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ORIGINAL RESEARCH

Comparison of Shear Bond Strength in Smokers and Non Smokers: In Vitro Study

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ABSTRACT:

Introduction: The bond strength between enamel and the orthodontic bracket is dependent on a number of varying contributing factors. Contamination can affect the structural and chemical properties of dental materials. Oral fluids such as saliva, blood, and crevicular fluid can cause chemical incompatibility with dental materials. This study was performed to compare the shear bond strength under uncontaminated conditions and contaminated conditions with smokers and non smoker's saliva. **Methodology:** In total 45 teeth were selected. They were divided into 3 groups of 15 teeth each and were designated as IA, IB and IC. An Universal Testing Machine was used to record the bond strength. **Group IA** consisting of metal brackets bonded with conventional primer. **Group IB** consisting of metal brackets bonded with conventional primer under contaminated condition with non-smokers saliva. **Group IC** consisting of metal brackets bonded with conventional primer under contaminated condition with smoker's saliva. **Results: Group IA, IB & IC** showed a mean shear bond strength of 10.73 Mpa,5.95 & 5.80 respectively. **Discussion:** In the conventional bonding system the clinical acceptable bond strength was only attained when the enamel surface was dry. We found no differences in bond strength between contamination with smokers and that with nonsmoker's saliva. **Conclusion:** The bond strength under contaminated conditions was clinically unacceptable. There was no difference in bond strength between contamination with smoker's and nonsmoker's saliva.

Key words: Bond strength, orthodontic bracket, Smokers.

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INTRODUCTION

The bond strength between enamel and the orthodontic bracket is dependent on a number of varying contributing factors. The composition of the adhesive is a critical factor. Secondary factors like the technique of enamel conditioning, concentration of the acid etch, duration of etching time, bracket base design, bracket material, oral environment and skill of the clinician are the other variables.

Contamination can affect the structural and chemical properties of dental materials. Oral fluids such as saliva, blood, and crevicular fluid can cause chemical incompatibility with dental materials.[1]

Saliva is composed of 99.4% water and 0.6% solids, which include inorganic particles such as calcium, sodium, and chloride; and organic particles such as urea, amino acids, fatty acids, and free glucose, enzymes, proteins.[2,3]

Various components of saliva cleanse the oral tissues in general and alter Ph in oral cavity to provide buffering action and prevent demineralization of the teeth. Saliva also acts as an antibacterial agent.[4,5]

Various studies have found the effects of different contaminants found or used commonly in the oral cavity on the bond strength enamel. For example, the effects of water, saliva, astringents, plasma, hand piece lubricant, zinc oxide–eugenol cement, and non-eugenol–zinc oxide cement on bond strength have been studied.[6–11]

About 1.5 billion person worldwide consume some kind of tobacco.[12] A cigarette contains at least 5000 chemicals that produce many changes in the oral environment, such as teeth pigmentation and inflammatory and degenerative illnesses. Furthermore, smoking causes cancer and is the main cause of death worldwide.[13-15] Tobacco may also affect the chemical interaction between oral biomaterials and the teeth. Thus, smoker's saliva may affect bond strength. In this study, we worked with smoker's saliva but we did not specifically work with smoker's teeth because we wanted to focus specifically on the effects of saliva.

This study was performed to compare the shear bond strength under uncontaminated conditions and contaminated conditions with smokers and non smokers saliva.

METHODOLOGY

Recently extracted for orthodontic purposes were used in this research. Those teeth were selected which had no caries or cracks, no pre-treatment with a chemical agent such as alcohol, formalin, or hydrogen peroxide, or any other form of bleaching. Their buccal surfaces were intact, and they had not been subjected to any type of treatment. In total 45 teeth were selected. All the selected teeth were cleaned of blood and saliva and they were stored in a buffered saline solution at room temperature. The teeth were placed in a self-cure acrylic and the crowns were

exposed avoiding contact between the resin and crown. The buccal surfaces were pumiced, washed with a spray, and dried with compressed air before enamel preparation. They were divided into 3 groups of 15 teeth each and were designated as IA, IB and IC.

