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Comparison of the Shear Bond Strength of Self-etch Adhesive Systems on Pre-etched and Non-etched Enamel Surfaces (an In-Vitro Study)

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ABSTRACT

Purpose: In order to simplify bonding procedures, self-etching adhesives have been implemented. It has less acidity than phosphoric acid, so there is a doubt whether these systems are strong enough for enamel bonding. **Materials and Methods:** The current study used 60 human molars. The teeth were divided into six groups (n= 10) randomly according to the used bonding agent and if etched or not. The shear bond strength was measured using Instron universal testing machine. One way (ANOVA) and the post hoc test of tukey's had been used for statistical analysis, (p value was <0.05). **Results:** The highest mean shear bonding strength (10.59± 2.39 Mpa) in Scotchbond universal was reported, for the pre-etched group and Clearfil Universal Bond (8.9741± 4.62 Mpa), the lowest was reported in Optibond XTR(8.17±5.85 Mpa), it was recorded that, for non-etched groups, Optibond XTR has recorded the highest mean shear bond strength (3.3583±1.31 MPa) and the lowest mean value (2.7391±0.84), and for Clearfil Universal Bond the mean value was (3.2164± 1.63Mppa), but the pre-etched groups showed significant difference between the Scotchbond Universal group and the Clearfil Universal group, but the difference was not significant between Clearfil Universal Group, Optibond XTR Group, and Optibond XTR Group, however, the difference was not significant between all non-etched groups. **Conclusion:** Enamel pre-etching has increased the shear strength of self etch adhesive systems significantly.

KEYWORDS

Shear, self-etching, non-etched enamel, self-adhesives.

INTRODUCTION

The self etching technique is based on monomers which are acidic resins [(1)] that allow simultaneous demineralization and penetration of partially de-mineralized substrate with the resin monomers [(2-4)]. Self etching adhesives are acidic aqueous mixtures of monomers, generally esters of phosphoric acid with a higher PH than phosphoric

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acid, and as they have different acidity, they could be classified as mild, intermediate and strong[5].

This difference in acidity has an impact on the morphological pattern of the etched surfaces [6,7]; it is so strong self-etching adhesive (pH of around 1). This gives patterns of etching as those obtained with total etch systems. These systems are more suitable for dentin but their agents are not efficient as phosphoric acid, and their strength is lower in enamel [4]. When enamel is exposed only, self etch systems are not suitable for removing these restrictions of enamel surface, rather pretreatment with phosphoric acid and washing before self etching is recommended [8, 9]. The in vitro study aimed at forecasting the effect of these systems on the shear bonding strength test on etched or intact enamel surfaces.

MATERIALS AND METHODS

A total of 60 human sound molars were used, removal of all debris and calculus with ultrasonic scales and storing teeth in a 0.2% chlorohexidine solution at room temperature until preparation of the specimen.

The teeth were placed in acrylic block to the cervical line. The mesial enamel surface was ground flat parallel to the tooth long axis using carbide bur (MANI Tochigi, Japan) with air water spray exposing 2 mm diameter by removing the superficial enamel only, to avoid dentin exposure all specimens are examined visually to ensure not exposing dentin surface. The teeth were divided to six groups (n= 10) randomly according to the used bonding agent and if etched enamel surface with phosphoric acid or not.

Cylindrical teflon mould was fabricated 2mm height and 2mm diameter. Half of the specimens were etched for 30 seconds using 37% of phosphoric acid Scotch bond enchant agent, (3M ESPE Dental Products St. Paul Mn, USA), then 10 seconds of air water spray rinsing then air dried, each adhesive system was applied following its manufacturers' instructions to its two groups one etched and the other not etched.

After light curing of the adhesive by Light Emitted Diode (LED) (Woodpecker, TMFreelight TM 2 St. Paul,MN,US), with an intensity of 800 mW/cm^2 , one nanohybrid composite Z250 XT (3M ESPE Dental Products St. Paul Mn, USA) was used for all the specimens to fill the mould and cured for 20 seconds with the same curing device. All the specimens were stored at 37ºC in distilled water for 24 hours. Then each specimen was placed in the universal testing machine (Model 3343; Instron Corp., Canton, MA, USA). Each specimen was placed in the machine lower jaw, so the base of the bonded cylinder was directly parallel to the applied shear force direction. The direction of the stress was occluso-gingivally, the speed of the crosshead is 1 mm/min (30-32), and the used materials were listed in table (1). The results were statistical analyzed by using One way (ANOVA) test and Turkey's post hoc test (p value <0.05).

RESULTS

For the pre-etching groups, the highest mean shear strength (10.59±2.39 Mpa) was recorded by Scotchbond universal and the lowest mean bond strength (8.9741±4.62 Mpa), followed by Clearfil Universal Bond (8.17±5.85 Mpa). For non-etched groups a reverse pattern resulted, Optibond XTR registered the highest mean value of shear bond strength (3.3583±1.31 Mpa), followed by Clearfil Universal Bond (3.2164± 1.63Mpa), while Scotchbond universal recorded the lowest mean value (2.7391±0.84).

