

Effect of Etching on Bond Strength in Permanent Teeth Using Two Different Time Interval

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ABSTRACT

Background: Comparison of two different etching times on bond strength in permanent teeth using 37 % phosphoric acid.

Materials and Methods: Thirty extracted premolar teeth were divided into two groups having 15 teeth each, with Group A (60 seconds etching) and Group B (120 seconds etching). The etching was done with 37% orthophosphoric acid (H₃PO₄) followed by bonding with Enlight light cure bonding material. The bond strength was tested measuring the force under which the brackets were debonded using an instron testing machine.

Results: Mean shear bond strength was found higher in Group A (60 seconds etching) i.e 17.06±3.80Mpa as compared to the Group B (120 seconds etching) as 9.78±3.77Mpa. Mean difference between these two was 1.15Mpa, which was statistically not significant ($P=0.49614$) according to unpaired student 't' test.

Conclusion: 60 seconds etching had high mean shear bond strength of 17.06Mpa, which is clinically high, as compared to 120 seconds etching time. So higher etching time of 120 sec is clinically not recommended.

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

INTRODUCTION

Buonocore¹ introduced the acid etching in 1955, for more efficient and direct bonding of the material to the teeth. This procedure has revolutionized the dental practice by simplifying the orthodontic restorative, prosthodontic and esthetic dentistry procedures.² Normally, phosphoric acid at a concentration between 30-40% provided optimum retentive enamel surfaces.³ Many studies have been done to standardize the concentration of acid^{4,5} and the duration of application.⁶

Initially enamel etching was recommended for 30 seconds in 85% concentration of phosphoric acid.¹ Conniff and Hamby⁷ and Silverstone^{8,9} reported that an etching time of 120 sec was necessary on permanent enamel to establish proper etching patterns. Fuks *et al.*,¹⁰ studied the etch pattern of permanent teeth using different etch times and found that a 240-sec etch gave the desired etch pattern. 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

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environment in oral cavity in which the polymer adhesive system operates.⁶ Because of these conflicting results it was felt that it would be advantageous to determine the etching time in permanent teeth for good sealant retention. The purpose of the present study was to compare the effects of two different etching times 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.¹¹ 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.¹² Specimens were divided into two groups 15 teeth each: Group A-Orange colour (60 seconds etching) (Figure 1) and Group B-Purple colour (120 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-resistant 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.¹³ 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 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 a universal testing machine.

RESULTS

The results of the present study were presented in table 1. Shear bond strength was found higher in Group A (60 seconds etching) i.e 17.06 ± 3.80 Mpa as compared to the Group B (120 seconds etching) which had SBS of 9.78 ± 3.77 Mpa. Mean difference between these two was 1.15 Mpa, which was statistically not significant ($P=0.49614$) according to Unpaired student 't' test.

Table 1: Comparison between Mean Shear Bond strength of Group A (60 seconds etching) and Group B (120 seconds etching).

Groups	SHEAR BOND STRENGTH (Mpa)		Mean Difference	Unpaired student 't' test value	'P' Value
	MEAN	S.D			
Group A	17.06	3.80	1.15	-0.68957	0.49614
Group B	9.78	3.77			

P value < .05 is significant.

The development of bonding of orthodontic brackets by Newman *et al.*,¹⁴ (1964) revolutionized the practice of clinical orthodontics. 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.⁷ Buonocore¹ 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 *et al.*,¹⁵ 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.*,¹⁶ 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 as statistically significant extent. In present study etching with 60 seconds was significantly higher bond strength than 120 seconds.

Al-Suleiman *et al.*,¹⁷ 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.

CONCLUSION

60 seconds etching had high mean shear bond strength of 17.06Mpa, which is clinically high, as compared to 120 seconds etching time. So higher etching time of 120 sec is clinically not recommended.

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. Silverstone LM. Fissure sealants: Laboratory studies. Caries Res 1974;8:2-26.
4. Manson-Rahemetulla B, Retief DH, Jamison HC. Effect of concentrations of phosphoric acid on enamel dissolution. J Prosthet Dent 1984;51:495-498.
5. Zidan O, Hill G. Phosphoric acid concentration: enamel surface loss and bonding strength. J Prosthet Dent 1986;55:388-392.
6. Sheen DH, Wang WN, Tarng TH. Bond strength of younger and older permanent teeth with various etching times. Angle Orthod 1993;63:225-230.
7. Conniff JN, Hamby GR: Preparation of primary tooth enamel for acid conditioning. J Dent Child 1976;43:177-179.
8. Silverstone LM: Fissure sealants. Dent Update 1977;4:73-83.
9. Silverstone LM. The acid etch technique; in vitro studies with special reference to the enamel surface and the enamel resin interface. Proceedings of an International Symposium on the acid etch Technique. St. Paul, Minnesota; North Central Publishing CO, 1975pp:13-39.

10. Fuks A, Eidelman E, Shapira J. Mechanical acid treatment of the prismless layer of primary teeth VS, acid etching only. Ann SEM Study. J Dent Child 1977;44:222-225.
11. Gwinnett AJ, Buonocore MG. Adhesives and caries prevention; a preliminary report. Br Dent J. 1965;119:77-81.
12. Cueto EI, Bonocore MG. Sealing of pits and fissures with an adhesive resin: its use in caries prevention. J Am Dent Assoc 1967;73:121-128.
13. Silverstone LM. State of the art on sealant research and priorities for further research. J Dent Educ. 1984;48:107-118.
14. Newman GV. Epoxy adhesives for orthodontic attachments: Progress report. Am J Orthod Dentofacial Orthop 1965;34:901-912.
15. Osorio R, Toledano M, Garcia-Godoy F. Bracket bonding with 15-or 60-second etching and adhesive remaining on enamel after debonding. Angle Orthod 1999;69(1):45-48.
16. Johnston CD, Burden DJ, Hussey DL, Mitchell CA. Bonding to molars – the effect of etch time (an in vitro study). Eur J Orthod 1998;20:195-199.
17. 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 Disord Ther 2014;2(2):1-5.