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Shear bond strength of metallic brackets bonded with and without enamel bonding agent

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Abstract

Introduction: Bonding of brackets is an important part of orthodontic treatment. The optimal bond strength is the main requirement for successful results of orthodontic treatment. The use of enamel bonding agents like primer, sealant on etched enamel surface enhance the shear bond strength, increase resistance against micro leakage, reduce decay susceptibility and increase etched enamel damping. The purpose of this study was to evaluate the shear bond strength of orthodontic brackets bonded with and without using the enamel-bonding agent.

Material and Methods: Hundred extracted maxillary premolars were collected and randomly divided into two groups of 50 each. 50 teeth were allocated to enamel-bonding agent group and 50 kept as control. All teeth in both groups were bonded with metallic brackets using transbond XT light cure composite resin. In the enamel-bonding agent group, two layers of enamel bonding agent were applied before bracket bonding. No enamel bonding agent was used in control group. Bonding was followed by incubation in normal saline at 37^0 C for 48 hours and then thermocycling at 1000 cycles. Debonding was performed with a shearing force and shear bond strength was measured using universal testing machine. Data was analyzed using SPSS version 17 and student-t test applied for comparison.

Results: There was no significant difference between the shear bond strength of the two groups.

Conclusions: The use of enamel bonding agent does not enhance bond strength.

Keywords: Thermocycling; debonding; acid etching; primer

Introduction

In the modern era, patients are very much concerned about their facial aesthetics and smile, as these are important factors to contribute in composition of one's overall beauty.[1] Fixed orthodontic attachments are used to obtain optimum dental occlusion scheme. Previously, orthodontic treatment with fixed attachments was performed by soldering brackets onto bands, but now bonding is preferred over banding as latter deteriorates the periodontal status of teeth and the technical advancements in orthodontic bonding have limited the use of banding on posterior teeth.[2,3] However for the treatment to be successful the bond strength of brackets to conditional material should be adequately resilient to prevent debonding during the treatment.[4,5]

The enamel-etching technique of Buonocore is commonly used to attach orthodontic brackets to the enamel surface.[6] Bonding of brackets to teeth includes four major steps; cleaning, conditioning (Acid etching), sealing/ priming and bonding.[7] After etching and drying an opaque enamel surface is achieved and then primer is applied in a thin layer onto the etched enamel surface with the help of a microbrush.[7] Application of an enamel bonding agent (EBA)/primer is suggested to enhance bond strength, increase resistance against marginal leakage, reduce decay susceptibility, increase etched enamel damping, protect enamel during debonding, protect against demineralization after etching and increase etched enamel retention.[8] It is suggested that when a thin layer of resin (also

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called primer, bonding agent, or sealant) is applied and penetrates the etched enamel, it can increase bond strength between the tooth and composite resin.[8] On the other hand, it is also reported that bonding without a resin can diminish the incidence of dermatitis without adversely affecting shear bond strength.[9]

Studies have been conducted to establish a relationship between shear bond strength (SBS) and use of enamel bonding agent (EBA). Faltermeier et al.[10] and Tang et al.[11] found that EBA had no influence on SBS. A similar study was performed in 2010 and found that shear bond strength with EBA was 9.1 ± 1.9 MPa and without EBA was 8.8 ± 1.7 MPa with non- significant difference at p= 0.0341.[9]

Review of previous literature showed a limited number of studies regarding influence of enamel bonding agent on the shear bond strength and no such study has been performed involving Pakistani population. Therefore, this study was conducted to help clinicians for quality orthodontic practice. The objective of this study was to evaluate and compare shear bond strength with or with-out using enamel bonding agent.

