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COMPARISON OF SHEAR BOND STRENGTH OF TRADITIONAL 3-STEP COMPOSITE WITH SELF ETCH PRIMER AND COMPOSITE.

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ABSTRACT: The revolution in orthodontics has been due to replacement of cemented bands by orthodontic brackets. Acid etching is required to bond a bracket on tooth's surface. Traditional three step acid etch procedure consisted of etching, sealing/priming and bonding. The self etch system (etchant and primer together) can be used without the need for surface preparation, saving chair side time and minimizing contamination. Objectives: To compare the shear bond strength (SBS) of orthodontic bracket bonded with Conventional etching primer (Transbond XT, 3M Unitek) with self etch primer (Adper Prompt L-Pop, 3M ESPE). Study Design: Prospective study Setting: Orthodontic Clinic of Ihsan Mumtaz Hospital, Lahore and PCSIR (Lahore). Period: 6 months from June 2018 to December 2018. Material and Methods: 60 human maxillary premolars were randomly divided into 2 groups of 30 each. Group-I was bonded with conventional etching primer + composite and Group-II was bonded with self etch primer + composite. Shear bond strength was measured through Ionstron force testing machine. Statistical Analysis: For each variable, shear bond strength, arithmetic mean, standard deviation, minimum and maximum values were calculated. t-test was used to compare the shear bond strength (SBS) of the two groups and P value less than and equal to 0.05 was considered significant. Results: The mean shear bond strength in group 1 and group II was10.5MPa and 7.36MPa respectively. Conclusion: The shear bond strength of Conventional etching primer + adhesive was significantly higher than the shear bond strength of self etch primer +adhesive group.

Key words: Conventional 3 Step Primer, Shear Bond Strength, Self Etching Primer (SEP).

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INTRODUCTION

Composite is an adhesive that is used to attach brackets onto the tooth surface. Composite has been used as a filling material before being used as adhesive cement for brackets. Detachment of brackets or bands during treatment is one of the most troubling features during treatment.[1] When brackets or bands loosen/break or fail, the treatment gets delayed; patient's unforeseen visits increase and overhead charges/expense shoots up.

One of the most important developments in orthodontics in the past 40-50 years is the acid etch technique. The technique used by Buonocore[2], microporosities formed by the acid etching through phosphoric acid, enamel surface area increased which helped adhesive tags to penetrate the enamel surface. Generally, roughening of the tooth surface is done with the help of 37% Phosphoric acid which is applied onto the tooth surface for 15 seconds to 1 minute per tooth.[3,4] Adhesive tags penetrating into enamel result in mechanical interlocks between enamel surface and adhesive.[5,6] In conventional system, tooth was first etched with acid, washed and dried, and then primer was applied on the chalky white etched area; adhesive was used along with the bracket. In self etch system; etchant and primer were dispersed in a single unit.[7] This merging as a single step led to fewer stages in bonding procedure, reducing the number of steps, reducing the chances of error and cross contamination, reducing chair side time for both

clinician and the patient and lesser extent of enamel decalcification.

METHODOLOGY

The prospective study was conducted at Orthodontic clinic of Ihsan Mumtaz Hospital, Lahore and (Pakistan Council of Scientific and Industrial Research) PCSIR (Lahore). Duration of the study was 6 months from June 2018 to December 2018. The sample size comprised 60 extracted human maxillary Pre-molar teeth. Non probability purposive sampling was the sampling technique used.

The criterion for including the teeth in the study was: extracted healthy human teeth without surface enamel defects, devoid of carious lesion, no evidence of enamel cracking and restorations. The criterion for excluding the teeth in the study was: fractured teeth, hypoplastic teeth, teeth previously bonded with brackets, teeth pre-treated with chemicals such as Hydrogen per oxide. The sample teeth were randomly divided into 2 study groups of 30 teeth each by using a computer generated random number table.

The study utilized 60 human maxillary pre-molars extracted for orthodontic purpose, which were kept for viability in Thymol 0.1% (wt/vol). The teeth were embedded in acrylic (polymethylmethacyrlate) so the crown of the teeth would be exposed. The buccal surfaces of the teeth were kept parallel to the applied force during the shear test. The teeth were cleaned and shined after they were placed/mounted on the acrylic block. Orthodontic premolar metal brackets (victory series, 3 M Unitek, Monrovia, Calif.) were used in the study. The surface area of the base of the bracket was considered to be 10.3 mm^2 by averaging the measurements of 10 brackets.

