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COMPARITIVE STUDY OF SHEAR BOND STRENGTH WITH ACIDULATED PHOSPHATE FLUORIDE APPLIED BEFORE AND AFTER ACID ETCHING IN ORTHODONTIC BONDING PROCEDURE

Orthodontology

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ABSTRACT

Topical fluoride is effective in increasing resistance to dental caries or enamel decalcification. The fluoride deposits in hydroxyapatite to form fluorapatite. However the fluorapatite may affect the bond strength .The aim of the study is to compare the shear bond strength with acidulated phosphate fluoride before and after acid etching. Sixty human premolar teeth were randomly divided into three groups of 20 teeth each to test the shear bond strength using Hounsfield Universal Testing machine The Mean shear strength of control Group I -10.76 MPa ,Group II (APF application before acid etching) - 10.55 MPa and Group III. (APF application after acid etching) 7.405 MPa. The results showed that there is no significant difference in bond strength with the APF application before acid etching but there is significant decrease in bond strength with APF application after acid etching compared to the control group.

KEYWORDS

Acidulated phosphate fluoride, shear strength, Hounsfield Universal testing Machine ,

INTRODUCTION

One of the most significant development in the field of orthodontics for more than 60 years is the acid etch technique introduced by Buonocore in 1955[19] that has been used in the direct bonding of orthodontic brackets.

Many studies have proven that topical fluoride is effective in increasing resistance to dental caries or enamel decalcification. These include pretreatment with topical fluoride before etching[17], incorporation of fluoride in the etching solution, and topical application of fluoride in the etched surface before bonding.

Acidulated phosphate fluoride increased the uptake of fluoride by the enamel at rates higher than either stannous fluoride or neutral sodium fluoride.

The mechanism by which fluoride reduces decalcification and caries has also been shown to increase the resistance of enamel to acids, increase the maturation rate of enamel and interfere with the metabolism of micro-organisms. The fluoride deposits in hydroxyapatite to form fluorapatite. However the fluorapatite may affect the bond strength Hence this study is to compare the shear bond strength with acidulated phosphate fluoride before and after acid etching.

MATERIALS AND METHODS

Sixty human premolar teeth were extracted from teenagers (9 to 16 years of age). Stainless steel mini-mesh curved Beggs bracket with the bracket base measurement of 3mm X 3mm (256 – 650C) manufactured by TP orthodontic Inc (USA) were used in this study. The teeth were randomly divided into three groups of 20 teeth each for evaluating shear strength. The specimens were mounted on an acrylic block of dimension (4x2x1cm) to make it compatible to the jigs of the Hounsfield universal testing machine.

Bonding Procedure

The buccal surfaces of the crown were cleaned with pumice using polishing brush for 10 seconds then washed with water and dried with an air spray.

The specimens of Group 1 (Control Group) the etchant solution was applied on the buccal surface of each crown for 15 seconds then rinsed with an abundant spray of water for 10 seconds and dried with an air spray. The etched surface became chalky white in appearance.

In the Group 2 the teeth were immersed in APF gel (Vishal Pharma Ahmedabad) for 4 minutes. The treated teeth were removed from the APF gel and left untouched for 30 minutes. Subsequently the gel was washed off with a 1 minute water spray. The enamel of each tooth was etched for 15 seconds with acid solution for bonding.

In the Group 3 the etchant was applied for 15 seconds, rinsed and dried as in the control group. However the crowns of the teeth were immersed in APF gel for 4 minutes after etching. The buccal surfaces of the teeth were abundantly washed with a water spray for 10 seconds then dried again etched enamel and bracket base were coated with a sealant and the composite resins (3M Unitek Co, USA) immediately applied to the bracket base. The brackets were accurately pressed to the demarcated etched buccal enamel with a placement scalar.

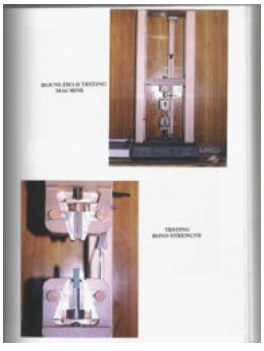

Figure1- Hounsfield Machine Testing Bond Strength

De-bonding procedure

To test the shear strength the acrylic blocks with Hounsfield Universal Testing Machine specimen tooth was mounted such that the bracket slot were perpendicular to the floor. Stainless steel ligature wire (.009) was threaded through the bracket and passed and passed upward to the movable cross head and twisted tightly. So that the load would be applied directly over the centre of the base. The cross head speed of 2mm/minute was used. The force at which the bond failed was recorded as breaking load and the bond strength values were recorded .

RESULTS

Sixty specimens were equally divided into here groups.
Group I - Control - Normal bonding
Group II - APF -Application before acid etching group.
Group III -APF Application after acid etching group.

Twenty specimens of each group were used for testing shear bond strength. The Hounsfield universal testing machine was used in this study.

