ORIGINAL ARTICLE

Comparison of two bonding approaches in terms of bond strength

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ABSTRACT

Introduction: The aim of this study was to compare the shear bond strength (SBS) of the adhesive pre-coated II (APC II) adhesive coated appliance system with that of Transbond XT composite resin. **Materials and Methods:** A total of 40 sound premolars extracted for orthodontic reasons were randomly divided into two equal groups. Each tooth was mounted vertically in a self-cure acrylic block so that the crown was exposed. In both groups, the bonding procedure was performed according to the manufacturer's instructions. The SBS test was performed with a universal testing machine. **Results:** The SBS was found to be higher in the Transbond XT group than in the APC II group. **Conclusion:** Although SBS for APC II was found to be higher than that of Transbond XT, the APC II system has been proven to be efficient for clinical use.

Key words: Adhesive pre-coated II, shear bond strength, Transbond XT

Introduction

Buonocore[1] advocated the use of phosphoric acid etching to improve the adhesion of acrylic resin filling materials to enamel in 1955. This procedure involves dissolution of the organic component of the enamel matrix, creating microporosities in the enamel surface. Etching increases the wettability of the surface and facilitates the penetration of the resin into the enamel. A mechanical bond is formed between the resin adhesive and the tooth.[2]

Direct bonding of attachments revolutionized the placement of orthodontic appliances in the late 1970s and 1980s. The pioneering work of Buonocore, Bowen, Wilson and Tavas made this valuable improvement in technique possible.[1,3-5] These researchers were instrumental in developing procedures and materials that have led to present-day standards in orthodontic adhesives. Acid etching, composite resins, glass ionomer cements and visible light-curing adhesives have evolved from these early efforts.[6] With the introduction of newer adhesive systems as well as photosensitive (light-cured) restorative materials in dentistry, additional methods have been suggested to enhance the polymerization of the materials used, including layering and more powerful light-curing devices.[7-13] In addition, other factors can potentially contribute to the strength of the bond between the enamel and the orthodontic bracket, including type of enamel conditioner, acid concentration, length of etching time, composition of the adhesive, bracket base design, bracket material, oral environment and skill of the clinician.[8,9]

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Precoated brackets (adhesive pre-coated [APC], 3M Unitek Dental Products, Monrovia, CA, USA) were introduced in 1992.[14] They provide a more uniform adhesive thickness and a reduction in the number of bonding procedures. [15] The properties of precoated brackets have improved. With the recent introduction of the APC II system (3M Unitek Dental Products), the clinician is provided with an adhesive, which is lighter and less viscous than the original APC adhesive. The APC II adhesive is soft enough to assure accurate placement yet firm enough to virtually eliminate bracket drift and excessive flash.

The aim of this study was to compare the shear bond strength (SBS) of APC II (3M Dental Products) adhesive coated appliance system with that of Transbond XT (3M Dental Products) composite resin.

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Materials and Methods

Teeth

A total of 40 human upper premolars free from caries and fillings were used. These had been extracted for reasons unrelated to the objectives of this study and with the informed consent of the patients. The teeth were washed in water to remove any traces of blood and then placed in a 0.1% of thymol solution. Afterwards, they were stored in distilled water that was changed daily. No tooth was stored for more than 1 month after extraction.

Bonding Procedure

The teeth were randomly divided into two equal groups. Each tooth was mounted vertically in a self-cure acrylic block so that the crown was exposed. The buccal enamel surfaces of the teeth were cleansed and polished with non-fluoridated pumice and rubber prophylactic cups, rinsed with water and dried in order to eliminate soft-tissue remnants and calculus. About 37 per cent phosphoric acid gel was used for acid etching of the premolars for 15 s. In Group 1, the bonding procedure was performed according to the manufacturer's instructions using Transbond XT primer and APC II. In Group 2, Transbond XT primer was applied to the etched surface in a thin film, then, Transbond XT adhesive paste was applied to the bracket base. Following bracket placement, the adhesive was light cured from the mesial and distal for 10 s each (total time 20 s) in both groups. All the brackets were bonded by one clinician (high-grade glioma) to eliminate inter-examiner variation.