Material and Methods

This randomized control study was conducted in the Department of Orthodontics, de'Montmorency College of Dentistry / Punjab Dental Hospital, Lahore in collaboration with PCSIR laboratories, Ferozepur Road, Lahore. Duration of study was from June to December 2016. Only healthy extracted premolar teeth with intact buccal surfaces were included in the study. Teeth with any surface anomaly e.g. caries, enamel hypoplasia and restoration were excluded from the study. Recently extracted 150 premolar teeth were collected from exodontia department of Punjab Dental Hospital, Lahore. Out of all collected premolars, 100 teeth were selected according to the inclusion criteria. These selected teeth were thoroughly rinsed under water to remove all blood and contamination and then stored in normal saline. The teeth were mounted on an acrylic jig. All teeth were equally distributed into two groups of 50 each with simple randomization. Enamel bonding agent (EBA) was labeled group A and the control group labeled as B, where no enamel bonding agent was applied. The teeth were etched with 37% phosphoric acid for 30 seconds and then rinsed and dried with oil free air for another 20 seconds. Group A teeth were coated with double layer of enamel bonding agent (Transbond XT Primer) and Group B was kept as control without application of enamel bonding agent. MBT metallic brackets (3M) were bonded to all teeth with Transbond XT light cured composite resin (3M Unitek). After bonding, all teeth were incubated in distilled water at 37^0 C for 48 hours. The teeth were thermo cycled between 5^0C and 55^0C for 1000 cycles to simulate accelerated aging from thermally induced stress and then tested for shear bond strength by using universal testing machine. Data was entered and analyzed by SPSS version 17.0. The shear bond strength is presented in the form of mean $\pm$ standard deviation and t-test was applied for comparison of shear bond strength between the two groups. P< 0.05 considered as statistically significant.

Results

The mean values of shear bond strength in group A and B were 8.99 ± 0.73 and 8.58 ± 0.64 MPa (Table I). Comparison between group A and B was made (Table II).

Table I

Group	N	Minimum	Maximum	Mean	SD
A	50	4.2	14.3	8.99	0.73
B	50	5.6	15.1	8.58	0.64

Table II: Comparison of Shear bond strength between group A and B

Group	Mean	SD	SEM	t-value	Df	P-value
A	8.99	0.73	4.09	0.07	49	>0.05
B	8.58	0.64	4.09		49	

* P>0.05= Non significant difference

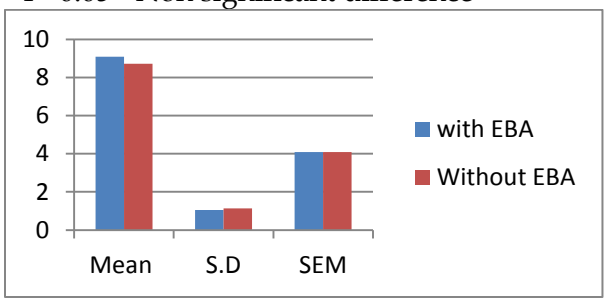

Fig 1: Comparison of sheer bond strength of metallic brackets with (Group A) and without enamel bonding agent (Group B)

Discussion

This comparative study was conducted on 100 extracted premolar teeth. Metallic brackets were bonded with or without using enamel bonding agent. The shear bond strength of both groups was estimated using universal testing machine. Buonocore[6] introduced the acid etching technique for bonding of orthodontic attachments and brackets directly to the enamel surface using adhesive composite. Therefore conventional use of orthodontic bands was eliminated and this simplified the clinical steps. Now the use of composites to attach brackets on enamel surface is well established and acceptable procedure with a lot of research to support the said procedure.

Many procedures have been introduced for bonding the brackets but the most popular one is etching followed by applying enamel bonding agent and lastly bracket bonding.[12,13] Few researchers suggest that application of enamel bonding agent is important and one of its advantages is that it increases the shear bond strength therefore preventing the bracket failure. On the other hand many others have opposite views and do not consider it a compulsory step. They are of the view that bracket failure results from many other factors, such as failure in the bonding technique, heavy masticatory forces, bracket bases with low retentive features and small size of the bracket base for esthetic reasons.[14,15]

The present study was aimed at evaluating the efficacy of enamel bonding agent during the bracket bonding procedure. The results showed statistically non-significant differences in shear bond strength values whether enamel bonding agent was used or not. The mean values of shear bond strength in enamel bonding agent group and control group were 8.99 ± 0.73 and 8.58 ± 0.64 MPa respectively. The results of the present study were similar to the values found by Tang et al11, Faltermeier et al,[10] and Wang and Tarng.[17]

Most of the studies cited here prove that the use of bonding agent increases the shear bond strength. However, it was suggested that the differences in shear bond strength values presented in various studies are related to a number of other factors, including type of adhesive, bracket base design, direction of force during debonding and thermocycling.