Breaking load at which bond failure occurred was recorded and the strength values were calculated for each specimen.

$$\text{Bond Strength} = \frac{\text{Breaking load}}{\text{Nominal area of bonding}}$$

The nominal area of bonding base was found to be 0.09 sq.cm
The Table 1 shows shear bond strength of control and experimental specimens.

The Mean shear bond strength of control group (Group I) 10.76 MPa Group II APF application before acid etching 10.55 MPa and

Group III. APF application after acid etching 7.405 Mpa.

Table – 1 Shear Bond Strength (in Mpa)

S. No.	Group I	Group II	Group III
1.	10.9	10.5	8.3
2.	11.7	11.3	7.8
3.	10.1	10.8	8
4.	9.9	10.2	7.7
5.	11.6	11	8.6
6.	10.3	11.3	6.8
7.	12.1	10.1	7.6
8.	10.8	10	7.5
9.	9.5	9.9	7.5
10.	9.9	10.5	8.1
11.	10.7	11.4	7.3
12.	10.2	10.2	6.8
13.	11.4	11.2	7.2
14.	11.5	10.8	7
15.	9.8	10.1	6.9
16.	11.2	9.7	7.2
17.	10.9	10.3	6.9
18.	10.5	9.4	7.1
19.	11.3	11.3	6.9
20.	10.9	11	6.9
Total	215.2	211.**0**	148.1
Mean	**10.76**	**10.55**	**7.405**

DISCUSSION

Proper oral hygiene compliance in orthodontic patients has always been difficult to maintain. The bands, brackets and the different orthodontic elements make most of the patient find it difficult to brush properly even with excellent brushing habit. As a result plaque readily accumulates around the brackets and the acidic nature of this material can enamel demineralization and white spot lesion.The dematerialized surface enamel is considered to be precursor of enamel caries.

Despite efforts to educate and motivate patients undergoing orthodontic treatment the presence of decalcification remains a problem because the preventive oral hygiene maintenance program rely heavily on patient compliance. White spot lesion after orthodontic treatment with fixed appliances may present an esthetic problem even 5 years or more after the treatment.

This persistent problem has speculated a search for a preventive procedure program for the prevention of decalcification and caries one or more of the following factors are responsible for the prevention program fluoride has a remarkable ability to reduce the incidence of dental caries by increasing the resistance of enamel to acid, increasing the maturation rate of enamel and interfering with the metabolism of microorganism. Recent evidence shows that fluoride may facilitate the demineralization of white spot lesion.

Regular use of fluoride tooth paste during fixed appliance therapy was not sufficient to inhibit lesion development adjacent to orthodontic brackets fluoride availability should be independent of patient cooperation and that the fluoride ion should diffuse or dissolve over a prolonged period.

Even though different fluorides are used for topical application neutral sodium fluoride, stannous fluoride, acidulated phosphate fluoride are the three agents that are currently in use; In orthodontics topical fluoride are applied before acid etching, incorporation of fluoride in the etching solution and topical application of fluoride to the etched enamel surface before bonding as a preventive measure against decalcification.

The acidulated phosphate fluoride which is selected as the material for this study has 1.23% of fluoride as sodium fluoride buffered to Ph of 3-4 in 0.1M phosphoric acids. The main advantage of APF is its ability to deposit fluoride in enamel to a deeper depth than neutral NaF and long term benefits. The short term benefit is that APF acts initially as a potent reservoir of fluoride and the long term effect is the formation of fluorapatite as the retained calcium fluoride layer is dissolved away from the enamel surface.

The brackets used in this study were mesh brackets. Mesh based brackets were used as they are better than metal brackets with perforated bases. Reynolds and Fraunhoten have reported that metallic attachments with a coarse mesh are the most suitable type for direct bonding procedure.

For the purpose of study sixty specimens were divided into three groups 20 each for the measurement of shear bond strength. The hounsfield universal testing was used to record the breaking load.

The bracket area was measured as 0.3 cm x 0.3 cm and calculated bracket base area was 0.09 sq.cm.

Shear stress were calculated by using the formula.

$$\text{Stress} = \frac{\text{Breaking load}}{\text{Area of the bracket base}}$$

In the control (group I) the mean shear strength calculated by using the above mentioned formula was found to be 10.76 MPa

In the experimental group (group 2) APF application before acid etching and mean shear strength was found to be 10.55 MPa.

In the experimental group (group 3) APF application after acid etching and mean shear strength was found to be 7.405 MPa.

In this study Group II APF application before acid etching no significant difference were noted in the bond strength of treated and untreated group. However in Group III APF application after acid etching the bond strength decreased compared to the control group.

The topical fluoride fills the interprismatic spaces occupied by $Ca_5(PO_4)^3$ and the formation of CAF2 after etching capacity of adhesives. This reaction product could be the cause of a reduction in resin bond strength.