In both groups, the brackets used were victory series maxillary premolar brackets (3M Unitek, Monrovia, CA, USA) with a base area of 9.6129 mm^2 as reported by the manufacturer.

Storage of Test Specimen

The specimens were stored in distilled water at 37°C for 24 h. Shear bond strength was measured with a universal testing machine (Instron, Testometric, Lancheire, UK) with a cross-head speed of 1 mm/min. A force parallel to the tooth surface was applied to the bracket in an occlusoapical direction. The force required to debond each bracket was registered in Newton's (N) and converted into megapascals (MPa = N/mm^2).

Statistical Analysis

The Kolmogorov-Smirnov normality test and the Levene variance homogeneity test were applied to the bond strength data. The data showed normal distribution and there was homogeneity of variances between the groups. Therefore, they were analyzed by using the Student's *t*-test for two independent samples.

Results

The SBS was found to be higher in Group I (mean 17.10 MPa) than in Group II (mean 12.41 MPa) group ($P < 0.005$) [Table 1].

Discussion

Cooper *et al*. listed the advantages of APC over the conventional light-cured systems as follows; consistent quality and quantity of light-cured adhesive, easier clean-up following debonding, reduced waste, improved asepsis and better inventory control.[16]

This investigation found a statistically significant difference in SBS between Transbond XT and APC II. It appears that the SBS of Transbond XT is higher than that of APC II under the *in vitro* conditions in this study. This finding is in agreement with previous studies that report a lower SBS for APC than Transbond XT.[17,18] The manufacturer has addressed this by modifying the adhesive used for precoating (APC I to APC II).

However, some other studies comparing the SBSs of APC and Transbond XT did not reveal any statistically significant difference.[13,19] An *in vivo* study found no statistically significant difference in bracket failure between the APC and the Transbond XT adhesive at any time period (90, 180, or 365 days).[20]

Sunna and Rock, in their *in vitro* study, reported that a 40 s light curing time significantly increased bond strength with APC brackets.[18] This finding is in agreement with the findings of Wang and Meng who reported higher bond strengths with Transbond XT when light curing was increased from 20 to 40 s.[21] However, this method would inevitably influence the chair time during bonding.

According to the results of several studies, orthodontic forces that are generated during treatment can vary between 5 and 20 MPa.[22-25] This wide range of values is more than likely due to the large variations in experimental design and procedures.[23] Bonds are subjected to stresses that are

Table 1: Shear bond strength (MPa)

Groups tested	*N*	Mean	SD	Range
Transbond XT	20	17.10	2.48	12.3-20.7
APC II	20	12.41	2.8	7.7-19.6

APC II: Adhesive pre-coated II, MPa: Megapascals, SD: Standard deviation

torsion, tensile or shear or a combination of all these and it is difficult to precisely measure and quantify these forces. [26] Therefore, individual clinicians must make the decision regarding the type of adhesive to use on the basis of their own clinical judgment and available research.[6]

Conclusions

Based on the above study it can be concluded that although SBS for APC II was found to be higher than that of Transbond XT, the APC II system has been proven to be efficient for clinical use.

