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Biofix as an alternative orthodontic adhesive for bonding orthodontic brackets

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Abstract

Objective: The aim of this study was to evaluate the shear bond strength of Biofix on bonding orthodontic brackets and to evaluate the penetration of Biofix into the enamel surface layer. Materials & Methods: Fifty freshly extracted human premolars for orthodontic purposes were used in the present study. Premolars were equally divided into two groups and two different types of orthodontic adhesives were used. For the fist group light bond was used and for Biofix was used in the second group. Results: Biofix showed the highest shear bond values when compared to shear bond. Conclusion: The shear bond strength of the two-step adhesive "Biofix" was higher than that of the three- step adhesive Light bond. Resin tag penetration of Biofix into the enamel surface was found to be less than that of the Light bond.

Keywords

Biofix , orthodontics, adhesive, strength

Introduction

Orthodontics involves using braces to aligning teeth of malocclusions cases. Braces consist of brackets bonded to the surface of the teeth and arch wires that bond those braces together. [1] Since the introduction of direct bonding orthodontics, bonding the brackets with various orthodontic adhesives to the tooth enamel has been a vital issue [2]. Consequently, numerous dental researches aim to investigate different bonding agents which can be used [3, 4].

There are many factors that determine the success of fixed appliance therapy. The

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most important factor is the resistance of the material to orthodontic different forces which are applied. Additionally, the orthodontic adhesive should stick the bracket to enamel during the whole period of treatment. It should also permit easy removal without causing damage to the enamel [5, 6, 7, 8, 9, 10]. It was reported that a maximum tensile bond strength of 5.9 to 7.9 MPa would be adequate to resist treatment forces but in vitro tensile strength level of 4.9 MPa have been proved to be clinically acceptable. [11]

Furthermore, the adhesive should be of least discomfort to the patient and non-irritating to oral mucosa [12]. The adhesive should provide simple way of application and suitable way of curing. [13] In addition, the adhesive should have also the potential for fluoride-release to reduce the enamel decalcification. [14, 15] As a result, several new bonding agents have been developed [1].

The last 35 years has seen major developments in adhesive materials with respect to the toughness, reliability and ease of use. [16] Conventional adhesive systems are based on acid etching followed by primer solution and adhesive system. There are systems that combine the primer and bonding adhesive in one step. [17] The reduction in the number of steps for bonding procedures reduces the enamel contamination during bonding and reduces the chair side time. Consequently, newer materials have been manufactured. [18]

The self etching primer which combines the etching and priming in one step, tend to simplify bonding procedures and reduce the chair time but the bond strength was not enough [19]. Acid etching causes demineralization of the surface enamel. It removes approximately 10 μm of enamel surface and creates a morphologically porous layer (5-50 um deep). [20, 21, 12]

Bonding procedures have been evolved from acrylic to chemically-cured to light-cured to dual-cured to moister-active. All these bonding systems use bonding primer to improve the bond strength. Biofix is another light-cured orthodontic composite that does not need applying a primer as a separate step before bonding. Biofix was claimed to reduce chair time, cost effective and generate sufficient bond strength. [4]

Consequently, the null hypothesis investigated in this study is that the Biofix has less strength while bonding orthodontic brackets and negative effect of enamel decalcification. Therefore, the aim of the study is to answer the question that: could Biofix be an effective orthodontic adhesive?

Material and Methods

Fifty freshly extracted human premolars for orthodontic purposes were used in the present study. The collected teeth were cleaned and stored in de-ionized water at 37º C for 48 hours to prepare the surface. After that, the teeth were then subjected to air-water spray for cleaning and were dried with air.

Premolars were equally divided into two groups and two different types of orthodontic adhesives were used. For the fist group: the conventional three-step adhesive "light bond" (Reliance Orthodontic Products, Inc., Itasca, III, USA) was used (Figure 1 a). The two-step adhesive "Biofix" (Biodinamica EuROPA S.L) was used in the second group. (Figure 1 b).

(a)

(b)

Fig 1: Biofix (a) and light bond (b).

