Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2019;10:1:160-163.

Effect of Different Etching Time on Bond Strength in Permanent Teeth Using 37% Phosphoric Acid

Garima Chouksey[1] Shirish M Bapat[2] Shail Kumari[3*] Abhilasha Mishra[4] Sonali Rai[5] Sunil Kumar Mishra[6]

[1]Private Consultant, Department of Orthodontics, Bhopal, Madhya Pradesh, India.
[2]Professor, Department of Orthodontics, Rishiraj College of Dental Sciences & Research Centre,Bhopal, Madhya Pradesh, India.
[3]Senior Lecturer, Department of Orthodontics, Rishiraj College of Dental Sciences & Research Centre,Bhopal, Madhya Pradesh, India.
[4]PG Student, Department of Orthodontics, Rishiraj College of Dental Sciences & Research Centre,Bhopal, Madhya Pradesh, India.
[5]Private Consultant, Patna, Bihar, India.
[6]Professor, Department of Prosthodontics, Peoples College of Dental Sciences & Research Centre,Bhopal, Madhya Pradesh, India.

ABSTRACT

Background: The purpose of the present study was to compare the effect of different etching time on bond strength in permanent teeth using 37 % phosphoric acid and Enlight light cure bonding material.

Materials and Methods: Thirty extracted premolar teeth were used in the present investigation. Teeth were divided into two groups having 15 teeth each, with Group A (15 seconds etching) and Group B (30 seconds etching).37% orthophosphoric acid (H_3PO_4) was used for etching and Enlight light cure bonding material was used for bonding. The bond strength was measured as a force reading at which the brackets were debonded using an instron testing machine.

Results: Shear bond strength was found to be higher in Group B (30 seconds etching) which was 13.416±1.76Mpa as compared to the Group A (15 seconds etching) as 12.988±3.28Mpa. No significant difference (*P*= 0.657) was found in between two groups.

Conclusion: Considering above findings it can be concluded that 15 seconds etching had clinically sufficient mean bond strength of 12.9Mpa. 15 seconds etching and 30 seconds etching time found be the most preferred procedures to obtain clinically acceptable mean shear bond strength with minimum loss of enamel mineral.

Keywords: Shear bond strength, Etching, Debonding, Enlight light cure.

INTRODUCTION

The introduction of the acid etching technique by Buonocore[1] in 1955, has greatly influenced and revolutionized dental and orthodontic practice by simplifying restorative, esthetic and orthodontic bonding procedures and making these procedures more efficient by direct bonding to the enamel of teeth.[2] Phosphoric acid etching causes dissolution of interprismatic material in the enamel, producing a roughened and porous layer having craters that range in depth from five to 50µm.[3] Normally, phosphoric acid at a concentration between 30-40% provided optimum retentive enamel surfaces.[4] Concentrations greater than 50% resulted in the formation of a monocalcium phosphate monohydrate that inhibits further dissolution. In lower concentrations up to 10%, the phosphoric acid solution did not produce adverse effects on the bond strength but reduced enamel surface damage by reducing depth of penetration and amount of dissolution of mineral components of enamel.[5]

Received: July. 21, 2019**: Accepted**: Sept. 4, 2019
***Correspondence Dr. Shail Kumari.**
Department of Orthodontics, Rishiraj College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh, India.
Email: drshailmishra@yahoo.com

pISSN 2278-0076
eISSN 2321-9270

Many studies have been done to standardize the concentration of acid [6,7] and the duration of application.[8] When enamel etching was introduced in 1955, the recommended time was 30 seconds for 85% phosphoric acid.[1] Then, at the time of its first clinical use (1960s), it was extended to 60 seconds.[9] In the 1980s, it was reduced to a 30-second application and which is accepted till today.[10] Most of the manufacturers of adhesive systems have recommended 15 seconds because it total bonding saves time without compromising the adhesive bond strength.

Many times bond failure occurs due to moisture contamination during bonding procedure. In any case adequate bond strength is needed despite presence of the unfavorable moist environment in oral cavity in which the polymer adhesive system operates.[11] The purpose of the present study was to compare the effect of different etching time on bond strength in permanent teeth using 37 % phosphoric acid and Enlight light cure bonding material.