References

1. Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J Dent Res 1955;34:849-53.
2. Retief DH. The mechanical bond. Int Dent J 1978;28:18-27.
3. Bowen RL. Compatibility of various materials with oral tissues. I: The components in composite restorations. J Dent Res 1979;58:1493-503.
4. Wilson AD, Kent BE. A new translucent cement for dentistry. The glass ionomer cement. Br Dent J 1972;132:133-5.
5. Tavas MA, Watts DC. Bonding of orthodontic brackets by transillumination of a light activated composite: An *in vitro* study. Br J Orthod 1979;6:207-8.
6. Owens SE Jr, Miller BH. A comparison of shear bond strengths of three visible light-cured orthodontic adhesives. Angle Orthod 2000;70:352-6.
7. Surmont P, Dermaut L, Martens L, Moors M. Comparison in shear bond strength of orthodontic brackets between five bonding systems related to different etching times: An *in vitro* study. Am J Orthod Dentofacial Orthop 1992;101:414-9.
8. Thanos CE, Munholland T, Caputo AA. Adhesion of mesh-base direct-bonding brackets. Am J Orthod 1979;75:421-30.
9. Wickwire NA, Rentz D. Enamel pretreatment: A critical variable in direct bonding systems. Am J Orthod 1973;64:499-512.
10. Chigira H, Koike T, Hasegawa T, Itoh K, Wakumoto S, Hayakawa T. Effect of the self etching dentin primers on the bonding efficacy of a dentin adhesive. Dent Mater J 1989;8:86-92.
11. Nishida K, Yamauchi J, Wada T, Hosoda H. Development of a new bonding system. J Dent Res 1993;72:137.
12. Bishara SE, Oonsombat C, Ajlouni R, Laffoon JF. Comparison of the shear bond strength of 2 self-etch primer/adhesive systems. Am J Orthod Dentofacial Orthop 2004;125:348-50.
13. Vicente A, Bravo LA, Romero M, Ortíz AJ, Canteras M. Shear bond strength of orthodontic brackets bonded with self-etching primers. Am J Dent 2005;18:256-60.
14. Sfondrini MF, Cacciafesta V, Klersy C. Halogen versus high-intensity light-curing of uncoated and pre-coated brackets: A shear bond strength study. J Orthod 2002;29:45-50.
15. Bishara SE, Ajlouni R, Laffoon J, Warren J. Effects of modifying the adhesive composition on the bond strength of orthodontic brackets. Angle Orthod 2002;72:464-7.
16. Cooper RB, Goss M, Hamula W. Direct bonding with light-cured adhesive precoated brackets. J Clin Orthod 1992;26:477-9.
17. Bishara SE, Olsen M, Von Wald L. Comparisons of shear bond strength of precoated and uncoated brackets. Am J Orthod Dentofacial Orthop 1997;112:617-21.
18. Sunna S, Rock WP. An *ex vivo* investigation into the bond strength of orthodontic brackets and adhesive systems. Br J Orthod 1999;26:47-50.
19. Bearn DR, Aird JC, McCabe JF. *Ex vivo* bond strength of adhesive precoated metallic and ceramic brackets. Br J Orthod 1995;22:233-6.
20. Kula K, Schreiner R, Brown J, Glaros A. Clinical bond failure of pre-coated and operator-coated orthodontic brackets. Orthod Craniofac Res 2002;5:161-5.
21. Wang WN, Meng CL. A study of bond strength between light- and self-cured orthodontic resin. Am J Orthod Dentofacial Orthop 1992;101:350-4.
22. Bradburn G, Pender N. An *in vitro* study of the bond strength of two light-cured composites used in the direct bonding of orthodontic brackets to molars. Am J Orthod Dentofacial Orthop 1992;102:418-26.
23. Rezk-Lega F, Ogaard B. Tensile bond force of glass ionomer cements in direct bonding of orthodontic brackets: An *in vitro* comparative study. Am J Orthod Dentofacial Orthop 1991;100:357-61.
24. Messersmith ML, Devine SM, Zionic AE. Effects of tooth surface preparation on the shear bond strength of resin-modified glass ionomer cements. J Clin Orthod 1997;31:503-9.
25. Keizer S, ten Cate JM, Arends J. Direct bonding of orthodontic brackets. Am J Orthod 1976;69:318-27.
26. Komori A, Ishikawa H. Evaluation of a resin-reinforced glass ionomer cement for use as an orthodontic bonding agent. Angle Orthod 1997;67:189-95.

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