In group I, 30 teeth were etched with 37% phosphoric acid gel for 15 seconds and then were well washed with water for 30 sec. After drying, chalky white appearance emerged on the etched area and then a layer of Transbond XT (3M Unitek) primer sealant was applied to the teeth. Transbond XT adhesive paste was then applied to the bracket base and brackets were placed on the teeth. Excessive adhesive was then removed using a sharp scaler, and the bracket was light cured with a LED curing light for 20 seconds.

In group II, on 30 teeth self etching primer (Adper Prompt L-Pop, 3M ESPE) with Transbond XT 3M Unitek adhesive was applied to the brackets which were then light cured for 15 seconds as described for group I.

Before debonding phase, special emphasis was placed in securing the block in a position that placed the facial surface of each tooth parallel to the plunger of testing machine. This allowed plunger's direction perpendicular to the bracket. The brackets were debonded using a shear load on an Ionstron universal testing machine (Shimadzu, autograph, made in Japan). A 50Kg load cell was applied on each bracket at a crosshead speed of 1mm/min. The force required to dislodge the bracket was measured in Newtons and the shear bond strength (1 mega Pascal (Mpa) = $1N/1mm^2$) was calculated by dividing the force values by the bracket base area (10.3 mm^2).

Data Analysis

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RESULTS

The mean shear bond strength of group I, conventional etching group was 10.50 ± 2.19 Mpa and the mean shear bond strength of group II, Self etching primer group was 7.36 ± 1.76 Mpa. The t- test comparison indicated a significant difference between shear bond strength(SBS) of orthodontic bracket bonded with Conventional etching primer (Transbond XT, 3M Unitek) with self etch primer (Adper Prompt L-Pop, 3M ESPE ($P < 0.0001$) indicating that the shear bond strength of conventional etching group was significantly higher than the self etching primer group (Table-I).

Group I: Shear bond strength of Conventional etching primer group.

Group II: Shear bond strength of Self etching primer group.

Groups	Minimum (MPa)	Maximum (MPa)	Mean±SD (MPa)	t(df)	P-Value
Group1	4.66	17.33	10.50±2.19	-6.014(58)	0.0001
Group2	2.11	11.85	7.36±1.76		

Table-I

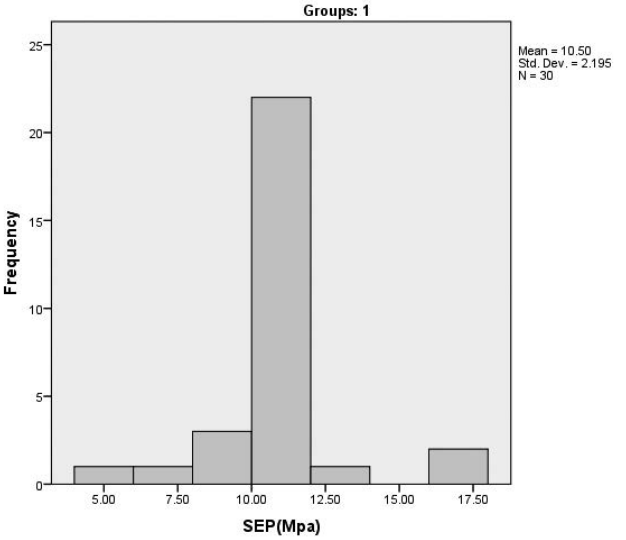

Figure-1

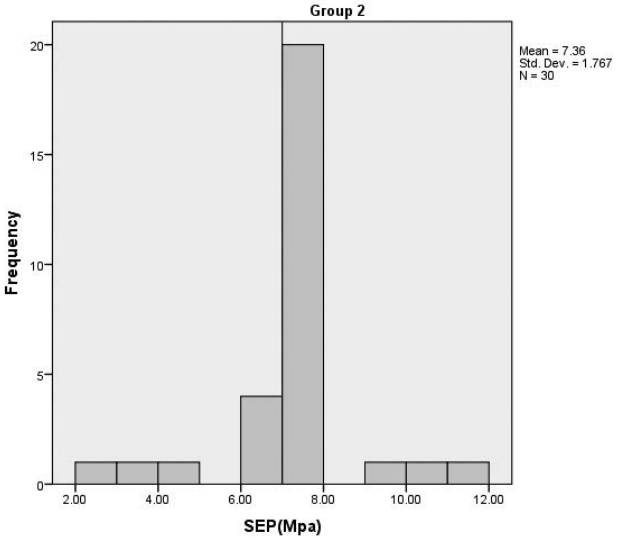

Figure-2

DISCUSSION

The objective of our investigation was to analogize the shear bond strength (SBS) of metal brackets bonded with traditional etching system and self etching system/ self etch primer (SEP).