MATERIALS AND METHODS

Total 30 extracted premolar teeth, were used in the present investigation. After extraction teeth were carefully washed with plain water and then stored in a dilute thymol (0.1%) solution prior to test procedures to prevent bacterial growth, the solution was changed weekly.[12] The teeth which were free of caries, macroscopic cracks, abrasions and staining were selected for the study. The selected teeth were then mounted in standardized 20mm x 23mm size acrylic blocks so that only crowns were exposed for etching and bonding.[13] Specimens were divided into two groups 15 teeth each: Group A-Red colour (15 seconds etching) (Figure 1) and Group B-Blue colour (30 seconds etching) (Figure 2).

The buccal surface of each tooth was polished for 20 sec using moderate pressure and a nonfluoride prophy paste. After polishing teeth were rinsed with distilled water spray. The teeth were painted with an acid-resistent colored varnish except for windows (2 mm diameter) on buccal surfaces to prevent spreading of etching liquid. The etchant used 37% orthophosphoric acid (H_3PO_4) was applied using a 00 camel's hair brush with tapping method. Each window was covered completely with 1 ml of acid and agitated continuously for the specified time.[14] The surfaces then were rinsed with distilled H_2O for 15 sec and air dried for 30 sec with chip blower. The sealant that was used was Enlight light cure material.

Fig 1: Group A samples tested for bond strength.

Fig 2: Group B samples tested for bond strength.

The blocks were secured in the jaws of an Instron machine model 3382 (Instron India, Chennai, Tamil Naidu, India) (Figure 3). The jig was moved for debonding at a cross head speed of 1 mm/ minute. The bond strength was measured as a force reading at which the brackets were debonded.

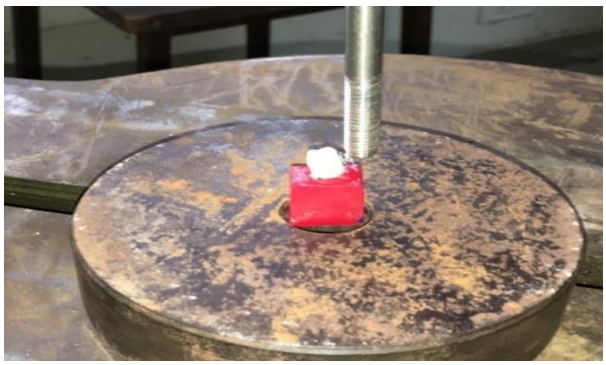

Fig 3: Testing of sample on an universal testing machine.

RESULTS

The results of the present study were presented in table 1. Shear bond strength was found higher in Group B (30 seconds etching) which was 13.416±1.76Mpa as compared to the Group A (15 seconds etching) as 12.988±3.28Mpa. Mean difference between these two group was 0.428Mpa, which was not statistically significant (*P*=0.657).

Table 1: Comparison between mean shear bond strength of Group A (15 seconds etching) and Group B (30 seconds etching)

Groups	Shear Bond Strength (Mpa)		Mean Difference	Unpaired student 't' test value	'P' Value
	MEAN	S.D			
Group A	12.988	3.28	0.428	0.445	0.657
Group B	13.416	1.76			

P value < .05 is significant.

DISCUSSION

The development of bonding of orthodontic brackets by Newman *et al*[15] (1964) revolutionized the practice of clinical orthodontics. Orthodontic bonding to enamel surfaces resulted in significant improvements such as greater patient comfort, elimination of the need for pre-treatment tooth separation, decreased gingival irritation, improved oral hygiene and esthetics.[16] Direct bonding of the bracket using acid etch bonding technique is now a routine orthodontic procedure and it is clinically acceptable method provided all the steps of enamel conditioning are properly followed.[17]

Bond testing of orthodontic adhesives can be performed in vitro by using extracted teeth as substrates (clinical simulation model) or by studying the adhesive/bracket interface, for example, by debonding a bracket from a layer of adhesive retained in a plastic well (isolated interface model).[16] Buonocore[1] originally used 85% phosphoric acid solution for 30 seconds for conditioning the enamel surface, which is now reduced to 37%. Many authors claim that acid concentrations for optimal strength vary between 35% and 50%, although reducing the concentrations down to 5%-10% does not seem to influence bond strength significantly.

Etching time in between 30-60-seconds is mostly recommended whereas lowering the etching time to as little as 10 seconds has been also found to be effective. Osorio R, *et al* [18] found that etching the enamel for 60 seconds produced statistically highly significant bond strength than etching for 15 seconds and also scanning electron microscope (SEM) evaluation revealed that the shorter etching time created a less retentive enamel surface. In present study etching with 30 seconds provided higher bond strength.