Each premolar was then placed in a self cure acrylic block as shown in (figure 2). Premolars were positioned with their long axis of crown parallel to the direction of the shear force to be applied in testing machine. All premolars were stored in distilled water after bonding at room temperature for 24 hours. A visible light curing unit Monitex (blue lex LD, 105 cordless curing light) was used for 20 second. A universal testing machine (Instron) ,at the faculty of Engineering, Al Azhar university, Cairo, was used for shear bond test. (Figure 3)

***Fig. 2*: A premolar put in a self a crylic block**

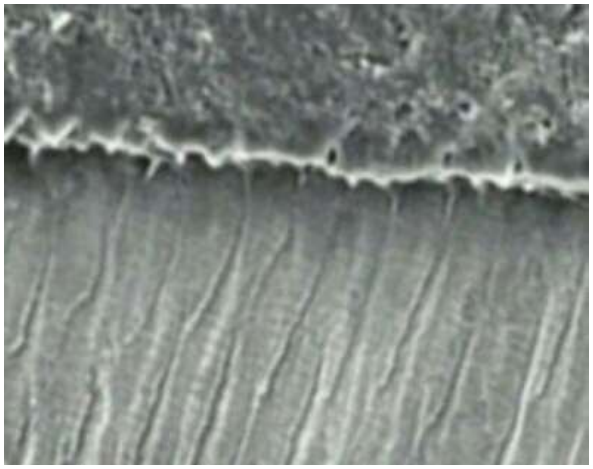
***Fig. 3*: Instron testing machine**

The load on the bracket was calculated using a personal computer attached to the testing machine. The shear bond strength values were calculated in *mega pascals (MPa)*, where the shear bond strength is equalled by dividing force of de-bonding on area of bracket base using the following equation:

$\partial = F / A$

After de-bonding, the teeth were sectioned and examined under scanning electron microscope in the Regional centre for Mycology and Biotechnology at Al Azhar university, Cairo, (Figure 4) to evaluate the resin penetration into enamel layer (Figure 5). All specimens were coated with gold palladium and observed in SEM (XL30, Philips, Eindhoven, The Netherland) operated at 10 kV at magnification of 500 times. Enamel adhesive interface was examined for adhesive penetration into enamel surface.

Fig. 4: Electron Microscope



(a)

(b)

Fig 5: Resin tag penetration comparison between Biofix (a) and light bond (b).

Statistical Analysis

Statistical analysis of the collected data has been done using Microsoft Excel Program on a personal computer. The program of SPSS IBM version 20 (Chicago USA) was used. T-test ,at 0.05 level of significance, was used to distinguish the significance of differences between both groups.

Results

Means and standard deviations of the recorded shear bond strength are shown in table 1. The statistical analysis of the findings showed significant differences between the two groups. Biofix (9.9 ± 0.46 MPa) showed the highest shear bond values when compared to shear bond (9.6 ± 0.26 MPa). Additionally, (figure 6) indicated the presence of significant difference between the bond strength values of both types of adhesives before and after using the adhesives.

Table 1. Shear bond strength values of tested groups.

Bond Strength of Adhesive	Biofix	Light Bond
Range	8.3 – 9.9	8.6 – 9.6
Mean ± SD	9.27 ± 0.46	9.06 ± 0.26
T. test	4.113	
P. value	0.048*	

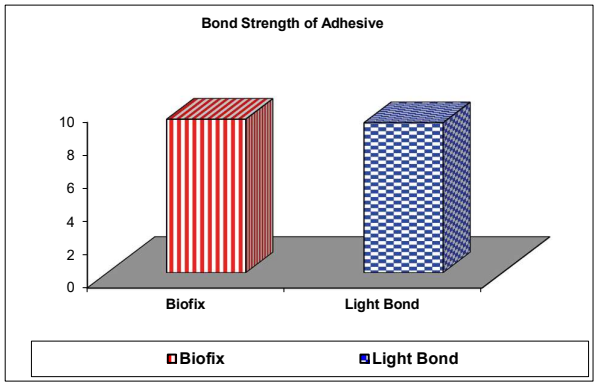


Fig. 6: percentages of bond strength of adhesives.

Discussion

During their daily practice, orthodontists seek the best ways of bonding attachments whether they are direct bonded or bands. However, the success and usability of the adhesive depends on using effective fast bonding, fulfilling the acceptable level of bond strength, reducing chair.

Most common forms of bonding adhesives present in markets are three-step adhesives. Nowadays new generations of adhesive materials have been developed as new successful approaches in orthodontic clinics. Three-step adhesives have been replaced with two-step ones then with one-step adhesive that becomes more appropriate and often used.

