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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: 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:** Fifty freshly extracted mandibular first premolars were collected and stored in normal saline. All the specimens were divided broadly into two study groups as follows: Group A: Specimens in which enamel bonding was done after acid etching, and Group B: 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. **Results:** Among specimens of group A and group B, mean shear bond strength was found to be 29.11 MPa and 14.92 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 in comparison to composite bonded after laser etching.

Key words: Bond strength, Enamel Surface, Etching

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Introduction

The composite resins that are mainly used, which are methacrylate-based, have some imperfections such as shrinkage after polymerization. As these composites are a mixture of different methacrylate monomers that polymerize linearly, their shrinkage can negatively compromise the longevity of resin-based restorations, resulting in unsatisfactory marginal adaptation, marginal discoloration, decrease in surface texture, secondary caries and excessive loss of anatomic form. With the purpose of overcome this imperfection, scientists introduced silorane-based resins that have ring-shaped monomers and have low polymerization shrinkage and hydrophobicity property.[1-3] In recent years, many studies have done about structural and clinical benefits of silorane composites. But among these researches, a few has pointed to the effect of additional etching of dental substrate before applying silorane-based adhesives on shear bond strength (SBS) of dentin and enamel.[4] Adhesion in restorative dentistry is founded on two concepts, first is chemical adhesion, unfolding intermolecular forces at the border and the second concept is centered on micromechanical retention; ascribing adhesion to the penetrability of each of the components. The low surface energy of smear layer, which remains post-cavity preparation; hinders the penetration of the tissue with the bonding agent preventing sufficient adhesion and the key of choice to this is acid etching. Enamel acid etching seems to increase the retention

by selective wear down of hydroxyapatite crystals and enabling the penetration of bonding agent resulting in resin tags formation of about 6–12 mm in length. The most extensively used protocol for enamel acid etching is 37% phosphoric acid for 15 s.[5- 8] 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

The present study was undertaken for assessing and comparing shear bond strength of composite resin to enamel surface with laser etching and acid etching. Fifty freshly extracted mandibular first premolars were collected and stored in normal saline. All the specimens were divided broadly into two study groups as follows:

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

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

As per their respective study, groups, bonding of composite to enamel surface was done. After completion of etching procedure, drying of the teeth specimens was done, followed by application of light cured bonding agent. Afterwards; composite resin was bonded to all the specimens. All the specimens were then placed in universal force testing machine for checking the shear bond strength. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software. Mann Whitney U test was used for evaluation of level of significance.

Results

Assessment of 50 freshly extracted permanent mandibular first premolars were included and were divided broadly into two study groups as follows: Group A: Specimens in which enamel bonding was done after acid etching, and Group B: Specimens in which enamel bonding was done after laser etching. Among specimens of group A and group B, mean shear bond strength was found to be 29.11 MPa and 14.92 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	29.11	2.52	4.855	0.01 (Sig.)
Group 2	14.92	1.76		

Discussion

Development of laser technology has enabled its use in multiple dental procedures, such as soft tissue operations, composite restorations, tooth bleaching, caries removal, and tooth preparations with minimal pain and discomfort. The use of lasers like high power diode laser and neodymium-doped yttrium aluminum garnet (Nd:YAG) in endodontics is an innovative approach for disinfection, providing access to formerly unreachable parts of the tubular network, due to their ability to penetrate dental tissues better than irrigant solutions. Laser etching has become available as an alternative to acid etching of enamel and dentin. Laser etching is painless and do not involve either vibration or heat, making this treatment highly attractive for routine use. Furthermore, laser etching of enamel or dentin has been reported to yield an anfractuous surface and open dentin tubules, both apparently ideal for adhesion.[7- 10] 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.

In the present study, assessment of 50 freshly extracted permanent mandibular first premolars were included and were divided broadly into two study groups as follows: Group A: Specimens in which enamel bonding was done after acid etching, and Group B: Specimens in which enamel bonding was done after laser etching. Among specimens of group A and group B, mean shear bond strength was found to be 29.11 MPa and 14.92 MPa respectively. Shahabi S et al evaluated the shear bond strength of composite resin bonded to enamel which is pretreated using acid etchant and Er,Cr:Ysgg. 40 extracted human teeth were divided in two groups of 20 each (Groups A and B). In Group A, prepared surface of enamel was etched using 37% phosphoric acid. In Group B, enamel was surface treated by a an Er, Cr: YSGG laser system operating at a wavelength of 2,780 nm and having a pulse duration of 140-200 microsecond with a repetition rate of 20 Hz and 40 Hz. Bonding agent ((Scotchbond Multipurpose, 3M) was applied over the test areas on 20 samples of Groups A and B each, and light cured. Composite resin (Ceram X duo Nanoceramic restorative, Densply) was applied onto the test areas as a 3 × 3 mm diameter bid, and light cured. The samples were tested for shear bond strength. Mean shear bond strength for acid-etched enamel (26.41 ± 0.66MPa, range 25.155 to 27.150 MPa) was significantly higher ($P < 0.01$) than for laser-etched enamel. For enamel surface, mean shear bond strength of bonded composite obtained after laser etching were significantly lower than those obtained after acid etching.[10]

In the present study, 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. Hajizadeh H et al compared the shear bond strength (SBS) of enamel and dentin between silorane-based adhesive resin and a methacrylate-based resin with or without additional etching. 40 sound human premolars were prepared and divided into two groups: 1- Filtek P60 composite and Clearfil SE Bond adhesive; 2- Filtek P90 composite and Silorane adhesive. Each

group divided into two subgroups: with or without additional etching. For additional etching, 37% acid phosphoric was applied before bonding procedure. A cylinder of the composite was bonded to the surface. After 24 hours storage and 500 thermo cycling between 5-55°C, shear bond strength was assessed with the cross head speed of 0.5 mm/min. Then, bonded surfaces were observed under stereomicroscope to determine the failure mode. Shear bond strength of Filtek P60 composite was significantly higher than Filtek P90 composite both in enamel and dentin surfaces ($P<0.05$). However, additional etching had no significant effect on shear bond strength in enamel or dentin for each of the composites ($P>0.05$). There was no interaction between composite type and additional etching ($P>0.05$). Failure pattern was mainly adhesive and no significant correlation was found between failure and composite type or additional etching ($P>0.05$). Shear bond strength of methacrylate-based composite was significantly higher than silorane-based composite both in enamel and dentin surfaces and additional etching had no significant effect on shear bond strength in enamel or dentin for each of the composites.[11]

Conclusion

From the above results, the authors concluded that mean shear bond strength of composite bonded after acid etching was significantly higher in comparison to composite bonded after laser etching. However; further studies are recommended.

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