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Original Article

COMPARATIVE EVALUATION OF THE SHEAR BOND STRENGTH OF FOUR DIFFERENT ORTHODONTIC BONDING ADHESIVES: AN IN VITRO STUDY

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ABSTRACT

Aim: The aim of this study is to compare the shear bond strength of four different brands of orthodontic bonding adhesives during debonding of metal brackets.

Methods: The sample included 100 specimens assigned to 4 groups according to the adhesive system applied: Group I: Enlight(ormco) adhesive, Group II: Ammdent orthodontic adhesive, Group III: Orthofix (anabond) adhesive, and Group IV: Medicept orthodontic adhesive For this purpose, metal brackets were bonded to extracted premolar teeth following the instructions from each manufacturer. The specimens were subjected to a shear test to assess bond strength (BS).

Results: The average shear strength for a tooth bonded using the adhesive system Enlight(ormco) adhesive8.49±0.80, while it was 6.31±0.79Mpa for Ammdent, 8.09±0.61Mpa for Orthofixanabond and8.02±0.46Mpa for Medicept.

Conclusion: In conclusion, both adhesive systems enlight ,orthofix and attained higher bond strength values than ammdent.

Keywords: Dental bonding. Shear bond strength. Orthodontic adhesive.

INTRODUCTION

The acid etching technique, introduced by Buonocore, has allowed the replacement of metal bands with directly cemented brackets.[2] The use of metal bracket with a retentive base was first reported by Mitchell in 1967.[4] The bond strength of bracket is influenced by various factors, including the size and design of bracket base.[5-9] The material and design of the bracket must be having ability to deliver orthodontic forces and masticatory loads. It should also be aesthetic and there should not be any damage to enamel surface during removal of the bracket. The mechanical interlock between base adhesive and resin-enamel plays an important role for the adhesion of metal brackets.[8]

Buonocore advocated the use of phosphoric acid etching to improve the adhesion of acrylic resin filling materials to enamel as early as 1955.[2] 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.

Tavas and Watts first described the use of visible lightcure composites used in orthodontic bonding in 1979.[16] In 1983, Newman et alinvestigated the depth of polymerization in teeth using a combination of 11 visible light-cured composite resins and 8 visible lights. He found large variations among the abilities of different light sources to polymerize the various light-cured composite resins.[17] Visible light-cured composites provide ease of use, extended working time, improved bracket placement, easier clean-up, and faster cure of the composite.[19,20]

In orthodontic treatment, it is necessary to develop a satisfactory bond between the enamel and brackets. Desirable shear bond strength of the orthodontic brackets should be to the extent that it can resisttreatment forces in the different treatment periods and at the same time facilitate debonding at the end of treatment without causing any damage to the enamel. The range recommended for desirable shear bond strength in the clinic as suggested in the study conducted by Reynolds is from 5.9 to 7.8 megapascals (MPa) and should not exceed 14 MPa, that is the level of enamel breaking. The conventional bonding system uses 3 different materials to bond the orthodontic

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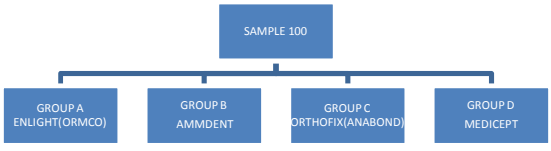
brackets to the enamel: 1) enamel conditioner, 2) primer solution, and 3) composite .[24]

MATERIALS AND METHODS

100 Sound human premolar extracted for orthodontic purpose were collected immediately after extraction. The teeth were cleared of soft tissue debris and blood and immediately stored in distilled water which was changed weekly to avoid bacterial growth

One hundred premolar teeth were randomly assigned to 4 groups with 25 teeth per group. Each tooth from the sample was mounted on acrylic blocks with the roots embedded in a self cure polymethylmethacrylate resin.



The teeth in Group A, Group B, Group C, and Group D were mounted vertically on the cylindrical acrylic block facilitating to test the shear bond strength. All the teeth were cleaned with oil – free slurry of pumice in a prophy cup with a slow speed hand piece and were rinsed with compressed air/water 3- way syringe.

Brackets were bonded to the teeth according to the instructions given by the manufacturer. All the bonding procedure were carried out by the same operator.

Buccal surface of the teeth of this group were etched with 37% phosphoric acid for 20 seconds and rinsed with water spray and dried till it looks frosty white. Bonding agent is then applied and gently air dried after 10 seconds to remove the excess solvent.

Bracket were coated with resin and placed on the tooth. The excess adhesive was removed with a scaler. The resin was cured for a period of 20 seconds.

The specimen of all groups were placed in a mounting jig in the instron universal testing machine in such a way that the bracket base was parallel to the debonding force of the knife mandrel to test the shear bond strength.