The results of present study showed that there was non-significant difference of shear bond strength of brackets was not affected by the use of enamel bonding agent or vice versa. These findings are in accordance to previously conducted studies.

Conclusions

There was no significant difference in shear bond strength of metallic brackets bonded with or without using enamel bonding agent.

References

1. Al Jabbari Y, Al Taweel SM, Al Rifaiy M, Alqahtani M, Koutsoukis T and Zinelis S. Effects of surface treatment and artificial aging on the shear bond strength of orthodontic brackets bonded to four different provisional restorations. The Angle Orthod July 2014;84(4):649-55

2. Aline Segatto Pires A, Felipe Weidenbach D, Roger Keller C, Vicente Castelo Branco L, Susana Maria Werner S, Fabr ́ıcio Mezzomo C. Orthodontic bracket bonding without previous adhesive priming: A meta-regression analysis. Angle Orthod 2016;86:391–8
3. Buonocore MG. Simple method of increasing the adhesion of acrylic filling materials to enamel surface. J Dent Res 1955;34:849-53
4. Edwa Jr. Swift. Bonding systems for restorative materials a comprehensive review. Pediatric Dentistry 1998;20:280-4
5. Faltermeier A, Behr M, Mussig D. A comparative evaluation of bracket bonding with 1, 2 and 3 component adhesive systems. Am J Orthod Dentofacial Orthop 2007;132:144e1-5
6. Julissa Janet R, Victor Elias A, Ana Lidia C, Jorge A, Lylian Kazumi K. Effects of sandblasting before ortho-phosphoric acid etching on lingual enamel: In-vitro roughness assessment. Am J Orthod Dentofacial Orthop 2015;147:S76-81
7. Katona TR, Long RW. Effect of loading mode on bond strength of orthodontic brackets bonded with 2 systems. Am J Orthod Dentofacial Orthop 2006;129:60-4
8. Kaya B and Uyar R. Influence on smile attractiveness of the smile arc in conjunction with gingival display. Am J Orthod Dentofacial Orthop 2013; 144: 541–7
9. Mostafa S, Farzin H, Nima M, Reza K, and Samir EB. Effects on shear bond strength and the enamel surface with an enamel bonding agent. Am J Orthod Dentofacial Orthop 2010;137:375-8
10. O'Brein KD, Watts DC, Read MJ. Residual debris and bond strength - is there a relationship? Am J Orthod Dentofacial Orthop 1988;94:222-30
11. Parnian-Alizadeh O, Mojgan K, Sahand R, Farzaneh F, Elmira-Jafari N. Effect of surface treatment with sandblasting and Er,Cr:YSGG laser on bonding of stainless steel orthodontic brackets to silver amalgam. Med Oral Patol Cir Bucal 2012;17:292-6
12. Paul G. The evolution of bonding in orthodontics. Am J Orthod Dentofacial Orthop 2015;147:S56-63
13. Rapheal P, Spiros Z, Geogrge E, Theodore E. Surface and interfacial analysis of sandblasted and acid-etched enamel for bonding orthodontic adhesives. Am J Orthod Dentofacial Orthop 2015;147:S64-75
14. Sam NS, Terry MT, Daranee T, Antheunis V. Enamel loss following ceramic bracket debonding: A quantitative analysis in vitro. Angle Orthod 2015;85:651-6
15. Tang AT, Bjorkman L, Lindback KF, Andlin-Sobocki A, Ekstrand J. Retrospective study of orthodontic bonding without liquid resin. Am J Orthod Dentofacial Orthop 2000;118:300-6
16. Thomas Z, Arianc H, Stefanie F, Thomas S. Accidental debondings: Buccal vs fully individualized lingual multi-bracket appliances. Am J Orthod Dentofacial Orthop 2014;145:649-54
17. Wang WN, Tarng TH. Evaluation of the sealant in orthodontic bonding. Am J Orthod Dentofacial Orthop 1991;100:209-11