Johnston *et al*[19] found that increasing the etching time from 15 to 30 seconds significantly increased the probability of bond survival of the adhesive interface between the resin and molar buccal enamel. A further increase of etching time to 60 seconds increased the probability of bond survival, but not to a statistically significant extent. In present study etching with 30 seconds produce significantly higher bond strength than 15 seconds. Al-Suleiman *et al*[20] in their study found that the shear bond strength with 25% phosphoric acid concentration was significantly increased (*P*< 0.05). However, they had found significant difference between two etching times (30 and 60 seconds) (*P* <0.05). The shear bond strength with 37% phosphoric acid concentration was significantly decreased (*P* < 0.05) and decreased more when delayed the application time.

In the present study the shear bond strength was found to be greater than the study by Johnston *et al*[19] but lesser than the study by Attilio *et al*.[13] This difference could be attributed to difference in methodologies. However, in all our samples the shear bond strength was adequate to obtain desired bond strength.

CONCLUSION

Considering above findings it can be concluded that 15 seconds etching had clinically sufficient mean bond strength of 12.9Mpa. 15 seconds etching and 30 seconds etching time found be the most preferred procedures to obtain clinically acceptable mean shear bond strength with minimum loss of enamel mineral.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Buonocore M. A Simple method of increasing the adhesion of acrylic filling materials to enamel surface. J Dent Res 1955;34:849-853.
2. Retief DH. Effect of conditioning the enamel with phosphoric acid. J Dent Res 1973;52:333-341.
3. Milia E, Lallai MR, García-Godoy F. In vivo effect of a self etching primer on dentin. Am J Orthod Dentofacial Orthop1999;12:167-171.
4. Silverstone LM. Fissure sealants: Laboratory studies. Caries Res 1974;8:2-26.
5. Chow LC, Brown WE. Phosphoric and conditioning of teeth of pit and fissures sealants. J Dent Res 1973;52:1158.
6. Manson-Rahemetulla B, Retief DH, Jamison HC. Effect of concentrations of phosphoric acid on enamel dissolution. J Prosthet Dent 1984;51:495-498.
7. Zidan O, Hill G. Phosphoric acid concentration: enamel surface loss and bonding strength. J Prosthet Dent 1986;55:388-392.
8. Sheen DH, Wang WN, Tarng TH. Bond strength of younger and older permanent teeth with various etching times. Angle Orthod1993;63:225-230.
9. Gwinnett AJ, Buonocore MG. Adhesives and caries prevention; a preliminary report. Br Dent J. 1965;119:77-80.
10. Silverstone LM. State of the art on sealant research and priorities for further research. J Dent Educ. 1984;48:107-118.
11. Retief DH. Failure at the dental adhesive etched enamel interface. J Oral Rehabil1974;1:265-284.
12. Galil KA, Wright GZ. Acid etching patterns on buccal surfaces of permanent teeth. Pediatr Dent 1979;1(4):230-234.
13. Attilio MD, Traini T, Di Iorio D, Varvara G, Festa F, Tecco S. Shear bond strength, bond failure, and scanning electron microscopy analysis of a new flowable composite for orthodontic practice. Angle Orthod 2005;75(3):410-415.
14. Redford DA, Clarkson BH, Jensen M. The effect of different etching times on the sealant bond strength, etch depth, and pattern in primary teeth. Pediatr Dent 1986;8(1):11-15.
15. Newman GV. Epoxy adhesives for orthodontic attachments: Progress report. Am J Orthod Dentofacial Orthop1965;34:901-912.
16. Graber LW, Vanarsdall RC, Vig KWL. Current principles and techniques. 5th ed. Philadelphia: Mosby;2012.
17. Movahhed HZ, Ogaard B, Syverud M. An invitro comparison of shear bond strength of a resin – reinforced glass ionomer cement and a composite adhesive for bonding orthodontic brackets. Eur J Orthod2005;27:477-483.
18. Osorio R, Toledano M, Garcia-Godoy F. Bracket bonding with 15-or 60-second etching and dhesive remaining on enamel after debonding. Angle Orthod 1999;69(1):45-48.
19. Johnston CD, Burden DJ, Hussey DL, Mitchell CA. Bonding to molars – the effect of etch time (an in vitro study). Eur J Orthod1998;20:195-199.
20. Al-Suleiman M, Feras B, Sawan MN, Suliman A. Mechanical evaluation of the effect of reducing phosphoric acid concentrations and etching duration on the bond strength of orthodontic brackets. J Dent Oral DisordTher 2014;2(2):1-5.