For etched with phosphoric acid groups the difference was significant between Scotchbond Universal group and Clearfil Universal group, and also a significant difference between Scotchbond Universal Group and Optibond XTR Group, while the difference was not significant between Clearfil Universal group, and Optibond XTR group, But for all Non etched groups, the difference was not significant between them, as shown in table (2).

Table (1): *The tested adhesive systems.*

Adhesive system	The Manufacturer	Composition	PH and Application protocol
Scotchbond Universal	3M ESPE, St. Paul, MN, USA	MDP phosphate monomer, HEMA, di-methacrylate resins, Vitrebond co-polymer, ethanol, filler, silane, ninitiators, water.	PH 2.7 1. Applied for ten seconds 2. Dried for five seconds 3. Light cured for ten seconds
Clearfil Universal Bond	Kuraray, Sakazu, Okayama, Japan	Bisphenol di-glycidylmethacrylate (15%-35%), ethanol (methacryloyloxydecyl), 2-hydroxyethyl methacrylate (10%-35%), di-hydrogen phosphate, hydrophilic aliphatic di-methacrylate, zirconium oxide, camphorquinone, colloidal silica, accelerators, initiators, water.	PH 2.3 1. Applied for ten seconds 2. Dried for five seconds 3. Light cured for ten seconds
OptiBond XTR	Kerr, Orange, CA, USA	Ethyl alcohol (20%-30%), alkyl di-methacrylate resins (47%-68%), fumed silica (silicon dioxide) (3%-10%) , barium aluminoborosilicate glass (5%-15%), and sodium hexa-fluorosilicate (0.5%-3%).	PH (Not identified) 1. Applying the primer for twenty seconds 2. Dry for five seconds 3. Apply the adhesive for fifteen seconds 4. Dried for five seconds 5. Light cured for ten seconds

Table (2): *Statistics of the shear bond strength.*

Adhesive	Max.		Min.	Mean ± SD	Turkey's test*
Scotchbond Universal	Phosphoric acid	13.373	7.8088	10.5909± 2.39	A
	None	3.6722	1.806	2.7391±0.84	B
Clearfil Universal Bond	Phosphoric acid	10.2082	7.74	8.9741±4.62	A C,D
	None	5.0998	1.333	3.2164± 1.63	B
Optibond XTR	Phosphoric acid	11.7476	4.6096	8.1786±5.85	A C
	None	4.1624	2.5542	3.3583±1.31	B

(*) Turkey test dividing the results according to significant difference (P value <0.05), into three symbols (A, B, and C).

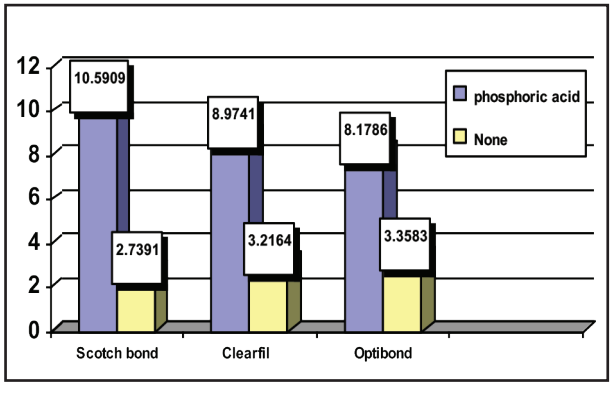

Figure (1) Chart graph showing the tested adhesives.

DISCUSSION

The results confirmed that the null hypothesis had been rejected. It was evident that all tested adhesives had significantly increased shear bond strength after treating the enamel's surface [10] a significant difference both in etched and non-etched groups of the same adhesive is in accordance with another study [11]. The value of bond strength of each adhesive tested is very close to those of Hema-based adhesives, although the hypothetical percentage

alcohol is significantly higher (acetone 25% to 50%) except OptiBond XTR (Kerr) constituents of GBU-500 (GC). The OptiBond XTR (Kerr) contains various functional monomers, alkyl dimethacrylate resin (47% –68%) and remarkable fillers in barium aluminum glass (5, % –15%) and fumed silica (silicone dioxide).

Fillers ensure the high density like flowable resin composite, which promotes the filling of pre-treated enamel microporosities and increases mechanical adhesion. The Scotchbond Universal (3 M ESPE), Clearfil Universal Bond (Kuraray) composition is comprised of similar amounts of fillers. This study showed a decreased mean shear bond strength values than the of another article [12] et al, that may due to using carbide bur which decreasing shear bond strength in comparison with silicone carbide papers.

The low bond strength for self-etching adhesives determined in the current study without the addition of phosphoric etching can be attributed to less demineralization and resin infiltrated at the surface of enamel which could be due to the inhibition of resin infiltration to enamel surfaces, which in agreement with another study [13].

CONCLUSION

Pre-etching of enamel increases the shear strength of self-etch adhesive systems.

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