The selected teeth were cleaned with a scaler and then with a pumice on a slow speed conventional hand piece.

For Group IA 37% phosphoric acid solution was applied to each enamel surface with a disposable foam pellet, for 30 seconds. The teeth were then rinsed for 20 seconds and air dried.

After surface preparation, in group IA primer was applied to the etched surface and left uncured. Standard edgewise premolar metallic brackets with a base surface area of 12 mm were bonded to the teeth using light cure adhesive .

For group IB and IC similar procedure for bonding was followed as in Group IA. The polished and dried buccal surface of each tooth was acid etched with 37% phosphoric acid for 30 seconds .The etched surface was rinsed thoroughly with distilled water and dried using an oil free air. The surface was checked for a uniform chalky appearance. Saliva from voluntary person, one non smoker and other smoker, was collected within an hour after brushing, without any food consumed in-between. Two coats of non smoker saliva were applied to the etched enamel surface in group IB and two coats of smoker's saliva were applied to the etched enamel surface in group IC and the excess was blotted, leaving the surface moist. After this in both group IB and IC primer was applied to enamel surface and left uncured. Standard edgewise premolar metallic brackets with a base surface area of 12 mm were bonded to the teeth using light cure adhesive.

An Universal Testing Machine was used to record the bond strength. The experiments were conducted at a room temperature of 25^0 C. The prepared acrylic blocks were positioned in the Universal Testing Machine with the long axis parallel to the direction of the load application. A load side density of 0-50 Kgs was set in the Universal Testing Machine and the cross head speed was adjusted for 1 mm per minute. A progressive load was applied till the bracket was debonded from the tooth surface. The load at which the bracket debonded was recorded in Newtons and subsequently calculated in Mega Pascals using the formula.

$$\text{Shear bond strength (Mpa)} = \frac{\text{F (debonding force in newtons)}}{\text{D X L mm}^2\text{ (bracket base area)}}$$

where D = Width of the bracket base and
L = Height of the bracket base

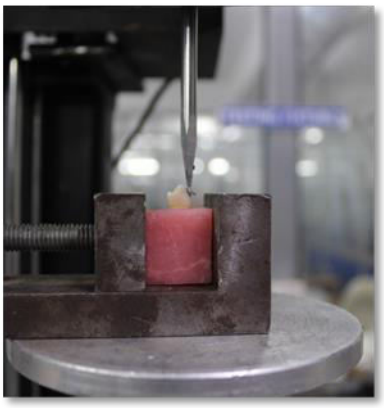

Fig 1:
showing bracket debonding

RESULTS

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Analysis of variance (ANOVA) Tukey–honestly significant difference procedure was employed for comparing shear bond strength. Graphically the data was presented by bar diagrams. A P-value of less than 0.05 was considered statistically significant. The results of this study evaluating the Shear bond strength of metal brackets at a speed of 1mm/min of the cross head of the universal testing machine under dry and contaminated conditions with smokers and non-smokers saliva (recorded in Newtons and Mpa) were tabulated in Table I.

Group IA consisting of metal brackets bonded with conventional primer under dry condition showed a mean shear bond strength of 10.73 Mpa, with standard deviation of ± 1.24.

Group IB consisting of metal brackets bonded with conventional primer under contaminated condition with non-smokers saliva showed mean shear bond strength of 5.95 Mpa, with standard deviation of ± 1.02.

Group IC consisting of metal brackets bonded with conventional primer under contaminated condition with smokers saliva showed mean shear bond strength of 5.80 Mpa, with standard deviation of ± 1.29.