One of the recently developed adhesives is "Biofix" as a two-step adhesive. Biofix is compared in the current study with one of the widely used three-step adhesives "Light bond". In vitro, both adhesive systems are compared for evaluation of their bond strength. Enamel surface was scanned for evaluation of enamel penetration by both adhesives. For ethical considerations, in vitro characterization of bond strength is used for its simulation of bonding techniques and load application by shear force.

It was reported that the shear bond strength in the range of 9 to12 MPa were acceptable. [17] This agrees with the current study as the shear bond strengths range from 8 to 10 MPa as in (table 1). Even though the bond strength of both Biofix and light bond are different, they are still in the acceptable range.

The current study showed that the shear bond strength of Biofix is slightly higher than that of the light bond. Although both Biofix and Light bond are comparable, both of them are still in the same range and this agrees with the studies of (Smith, R. and Shivapuja, P., 1993; Galindo, H., 1998) [22,23].

Furthermore, the present study showed that bond strength of Biofix is (9.9 ± 0.46) and this agrees to some degree with the study of (Pillai, A., etal, 2014) [4], as in their study they found the bond strength of Biofix to be (9.3050).

As previously mentioned, effective bonding adhesive should permit stickiness to the enamel during bonding and easy removal without causing damage to the enamel surface. Evaluating the bonded enamel surface using the electron microscope showed the results detailed in table 2.

Resin tag penetration after using both Biofix and Light bond was compared in (figure 5). The resin tag penetration of light bond (5-10 μm) was found to be greater than that of Biofix (3-8 μm). Since it is thought that there is no correlation between bond strength and resin tag penetration [18, 24] , the remaining resin after bonding and cleaning up can cause discoloring and damage to the enamel by time.

Consequently, using an adhesive with higher bond strength and lowest penetration is the best option to be used. Being compared with the three-step adhesive "Light bond", Biofix has the highest bond strength (9.9± 0.46) and the lowest penetration from 3 to 8 μm. As a result, using Biofix can reduce chair time, reduce cost, permit fast bonding and safe cleaning and avoid enamel penetration and this agrees with the study of (Pillai, A., etal, 2014) [4].

Conclusion

- The shear bond strength of the two-step adhesive "Biofix" was higher than that of the three- step adhesive Light bond.
- Resin tag penetration of Biofix into the enamel surface was found to be less than that of the Light bond.

References

1. Marković, E., Glišić, B., Šćepan, I., Marković, D., & Jokanovic, V. (2008). Bond strength of orthodontic adhesives. Metalurgija-Journal of Metallurgy, 79-88.

2. Newman, G. V., Newman, R. A., & Sengupta, A. K. (2001). Comparative assessment of light-cured resin-modified glass ionomer and composite resin adhesives: in vitro study of a new adhesive system. American Journal of Orthodontics and Dentofacial Orthopedics, 119(3), 256-262.

3. de Carvalho, R. C. C., de Carvalho, N. M. P., Herênio, S. S., de Oliveira Bauer, J. R., Paiva, A. E. M., Costa, J. F., ... & de Oliveira Bauer, J. R. (2012). Evaluation of shear bond strength of orthodontic resin and resin modified glass ionomer cement on bonding of metal and ceramic brackets. RSBO: Revista Sul-Brasileira de Odontologia, 9(2).

4. Pillai, A. R., Gangadharan, A., Kumar, S., & Gangadharan, J. (2014). Comparison in Shear Bond Strength of Orthodontic Brackets between Biofix and Conventional Bonding Systems: An in vitro Study. Journal of Indian Orthodontic Society, 48(7), 461.

5. Chicri RO, Sasaki RT, Carvalho AS, Nouer PRA, Lima-Arsati YBO. (2010). Effect of enamel pretreatment on shear bond strength of brackets bonded with resin-modified glass-ionomer cement. J Orthod, 11(1):11-5.

6. Fleischmann LA, Sobral MC, Santos Jr GC, Habib F. (2008). Estudo comparativo de seis tipos de brackets ortodônticos quanto à força de adesão. Dental Press Ortodon Ortop Facial, 13(4):107-16.

