10.5005/jp-journals-10024-1446
ORIGINAL RESEARCH

An Evaluation of Shear Bond Strength of Self-Etch Adhesive on Pre-etched Enamel: An *in vitro* Study

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ABSTRACT

Aim: To determine the shear bond strength of self-etch adhesive G-bond on pre-etched enamel.

Materials and methods: Thirty caries free human mandibular premolars extracted for orthodontic purpose were used for the study. Occlusal surfaces of all the teeth were flattened with diamond bur and a silicon carbide paper was used for surface smoothening. The thirty samples were randomly grouped into three groups. Three different etch systems were used for the composite build up: group 1 (G-bond self-etch adhesive system), group 2 (G-bond) and group 3 (Adper single bond). Light cured was applied for 10 seconds with a LED unit for composite build-up on the occlusal surface of each tooth with 8 millimeters (mm) in diameter and 3 mm in thickness. The specimens in each group were tested in shear mode using a knife-edge testing apparatus in a universal testing machine across head speed of 1 mm/minute. Shear bond strength values in Mpa were calculated from the peak load at failure divided by the specimen surface area. The mean shear bond strength of all the groups were calculated and statistical analysis was carried out using one-way Analysis of Variance (ANOVA).

Results: The mean bond strength of group 1 is 15.5 Mpa, group 2 is 19.5 Mpa and group 3 is 20.1 Mpa. Statistical analysis was carried out between the groups using one-way ANOVA. Group 1 showed statistically significant lower bond strength when compared to groups 2 and 3. No statistical significant difference between groups 2 and 3 ($p < 0.05$).

Conclusion: Self-etch adhesive G-bond showed increase in shear bond strength on pre-etched enamel.

Keywords: Shear bond strength, Self-etch adhesive, Pre-etched enamel.

How to cite this article: Rao B, Reddy SN, Mujeeb A, Mehta K, Saritha G. An Evaluation of Shear Bond Strength of Self-Etch Adhesive on Pre-etched Enamel: An *In vitro* Study. J Contemp Dent Pract 2013;14(6):1036-1038.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Bonding of resin composites to enamel is brought about by etching with acid which by preferential dissolution of the prisms creates a rough surface. The monomers of the subsequently applied adhesive system penetrate into the rugosities and, after polymerization, become micromechanically attached to the surface. Early bonding procedures had several steps which involved (i) an acid to etch the enamel and demineralize the dentin, (ii) a primer to infiltrate the demineralize dentin, (iii) an adhesive resin to penetrate the enamel and combine with the primer to form the hybrid layer in the surface of the dentin and (iv) application of the resin composite. Consequently, developments have been reduced the number of steps that necessary to ensure bonding, most often by combining steps ii and iii (above) but also combination of steps 1 and 2 into so-called self-etching systems have been effective in bonding to enamel and also to dentin. A further development has been the combination of all three steps into what may be termed self-etching one step adhesives.[1] Earlier studies had have shown that these self-etching adhesives showed good bond strength to dentin. Studies have shown that the application of self-etch adhesives on pre-etched enamel has been increased bond strength than the direct application of self-etch adhesives. The use of acid etching is to modify the tooth surface with phosphoric acid; this has become a standard procedure for conditioning prior to bonding agent application. The infiltration of adhesive resin into the porous zone results in the form of resin tags, thereby, establishing micromechanical retention to the etched surface.[2] Selective etching with phosphoric acid is potential techniques to use with self-etch adhesive (SEA) system to improve the performance. The success of this technique presumes that the bond strength and durability of the bond for SEA systems, used on pre-etched with phosphoric acid will be equivalent to those obtained with etch and rinse (ERA) systems. G-bond is a self-etch adhesive that was recently introduced in the market. The hypothesis is that the shear bond strength of SEA G-bond is higher on pre-etched enamel than the direct application of SEA G-bond. The purpose of the present study is to evaluate

the shear bond strength of SEA G-bond on pre-etched enamel to that of direct application of G-bond and with another total etch system.