RESULT

In the present study 100 extracted premolars were taken and four different types of adhesives were applied to undergo shear bond strength test. The data entry was done using Microsoft office excel

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spreadsheet and was analysed using Statistical Package for Social Sciences (SPSS) Software version 17. Both descriptive and analytical statistics were performed. Descriptive statistics include mean and standard deviation (SD) for all the parameters. The mean value for shear bond strength was calculated for all the groups. Analytical statistics includes Analysis of Variance (ANOVA) to find out the significance between the groups. After the testing of shear bond strength under universal testing machine, it was calculated according to the following formula: Stress= Failure load (N)/ Surface area (mm^2). As a result:

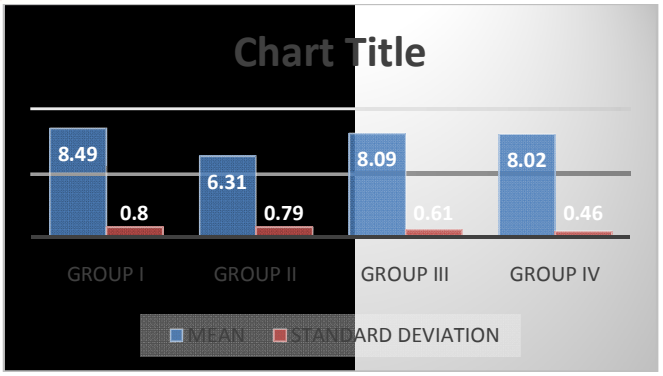
GROUP I (ENLIGHT ORMCO): 8.49±0.80

GROUP II (AMMDENT): 6.31±0.79

GROUP III (ORTHOFIX ANABOND): 8.09±0.61

GROUP IV (MEDICEPT): 8.02±0.46

GRAPH 1: SHOWING MEAN SHEAR BOND STRENGTH OF ALL THE GROUPS



From the above results it was concluded that the highest shear bond strength was observed with GROUP I (ENLIGHT ORMCO) followed by GROUP III (ORTHOFIX ANABOND), GROUP IV (MEDICEPT) AND GROUP II (AMMDENT).

A p-value is a measure of the probability that an observed difference could have occurred just by a random chance. The lowerthe p-value, the greater the statistical significance of the observed difference. So in our study we got statistically significant result with p value of 0.00 between the groups. Numerically all the groups showed almost equal shear bond strength, GROUP I: 8.49 MPa, GROUP II: 6.31 MPa, GROUP III: 8.09 MPa and GROUP IV: 8.02MPa and statistically one-way ANOVA between the groups showed statistically significant result. (p value=0.00)

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DISCUSSION

Shear bond strength is the main factorwhich has to be concerned in the evolution of bonding materials. The bond strength of the orthodontic bracket must be able to withstand the forces applied during the orthodontic treatment. Reynolds stated that 5.9-7.8 MPa resistances are sufficient to withstand masticatory forces. On further investigation a shear bond strength of 10.4±4.4 MPa was considered clinically acceptable. An ideal orthodontic adhesive should have adequate bond strength while maintaining unblemished enamel after debonding.[25]

Many bond strength studies, because of the difference in the test methods used lacks comparability. General problems with bond testing protocols includes the load location, test mode (shear, tensile, torsional), and the differences in enamel preparation. This study followed recognized protocols using the universal testing machine as the gold standard.[40]

In the Present study we used four different commercially available composite adhesive materials Enlight (Ormco), Ammdent, Orthofix (Anabond), And Medicept. As a result the highest shear bond strength was found in GROUP I: EnlightOrmco (8.44 MPa) followed by GROUP III: Anabond (8.09MPa), GROUP IV: Medicept (8.02 MPa), and GROUP II: Ammdent (6.31MPa) in decresing order. It was inferred that GROUP I: Enlightormco, GROUP III: Anabond and GROUP IV: Medicept showed almost equal shear bond strength as compared to GROUP II: Ammdent, which was statistically significant (p value= 0.00).

Despite the clarity of the results achieved, it is difficult to compare them to the results achieved by other researchers due to the variety of the laboratory procedures used. As far as the research methodology and equipment used in tests performed by other researchers are concerned, there seems to be no methodological compatibility, especially in terms of extracorporeal tooth preparation, curing and application of external forces on the bond, leading to results which not only are different but also incomparable. When evaluating adhesives, it is important not to conclude with the absolute empirical values of the results achieved, but focus more on comparing the values produced by the research method used.

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Even though the brackets were applied with great care to avoid mistakes, the minimum bonding strength of the adhesives listed was lower than the strength needed to ensure that the braces stay in place. This shows that there is a greater possibility of making errors while the appliance in clinical conditions with the use of the above mentioned materials.

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