7. Ianni Filho D, Silva TBC, Simplício AHM, Loffredo LCM, Ribeiro RP. (2004). Avaliação in vitro da força de adesão de materiais de colagem em ortodontia: ensaios mecânicos de cisalhamento. R Dental Press Ortodon Ortop Facial, 9(1):39-48.

8. S Suna WPR. (1999). An ex vivo investigation into the bond strength of orthodontic brackets and adhesive systems. Br J Orthod, 26(1)47.

9. Millett D, Mandall N, Hickman J, Mattick R, Glenny AM. (2009). Adhesives for fixed orthodontic bands. Angel Orthod, 79(1):193-199.

10. Rikuta A et al. (2008). Influence of environmental conditions on orthodontic bracket bonding of self-etching systems . Dental Materials Journal, 27 : 654 – 659.

11. Zachrisson B U , Büyükyilmaz T. (2005). Bonding in orthodontics . In: Graber T M , Vanarsdall R L , Vig K W (eds). Orthodontics: current principles techniques , 4th edn . Elsevier Mosby , St Louis , pp. 579 – 659

12. Yoshida, S., Namura, Y., Matsuda, M., Saito, A., & Shimizu, N. (2012). Influence of light dose on bond strength of orthodontic light-cured adhesives.The European Journal of Orthodontics, 34(4), 493-497.

13. Mota, S. M., Enoki, C., Ito, I. Y., Elias, A. M., & Matsumoto, M. A. N. (2008). Streptococcus mutans counts in plaque adjacent to orthodontic brackets bonded with resin-modified glass ionomer cement or resin-based composite.Brazilian oral research, 22(1), 55-60.

14. Baturina, O., Tufekci, E., Guney-Altay, O., Khan, S. M., Wnek, G. E., & Lindauer, S. J. (2010). Development of a sustained fluoride delivery system.The Angle Orthodontist, 80(6), 1129-1135.

15. Peumans M, Kanumilli J, De Munck J, Van Landuyt K, Lambrechts P, & Van Meerbeek B (2005) Clinical effectiveness of contemporary adhesives: a systematic review of current clinical trials Dental Material 21(9)864-881.

16. Tyas, M. J., & Burrow, M. F. (2004). Adhesive restorative materials: a review. Australian Dental Journal, 49(3), 112-121.

17. Bishara, S. E., VonWald, L., Laffoon, J. F., & Warren, J. J. (2001). Effect of a self-etch primer/adhesive on the shear bond strength of orthodontic brackets.American Journal of Orthodontics and Dentofacial Orthopedics, 119(6), 621-624.

18. Fjeld, M., & Øgaard, B. (2006). Scanning electron microscopic evaluation of enamel surfaces exposed to 3 orthodontic bonding systems. American Journal of Orthodontics and Dentofacial Orthopedics, 130(5), 575-581.

19. Burapavong, V., Marshall, G. W., Apfel, D. A., & Perry, H. T. (1978). Enamel surface characteristics on removal of bonded orthodontic brackets. American journal of orthodontics, 74(2), 176-187.

20. Pus, M. D., & Way, D. C. (1980). Enamel loss due to orthodontic bonding with filled and unfilled resins using various clean-up techniques. American journal of orthodontics, 77(3), 269-283.

21. Ajlouni, R., Bishara, S. E., Soliman, M. M., Oonsombat, C., Laffoon, J. F., & Warren, J. (2005). The use of Ormocer as an alternative material for bonding orthodontic brackets. The Angle Orthodontist, 75(1), 106-108.

22. Smith, R. T., & Shivapuja, P. K. (1993). The evaluation of dual cement resins in orthodontic bonding. American Journal of Orthodontics and Dentofacial Orthopedics, 103(5), 448-451.

23. Galindo, H. R. A., Sadowsky, P. L., Vlachos, C., Jacobson, A., & Wallace, D. (1998). An in vivo comparison between a visible light-cured bonding system and a chemically cured bonding system. American Journal of Orthodontics and Dentofacial Orthopedics, 113(3), 271-275.

24. Legler, L. R., Retief, D. H., Bradley, E. L., Denys, F. R., & Sadowsky, P. L. (1989). Effects of phosphoric acid concentration and etch duration on the shear bond strength of an orthodontic bonding resin to enamel: an in vitro study.American Journal of Orthodontics and Dentofacial Orthopedics, 96(6), 485-492.