Surface roughness is produced by Phosphoric acid, which results in ditching and small micro holes formation on the tooth's outer surface (enamel).[8] Readily flow able/less viscous resin (composite) goes into small holes. When cured with LED (Light emitting diode) Blue curing light, the resin gets set/ hardened. This set/cured resin results in interlocking or withholding of the composite onto the tooth's surface.[9] This gives adequate strength to the bond between enamel and the bracket. On the contrary, Self-etching primers when placed on the tooth surface are not washed off. Calcium, Phosphate ions from hydroxyapatite, and all the minerals get included into the resin. The reasoning for this is, the process of demineralization and penetration of tooth s outer layer, both the processes occur together.[10]

In this study, use of self etching primers for orthodontic purpose was evaluated and was compared with conventional etching primer. The findings indicated that Self etching group provided shear bond strength (mean strength 7.36±1.76 Mpa) which was significantly less than the conventional etch group (mean strength 10.50±2.19) when used to bond orthodontic brackets to the enamel surface. These values are still considered to be acceptable but certainly less than the conventional group. It must be remembered that this is an in vitro study, and results can be different with respect to those that might be obtained in the oral environment. More such research is required to determine the shear bond strength of these self etch primers in the first half hour, simulating the time when the arch wires are tied into the brackets after bonding.

Lots of investigations have been done about the composite bond with dentin using SEPs but less work has been done on enamel.[11-13] Interestingly, studies done over the above mentioned topic carries different opinion. Nakanuma et al[14] found that using SEPs on enamel and dentin when

bonding resin, the enamel bond was weaker. On the contrary, Barkmeier et al[15] found opposite results in his study as that of Nakanuma. The work of Hayakawa and Nemoto[16] showed that composite glued firmly to glossy/shiny dentin as compared to glossy/shiny enamel while using SEPs. Kanemura et al[17], s work states of low bond values while using SEPs as in comparison with traditional priming system.

Perdiagao and Lopes[18] and Hannig and Reinhardt[19] had results different from our study. Their comparison of conventional etching system with the SEPs extracted not much substantial difference. Self etch system is generally a single step system, so workers/operators may think it is easier to use or less technique sensitive.[12,13] When resin is kept thick between tooth s enamel and the bracket, there are chances of lower bond strength because thickened resin may have decreased tensile strength. So, air thinning step is mandatory with SEPs.[5] It is important to notice it the other way; too much of air thinning may decrease the strength of the material as well. Oxygen may diffuse in and may interfere with the elongation or formation of radical chains and may interfere in their growth, hence decreasing bond strength.[7] So, excessive thinning or excessive thickness of the material, both have less optimum effects on the strength of the bond.

Clinicians who worked over both the systems found that the acid etching pattern was also different when compared.[10] Conventional etching system involves Phosphoric acid etching, which is considered strong and aggressive; results in deeper pores formation. While in self etch system, etching is not that aggressive and pores formed on the enamel are not that deep. This may lead to chances of lesser bond strength, but it can be somehow an advantage during debonding. This low bond strength is assumed because of the formation of Calcium ions and Phosphorous Ions from the surface of enamel which interferes with further deepening of the pores over the enamel surface.[16] Some clinicians and investigators advocate of not much difference in bond strength between the two systems; so lesser demineralized enamel is certainly an advantage.

CONCLUSION

Reducing the steps in the procedure while orthodontic bonding has the advantage of saving time for the clinician as well reduction in the chances for cross contamination and possible errors. Our investigation indicates that self etch primers has lower bond strength values when compared with the conventional primers but it is probable to use it favorably for orthodontic bonding.

LIMITATIONS OF THE STUDY

- This was an in-vitro study. The wet oral environment could not be simulated. Hence, In-vivo studies are required.
- The sample size was limited. So larger sample size is recommended.