Table 1: Showing shear bond strength among various groups

Group	N	Mean	SD
IA	15	10.73	1.24
IB	15	5.95	1.02
IC	15	5.80	1.29

S. No.	Comparison between groups	Calculative p-value	Result
1	Group IA vs Group IB	0.014*	Significant
2	Group IA vs Group IC	0.012*	Significant
3	Group IB vs Group IC	0.073	Not Significant

P value <0.05 was considered statistically significant.

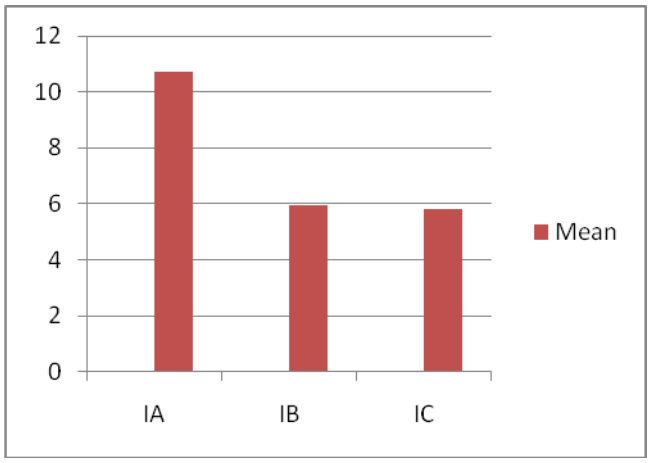

Fig 2: Graph showing mean shear bond strength between different groups

DISCUSSION

Saliva in oral cavity is important for reasons such as immunological defense and antioxidant and enzymatic functions. Saliva also protects the mucosa and promotes healing.[16]

Bonding in orthodontics is a technique-sensitive procedure owing to the hydrophobic nature of the bonding materials that requires dry and isolated fields to achieve acceptable bond strength.

This acceptable value as presented by Reynolds[17]as a minimum bond strength of 6 to 8 Mpa is adequate for most clinical orthodontic needs.

Moisture is considered the most common causes of bond failure.[18,19] The mean shear bond strength of the composite adhesive is reduced to 50 % if applied to saliva-contaminated etched enamel surfaces compared with uncontaminated etched enamel surfaces.[20-22]

In this study, among the conventional bonding system groups, a dry enamel surface condition showed high bond strength of (10.73MPa) when compared with wet conditions (salivary contamination) which showed bond strength of 5.95Mpa (non smokers saliva) and 5.80Mpa(smokers saliva). This finding was in agreement with the previous studies.[23-25]In the conventional bonding system the clinical acceptable bond strength was only attained when the enamel surface was dry. This was because the conventional bonding system was hydrophobic in nature, and hence, a wet surface would lead to reduced bond strength.

We found no differences in bond strength between contamination with smoker's and that with nonsmoker's saliva.

CONCLUSION

Un-contaminated enamel surfaces had the higher bond strengths as compared to contaminated. The bond strength under contaminated conditions was clinically unacceptable. There was no difference in bond strength between contamination with smoker's and nonsmoker's saliva.

REFERENCES:

