Original Article

A Method for Prevention of Excess Enamel Etching for Orthodontic Bonding of Begg's Appliance Brackets: An Experimental Study

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Abstract

Aim: This study aims to study a method for prevention of excess enamel etching for orthodontic bonding of Begg's appliance brackets. **Background:** The routinely used methods of enamel etching such as etchant brush applicator and Echant dispenser syringe tip can do either excess or less enamel surface etching than required for bonding of orthodontic brackets. **Materials and Methods:** The study consists of patients requiring fixed orthodontic treatment with a total sample of 200 teeth. The right side upper and lower quadrant teeth enamel surfaces were etched with the help of Begg's appliance flat and curved bracket base. The most excess teeth enamel surface etched among coronal, apical, mesial, or distal was noted using digital caliper. The left side upper and lower quadrants teeth enamel surface etched with etchant brush applicator method. The present innovative method readings were compared with readings of brush applicator technique and also with ideal group, that is, ideal size of Begg's bracket base. **Results:** The study showed the statistically significant difference between the amount of etched enamel surfaces with present etchant application method and amount of etched enamel surfaces with brush applicator method ($P < 0.000$). **Conclusion:** The present method of enamel etching for orthodontic bonding of Begg's appliance brackets can be applied clinically since it can prevent both the excess enamel surface etching and less than required surface of enamel etching.

Keywords: Enamel etching method, New technique, Orthodontic bonding.

Introduction

Various researchers found the amount of tooth enamel loss after etching procedure with the help of microscopic examination. Even though we know about the tooth enamel surface gets remineralized in mouth after etching with 37% phosphoric acid, God only knows actual percentage of re-mineralization of enamel surface after etching. Hence, this article is giving a message to limit the area of etching while orthodontic bonding procedures.

Enamel etching before orthodontic bonding is most essential part of orthodontic bonding procedure. Various methods of etching enamel for orthodontic bonding procedures have been introduced by expert authors. Etching excessive surface of enamel than required surface for orthodontic bonding of brackets can be an iatrogenic injury to the teeth since teeth enamel gets decalcified with enamel etching with 37% phosphoric acid. The enamel etching technique is commonly used with composite resin when bonding brackets to the enamel surface. Initially, it was presented by Buonocore.[1] Phosphoric acid is used for etching causes dissolution of interprismatic material in the enamel. Etching produces a roughened enamel surface, and it forms resin tags within enamel. The acid etching technique is a very useful procedure in the orthodontic field, but certainly there is a need of improvement in bonding procedure to maintain the useful bond strengths while minimizing the amount of enamel loss, reducing the number of steps, and to simplify the technique.[2]

Etching with phosphoric acid has been blamed for decalcification of enamel and the development of white spot lesions around

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bonded orthodontic appliances.[3,4] Some research reports have mentioned about the mechanical damage to the teeth enamel during debonding and removal of the remaining adhesive resin from teeth surface after acid etching.[5,6]

Acid etching of enamel before bonding is a possible causative factor in the decalcification of enamel associated with orthodontic treatment. Etching demineralizes the teeth enamel surface[7,8] at depths within enamel ranging from 5 μm to 25 μm.[9,10]

Materials and Methods

The study consists of patients requiring fixed orthodontic treatment with a total sample of 200 teeth. Patient selected for this study was having normal teeth morphology and normal texture. The teeth selected for enamel surface etching were central incisors, lateral incisors, canines, first premolars, and second premolars in all the four quadrants of dentition. The right side upper and lower quadrant teeth enamel surfaces were etched with the help of Begg's appliance flat and curved bracket base. Bracket positioner was used to hold the Begg's brackets. The Begg's flat bracket base 2.67 mm × 2.67 mm base size for central and lateral incisors and curved bracket 2.67 mm × 2.67 mm base size for canine, first premolars, and second premolars were used as an etchant applicator for teeth enamel surface. Etching procedure was done by a single operator. The pencil markings were done with boons guage for all selected teeth for etching. About 37% phosphoric acid in liquid form was used for etching. Echant dispenser was selected such that it will dispense same amount of etchant for every bracket. 0.1 ml of liquid etchant was placed with a fine curved needled syringe at center of every bracket base and light pressure was applied with bracket base perpendicular to the long axis of teeth at center of marked position (Figure 1) on labial and buccal surface of all selected teeth. Etching was done for 15 s for all selected teeth. After thorough cleaning of etchant from teeth surface, the frosted appearance surface was clinically observed and measured under good light with digital caliper occlusogingivally and mesiodistally. Again, the pencil markings were done with boons guage after etching procedure for all selected teeth for the measurement of etched surface. Readings for enamel surface etching observed from center of pencil marked bracket bonding area to observe either the etched surface are excess toward coronal, apical, mesial, or distal surface. If the excess surface etched toward coronal, apical, mesial, or distal side from center of bracket bonding area, then the readings noted by parameters named coronal, apical, mesial, or distal, respectively. The most excess surface etched among coronal, apical, mesial, or distal was noted as an excess etched surface.