The APF gel produced surface coating appeared to consist of a uniformly thick layer of densely packed small globular particles present before and after acid etching. The recent research [5,15,] indicate that the onetime preventive procedure at the time of bonding has little beneficial effect in reducing white spot formation but the regular and repeated use of the low concentration of fluoride reduces the incidence and severity of white-spot formation.

Hence the application of acidulated phosphate fluoride before acid etching may offer protection from decalcification or a caries attack without affecting the bond strength. But the application APF after acid etching will have an adverse effect on orthodontic bond strength of human enamel.

CONCLUSION

An experimental study was undertaken to evaluate the shear bond of orthodontic brackets with acidulated phosphate fluoride application before and after acid etching.

The results showed that there is no statistically significant difference in bond strength with the APF application before acid etching but there is significant decrease in bond strength with APF application after acid etching compared to the control group.

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Conflicts of Interest
There are no conflicts of interest

REFERENCES

1. Arnold M. Geiger, Leonard Gorelick, John Gwinnett A. and Barbara J. Benson (1992) Reducing white spot lesion in orthodontic populations with fluoride rinsing. Am J Orthod Dentofac Orthop 101 : 403 – 7,
2. Arends. J., Christoffersen J, (1990) Nature and role of loosly bound fluoride in dental enamel J Dent. Res 69: 601-5,
3. Ashraf OB, Stanley RN, Jakobsen J.R. (1997) Fluoride release and shear bond strengths of three light cured glass ionomer cements. Am J Orthod Dentofac Orthop 111: 260-5
4. Banks PA., Burn A. O' Bren K. (1997) Clinical evaluation of the effeteness of including Fluoride in an orthodontic bondy adhesives. Eur J Orthod 19: 391-5,
5. Basdra E.K., Huber H., and Komposch G, (1996) Fluoride released from Orthodontic bonding agents alters the enamel surface inhibits enamel dimeneralization in vitro. Am J Orthod Dentofac Orthop 109: 466-72, .
6. Berkmen, Gwinnett and Shaffler (1985) Effects of enamel etching time on bond strength and morphology, J Clin Orthod 19: 36-38,
7. Bishara SE, Chan D., Adadin Er.,(1989) The effect of the bonding strength of

orthodontic Brackets of fluoride application after etching, Am J Orthod Dentofac Orthop 95: 259 -60, .
8. Bjorn Ogaard (1989) Prevalence of white spot lesions in 19 Year olds. A study on untreated and orthodontic ally treated persons. 5 years after treatment. Am J Orthod Dentofac Orthop 96: 423-7,
9. Bjorn Ogaard, Felipe Rezk – Lega, Jan -Ruban and Joop Arends (1992) Cariostatic effect and fluoride release from a visible light curing adhesive for bonding or orthodontic brackets. Am J Orthod Dentofac Orthop 101: 303-7,
10. Bjorn Ogaard, Joop Arends, Halvard Helseth Gabrielle Dijkuman and Marjan Van derkuiji (1997) Fluoride level in Saliva after bonding orthodontic brackets with a fluoride containing adhesive, am J Orthod Dentofac Orthop 111: 199-202, .
11. Bjoru Ogard, Rolla. G. and Arends J, (1998) Orthodontic appliances and enamel deminelization, Am J Orthod Dentofac Orthop 94: 68-73
12. Borsboom P., Vander Mer H.G. Arends J. (1985) Enamel lesion formation with and without 0.12 PPMF in solution Caries Res 19: 396 -402,
13. Bounoure GM, Vezin J.C, (1980) Orthodontic fluoride protection J Clin Orthod 25: 321 -335,
14. Bowen R.L, (1962) Adhesive bonding of various materials to enamel surfaces J Den Res 110: 690 -95, .
15. Bronwen vorhies A., Kevin J. Donly. Robert N. Staley and James S. Wefel (1998) Enamel demineralization adjacent to orthodontic brackets bonded with hybrid glass ionomer cements. An in vitro study. Am J Orthod Dentofac Orthop 114: 668 -74,
16. Brannstrom M., Malmgren O and Nordenvalli KJ (1978) The effect of various pretreatment methods of the enamel in bonding procedures. Am J Orthod 74: 522-530,
17. Bryant. S, Retief. D.H., Bradley E.L., Denys FR(1986) The effect of topical fluoride treatment I enamel fluoride uptake and the tensile bond strength of orthodontic bonding system. Am J Orthod Dentofac Orthop 87: 294-302
18. Buonocore M.G. (1955) A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J Dent Res 34: 849-853,
19. Buonocore MG, Gwinnett AI(1968 Penetration of resin dental materials into enamel surface with reference to bonding. Arch Oral Biol 13: 16-17.
20. Buyukyilmaz T., Ogaard B., Dahm.S, (1995) The effect on the tensile bond strength of orthodontic brackets of titanium tetrafluoride application after acid etching. Am J Orthod Dentofac Orthop 108: 256-61,