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CONFLICT OF INTEREST

The authors declare no conflict of interest for this investigation.

REFERENCES

1. Cochrane NJ, Lo WG, Adams GG and Schneider PM. **Quantitative analysis of enamel on debonded orthodontic brackets.** Am Journal of Orthod: 152 (3) September 2017; 312-319.

2. Buonocore MG. **A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces.** J Dent Res 1955; 34:849-53.

3. Abreu LG, Paiva SM and Pretti Het al. **Comparative Study of the Effect of Acid Etching on Enamel Surface Roughness between Pumiced and Non-pumiced Teeth.** J Int Oral Health. 2015 Sep; 7(9): 1–6.

4. Hamdani S, Anita G, Sodawala J, Gandhi S and Ali SM. **The effect of pre-etching with 37% orthophosphoric acid on the shear bond strength of orthodontic brackets bonded using self-etching primer-adhesive system.** Indian J Dent Res 2016; 27:498-501.

5. Hashimoto M, Nagano F, Endo K and Ohno H. A review: **Biodegradation of resin–dentin bonds.** Japanese Dental Science Review. 2011; 47:1; 5-12.

6. Ioannidis A, Spyridon N, Papageorgiou and I Sifakakis et al. **Orthodontic bonding and debonding induces structural changes but does not alter the mechanical properties of enamel.** Progress in Orthodontics 2018; 19: 1; 1.

7. Zope A, Zope-Khalekar Y, Chitko S, Patil HA et al. **Comparison of Self-Etch primers with conventional acid etching system on orthodontic brackets.** J Clin Diagn Res. 2016 Dec; 10(12): ZC19–ZC22.

8. Retief DH. **Effect of conditioning the enamel surface with phosphoric acid.** J Dent Res 1973; 52:333-41.

9. Craig RG. **Dental Materials: Properties and manipulation.** St Louis: Mosby-year book; 1992. P. 17-19.

10. Gordan VV, Vargas MA, Cobb DS. **Evaluation of adhesive systems using acidic primers.** Am J Dent 1997; 10:219-23.

11. Kwong SM, Cheung GS, Kei LH, Itthagarun A, Smales RJ, Tay FR. **Micro-tensile bond strengths to sclerotic dentin using a self-etching and a total-etching technique.** Dent Mater 2002; 18:359-69.

12. Koibuchi H, Yasuda N and Nakabayashi N. **Bonding to dentin with a self-etching primer: Effect of smear layers.** Dent Mater 2002; 17:403-9.

13. Nikaido T, Kunzelmann KH, Chen H, Ogata M, Harada N and Yamaguchi S. **Evaluation of thermal cycling and mechanical loading on bond strength of a self-etching primer system to dentin.** Dent Mater 2002; 18:269-75.

14. Nakanuma K, Hayakawa T, Tomita T and Yamazaki M. **Effect of the application of dentin primers and a dent in bonding agent on the adhesion between the resin-modified glass ionomer cement and dentin.** Dent Mater 1998; 14:281-6.

15. Barkmeier WW, Los SA and Triolo PT. **Bond strengths and SEM evaluation of Clearfil Liner Bond.** Am J Dent 1995; 8:289-93.

16. Hayakawa T, Nemoto K. **Efficacy of self-etching primers in the adhesion of 4-META/MMA-TBB resin cement to enamel.** J Adhes Dent 2002; 4:105-13

17. Kanemura N, Sano H, Tagami J. **Tensile bond strength to and SEM evaluation of ground and intact enamel surfaces.** J Dent 1999; 27:523-30.

18. Perdiagao J and Lopes L. **Effects of a self-etching primer on enamel shear bond strengths and SEM morphology.** Am J Dent 1997; 10:141-6.

19. Hannig M and Reinhardt KJ. **Self-etching primer versus phosphoric acid (an alternative concept for composite-to-enamel bonding).** Oper Dent 1999; 24: 172-80.

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
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2	Uzma Ijaz	Data collection, Data interpretation and drafting the article.	
3	Saad Haroon	Data collection, Data analysis and drafting the article.	
4	Taimoor Khan	Data analysis and Drafting the artilce.	
5	Raheela Yasmin	Data analysis and Drafting the artilce.	
6	Rashid Mehmood	Data analysis and Drafting the artilce.	