they typically illustrate lower bond strength when used on dentin compared with enamel.[5] Progressing to increase the strength of this bond, several adhesive systems have been introduced.[6] Per the technique used and also the mechanism of adhesion, adhesive systems are broadly categorized into two main categories: total-etch and self-etch adhesive systems.[7] Many companies produce total-etch adhesive systems as either a three-step system (acid etchant, primer, and adhesive) or a two-step system (acid etchant, and a combination of primer and adhesive in a single bottle.[8] Self-etch adhesive systems are composed of a self-etching primer and an adhesive resin that's either provided in two separate bottles (two-step system) or combined in a single bottle (one-step system). Three-step total-etch adhesives are believed to be the gold standard in enamel bonding thanks to the effective bond formed after the utilization of the solvent-free, neutral pH, hydrophobic, and adhesive resin layer as a separate step.[9]

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

In order to conduct this investigation, 100 recently extracted maxillary canines were used. Then, these were mostly divided into two groups: those in Group 1 received acid etching, then enamel bonding, whereas those in Group 2 underwent laser etching, then enamel bonding. According to each group's methodology, composite bonding to the enamel surface was carried out. After the etching procedure, the teeth were dried, and a light cure bonding chemical was then applied. To compare the shear bond strengths of all specimens, a universal force testing machine was used. Results were saved in Microsoft Excel sheets, and SPSS software was used to analyse them.

Results

Group 1 was found to have mean shear bond strength of 42.96 MPa whereas group 2 was found to have mean shear bond strength of 27.41 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.

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

Group	**Mean shear bond strength (MPa)**	**p- value**
Group 1	42.96	0.001 (Significant)
Group 2	27.41	

Discussion

To date resin composite bond strength to enamel and dentine conditioned with Er,Cr:YSGG lasers remains debating. Laser conditioning of enamel and dentin require different laser parameter than that used for cavity preparation. The laser type utilized in the current study features a fixed parameter by the manufacture for conditioning which is the parameter applied to perform this study (4.5 W/50 Hz). Various features of Erbium lasers have been manipulated and assessed in several studies aiming to control the results and offer higher bond strength and a tighter marginal seal.[10,11] For instance, Usumez and Aykent[12] adjusted the laser wavelength and irradiated the enamel surface with Er,Cr:YSGG laser at a power output of (2 W, 20 Hz, 100 mJ) or (1 W, 20 Hz, 50 mJ). Decreasing the power to half decreased the bond strength of the irradiated surface, although variable results were recorded. Within the current study, a power of 4.50 W with energy density of 90 mJ was utilized to irradiate the enamel and dentin groups and higher shear bond strength was achieved compared with that obtained in previous studies.

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.

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Bahrololoomi Z et al[13] 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.

Most studies identified by the reviewers focused on Er:YAG lasers, a type of laser with application in cavity preparations in dental practice. Studies compared laser conditioning with conventional 37% phosphoric acid, revealing that the two methods can provide similar shear bond strengths.[14-16] There are certain studies revealing even a higher bond strength for laser etching.[17] The laser helps in improving shear bond strength values when bonding orthodontic brackets to the enamel surfaces by using a self-etching adhesive system. Nd:YAG and Diode lasers also help improve the adhesion of self-etching systems in cavities.[18] When comparing Er:Yag to Nd:Yag for laser etching, the latter showed significantly lower results.[19,20] When combining acid and laser etching, the fissure sealant retention was improved.[21]

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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