MATERIALS AND METHODS

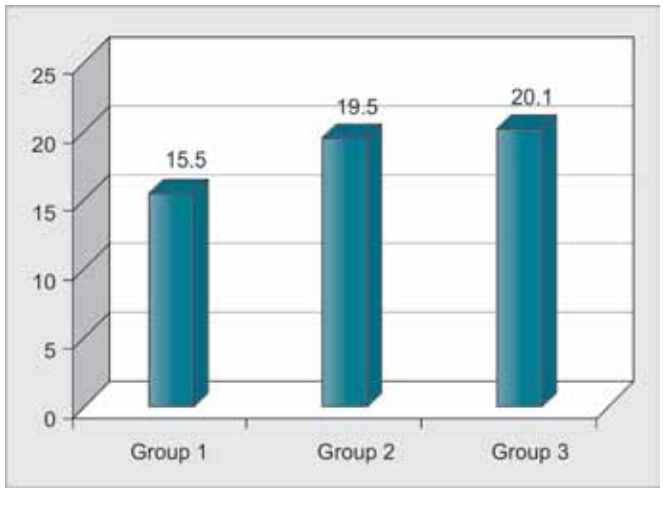
Thirty caries free human mandibular premolars extracted for orthodontic purpose were used for the study (Fig. 1). All the teeth were thoroughly cleaned and stored in physiological saline till use. Occlusal surfaces of all the teeth were flattened with diamond bur to 0.5 mm and a silicon carbide paper was used for smoothening the surface to make sure that the surface is in enamel (Fig. 2). G-bond (GC Corporation, Tokyo, Japan) a SEA was compared with Adper single bond (3M ESPE St Paul, USA) a two-step total etch adhesive. The thirty samples were randomly grouped into three groups, ten teeth in each group. G-bond is a single bottle SEA system was used on the samples of group 1. The flat occlusal surface of the each tooth was blot dried with a blotting paper. The surface was coated with adhesive using applicator tip, left undisturbed for 10 seconds. The surface was dried thoroughly with oil free air spray to remove excess adhesive. Light cured for 10 seconds with a light-emitting diode (LED) unit (Gnatus, Brazil). This was followed by incremental build up of composite (Filtek Z250, 3M ESPE, St Paul, USA) on the occlusal surface of each tooth. Dimensions of each composite build up were 8 mm in diameter and 3 mm in thickness. Phosphoric acid (37%) was applied on the flat occlusal surface for 15 seconds in group 2 samples and acid was rinsed off and then blot dried with a blotting paper. Then the remaining procedure is carried out similar to group 1. Adper single bond—a two-step total etch adhesive—was used in group III samples. As per manufacturer instructions, 37% phosphoric acid was applied for 15 seconds, then rinsed with water and blot dried. Single bond was applied and left for 5 seconds and light cured for 10 seconds. Composite build up was done same as groups 1 and 2. The specimens in each group were tested in shear mode using a knife-edge testing apparatus in a universal testing machine (Instron Corp, Canton, MA, USA) across head speed of 1 mm/minute. Shear bond strength values in Mpa were calculated from the peak load at failure divided by the specimen surface area.

RESULTS

The mean bond strength of group 1 is 15.5, group 2 is 19.5 and group 3 is 20.1. Statistical analysis was carried out between the groups using one-way ANOVA. Group 1 showed statistically significant lower bond strength when compared to groups 2 and 3. No statistical significant difference between groups 2 and 3. Statistical significance of p-value is considered < 0.05 the findings that were found in the present study was mentioned in Graph 1.

Fig. 1: Premolars used for the study distributed into three groups (each row one group)

Fig. 2: Premolars used for the study distributed into three based on color



Graph 1: Distribution and comparison of mean values (bond strength) of three groups

DISCUSSION

The primary purpose of this study is to determine whether there is any increase in bond strength of SEA G-bond on pre-etched enamel. Many studies were carried out on bond

strength of self-etch adhesives to pre-etched enamel and showed increase in bond strength but, in most of the studies, total etch system was not taken to judge the effectiveness of increase.[3-8] The present study is similar to the studies carried out by Patricia et al and Robert et al in which they tested different self-etching adhesive systems on pre-etched enamel, and total etch-system was taken as one of the study group.[9,10] In the present study, G-bond SEA system is tested whereas different other SEA systems were tested in the above-mentioned studies. They found out that there is an increase in shear bond strength of SEA systems on pre-etched enamel is in accordance to the results of the present study. But, in the present study, the shear bond strength of SEA on enamel is less than the total etch system. This could be due to less demineralization of enamel by the priming agent compared to total etch system. The shallow pattern of demineralization associated with self-etching primers could be due to a difficulty in penetration of the primer into the enamel or due to some mineral precipitation on the enamel which would modify the depth of demineralization.[9,11] However regardless of the time, the primer is left on the tooth or the number of applications the department of mineralization cannot be changed. For this reason, the use of phosphoric acid prior to applying the self-etching system has been considered in order to deepen the demineralization in enamel.[12,13] In the present study, this could be the reason for increase in the shear bond strength of SEA on pre-etched enamel and the bond strength was comparable to total etch system. Self-etching systems facilitate application in practice by removing the acid etching step. There are a number of other advantages that can be listed in comparison to total-etch systems: it avoids critical problems with acid etching, such as the moisture content when applied in dentin, the resin monomers diffuse to the same depth to which the surface was demineralized, thus providing better interlocking and there is a reduced risk of postoperative sensitivity.[14] Since high bond strength to enamel is critical to good margins and seal of the restorations, applying the etching step should be considered in case of restorations that rely mainly on enamel bonding. Those would include class IV, diastema closures and restorations with high C factor. However, this can be only applied to enamel and should be avoided in dentin.[9]

CONCLUSION

Within the limits of the present study, the G-bond SEA system has good bond strength when applied to pre-etched enamel and is comparable to Adper total etch system.

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