1. Powers JM, O'Keefe KL, Pinzon LM. Factors affecting in vitro bond strength of bonding agents to human dentin. Odontology 2003;91:1–6.
2. Thornton DJ, Davies JR, Carlstedt I, Sheehan JK. In air way mucus: basic mechanisms and clinical perspectives; Rogers DF, Lethem MI, Editors. Basel, Switzerland: Birkhauser; 1997. p. 41–66.
3. Eiriksson SO, Pereira PN, Swift EJ Jr, Heymann HO, Sigurdsson A. Effects of saliva contamination of resin-resin bond strength. Dent Mater 2004;20:37–44.
4. Ellison SA. Proteins and glycoproteins of saliva. In: Handbook of physiology, section 6, alimentary canal. Baltimore: Williams and Wilkins; 1967.
5. Gupta R, Jentoft N, Jamieson AM, Blackwell J. Structural analysis of purifi ed human tracheobronchial mucins. Biopoly 1990;29:347–55.
6. Matos AB, Oliveira DC, Vieira SN, Netto NG, Powers JM. Influence of oil contamination on in vitro bond strength of bonding agents to dental substrates. Am J Dent 2008;21:101–4.
7. Itoh T, Fukushima T, Inoue Y, Arita S, Miyazaki K. Effect of water, saliva and blood contamination on bonding of metal brackets with a 4-META/MMA/TBB resin to etched enamel. Am J Dent 1999;12:299–304.
8. Benderli Y, Gokce K, Buyukgokcesu S. In vitro shear bond strength of adhesive to normal and fl uoridated enamel under various contaminated conditions. Quintessence Int 1999;30:570–5.
9. Yoo HM, Pereira PN. Effect of blood contamination with 1-step self-etching adhesives on microtensile bond strength to dentin. Oper Dent 2006;31:660–5.
10. Van Schalkwyk JH, Botha FS, van der Vyver PJ, de Wet FA, Botha SJ. Effect of biological contamination on dentin bond strength of adhesive resins. J S Afr Dent Assoc 2003;58:143–7.
11. Bishara SE, Oonsombat C, Ajlouni R, Denehy G. The effect of saliva contamination on shear bond strength of orthodontic brackets when using a self-etch primer. Angle Orthod 2002;72:554–7.
12. Irani S, Pinzon LM, Powers JM. Effect of saliva contamination on bond strength of self etching adhesives to dentin. J Dent Res 2003;82:AADR Abstract #571.
13. Pinzon LM, O'Keefe KL, Powers JM. Adhesion of composite with self-etching primer to saliva-contaminated moist and dry dentin. Trans Acad Dent Mater 2002;16:Abstract #P2.
14. Schaneveldt S, Foley TF. Bond strength comparison of moistureinsensitive primers. Am J Orthod Dentofacial Orthop 2002;122: 267–73.
15. Hitmi L, Attai JP, Degrange M. Infl uence of the time-point of salivary contamination on dentin shear bond strength of 3 dentin adhesive systems. J Adhes Dent 1999;1:219–32.
16. Stewart BW, Kleihues P. World cancer report. Lyon, France: IARCPress; 2003.
17. Reynolds J.R. A review of direct orthodontic bonding. Br J Orthod 1975; 2 : 171-180.
18. Buyukyilmaz T, Usumez S, Karaman A. Effect of Self-Etching Primers on Bond Strength -Are They Reliable? Angle Orthodontist 2003;73:64-70.
19. Cehreli ZC, Kecik D, Kocadereli I. Effect of self etching primer and adhesive formulations on the shear bond strength of

orthodontic brackets. Am J Orthod dentofacial Orthop 2005;127(5):573–9.
20. Trites B, Foley TM, Banting D. Bond strength comparison of 2 self-etching primers over a 3-month storage period. Am J Orthod 2004;126:709-716.
21. Sonis AL. Effect of a new bonding agent on bond strength to saliva contaminated enamel. J Clin Orthod. 1994;28(2):93–4.
22. Buonocore MG, Matsui A, Gwinnett AJ. Penetration of resin dental materials into enamel surfaces with reference to bonding. Arch Oral BioI 1968.
23. Santos BM, Pithon MM, Ruellas ACO, Sant'Anna EF. Shear bond strength of brackets bonded with hydrophilic and hydrophobic bond systems under contamination. Angle Orthod 2010 ;80:963–967.
24. Sfondrini MF, Cacciafesta V, Scribante A, De Angelis M, Klersy C. Effect of blood contamination on shear bond strength of brackets bonded with conventional and self-etching primers. Am J Orthod Dentofacial Orthop 2004;125:357-60.
25. Sayinsu K, Isik F, Sezen S, Aydemir B. Light Curing the Primer: Beneficial When Working in Problem Areas? Angle Orthod 2006;76:310-3.