The left side upper and lower quadrants teeth enamel surfaces etched with etchant brush applicator method. 0.1 ml etchant was dispensed over the brush tip 0.1 ml etchant liquid was placed directly over the pencil marked center area of tooth surface with the help of brush applicator (Figure 2). The

Figure 1: Etchant application method with base of bracket

Figure 2: Etchant brush applicator method

Table 1: All margins combined inter group comparison (curved and flat bracket)

	N	Mean	Std. deviation	Std. error	F	*P*	Inference
Brush	400	2.6933	0.05394	0.00270	64.662	0.000	ANOVA suggested a significant difference in the means of three groups.
Bracket	400	2.6730	0.00732	0.00037			
Ideal	400	2.6700	0.00000	0.00000			

selected teeth on upper left quadrant and lower left quadrant were observed and readings were noted for etched enamel surfaces. Measurement technique for etched enamel surfaces was same as for bracket application method. The etched enamel surface readings from present innovative method were compared with etched enamel surface readings of brush applicator technique and also with ideal group, that is, ideal size of Begg's bracket base.

Inclusion criteria

The following criteria were included in the study:

- Patients with vital, normal clinical and morphological appearance of teeth.
- Patients with at least 20 natural selected teeth.
- Central incisors, lateral incisors, canines, and premolars in all quadrants of upper and lower dental arches.

Table 2: Individual margin wise comparison in etched area by different techniques

Margin	Groups	N	Mean	Std. deviation	Std. error	F	Sig.	Inference
C	Brush	100	2.7287	0.05253	0.00525	114.203	0.000	ANOVA suggested a significant difference in the means of etched margins of three groups
	Bracket	100	2.6740	0.00816	0.00082			
	Ideal	100	2.6700	0.00000	0.00000			
A	Brush	100	2.7133	0.04606	0.00461	77.844	0.000	ANOVA suggested a significant difference in the means of etched margins of three groups
	Bracket	100	2.6744	0.00820	0.00082			
	Ideal	100	2.6700	0.00000	0.00000			
M	Brush	100	2.6679	0.04063	0.00406	0.504	0.605	ANOVA suggested a non-significant difference in the means of etched margins of three groups for M and D margins
	Bracket	100	2.6712	0.00327	0.00033			
	Ideal	100	2.6700	0.00000	0.00000			
D	Brush	100	2.6633	0.04431	0.00443	2.582	0.077	
	Bracket	100	2.6708	0.00273	0.00027			
	Ideal	100	2.6700	0.00000	0.00000			

Exclusion criteria

- Patients with non-vital, abnormal clinical and morphological appearance of teeth.
- Stained and hyperplastic or hypoplastic teeth.
- Molar teeth were excluded from the study.

Results

The study showed the statistically significant difference between the amount of etched enamel surfaces with present etchant application method and amount of etched enamel surfaces with brush applicator method ($P < 0.000$).

The brush application method showed great variation in the amount of enamel surface etched. ANOVA suggested a significant difference in the means of three groups (Table 1).

Bonferroni *post hoc* analysis suggested that mean of etched area was significantly greater ($P = 0.000$) in brush application group when compared individually with bracket application group and ideal size of bracket group.

ANOVA suggested a significant difference in the means of margins for coronal etched area in upper arch teeth and apical etched area in lower arch teeth of three groups. Furthermore, there was a non-significant difference in the means of margins for mesial and distal etched area in upper and lower arch teeth of three groups (Table 2).

Bonferroni *post hoc* analysis suggested that coronal margin of area etched in upper arch teeth and apical margin of area etched in lower arch teeth was significantly greater ($P = 0.000$) in brush application method when compared with bracket application method and ideal size of bracket group. It may be due to the curved surface of canine and premolars and gravitational force on liquid etchant.

Discussion

Etching tooth enamel with 37% phosphoric acid etchant creates surface irregularities and microporosities which help in bonding orthodontic brackets, but etchant makes the enamel weak by decalcification. The teeth enamel can remineralize after acid etching, but the amount of time required to remineralize the enamel after acid etching is variable, and the extent of recovery is incomplete.[11,12]

The acid etched enamel exposed to cariogenic solutions has been shown to be more severely affected than enamel which is not etched.[13,14] Due to this fact, the amount of enamel surface area to be etched is very important.

The different enamel preparations[15,16] and adhesives systems[17,18] have been investigated as an alternative approaches to bonding but the study on accurate and exact surface area to be etched for bonding orthodontic brackets has not been done till date, so this is the study for evaluating the effectiveness of this method.

Etching for 15 s produces greater bond strength than required for successful orthodontic bonding.[19] Considering this fact, etching was done for 15 s for each tooth. In the present study, etching with 37% phosphoric acid for 15 s, the etched surfaces of all teeth showed frosty appearance.

Since there is great variation and excess or less etching of enamel surface with brush applicator method definitely, we can use the present etchant application method to prevent either excess enamel surface etching as well as less enamel surface etching for bonding of orthodontic Begg's appliance brackets.

Conclusion

The present method of enamel etching for orthodontic bonding of Begg's appliance brackets can be applied clinically since it can prevent both the excess enamel surface etching as well as less than required surface of enamel etching for bonding of Begg's appliance brackets.

Microscopic study for observation of actual enamel etching is needed.

The present study used Begg's brackets for etching enamel surface. Study of enamel etching using straight wire appliance bracket is needed since there is variation in size of straight wire appliance brackets.

Further research study on larger sample is required to test the accuracy of this method of etchant application.

Ethical Clearance

Approved by Institutional Ethical Committee of Government Dental College and Hospital, Aurangabad, Maharashtra, bearing number ECR/684/inst/MH/2014/RR-17.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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