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Comparison of Shear Bond Strength of Orthodontic Brackets with Fifth and Eighth Generation Adhesive Systems

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Abstract

Introduction*: Self-etching primers (SEPs) has streamlined orthodontic braces placement process by minimizing clinical process, chairside time and has enhanced patient comfort.*

Materials & Methods*: 60 untreated extracted premolars from all quadrants of jaws of males and females, aged between 12-35 years, were included. Defective, restorative and anomalous premolars were excluded. Attachment of brackets on the facial surface, with composite (Transbond XT 3M UNITEK) which then was cured for 20 seconds by a light source, using Transbond XT (fifth generation) and Futurabond DC (eighth generation) as bonding agents was done. Universal testing machine was used to test Shear bond strength (SBS), in COMSATS.*

Results*: Group 1 had 22.87 ± 6.08 years as average age, while group 2 had 20.67 ± 5.20 years. 34 patients (56.67%) were males and 26 (43.33%) were females. Group 1 (fifth generation) had an average SBS of 16.40 ± 3.47 MPa, and in Group 2 (eight generation), it was 34.9 ± 4.02 MPa.*

Conclusion*: The research concluded, that in brackets average SBS with generation eight wass superior to the ones attached with fifth generation adhesive.*

Key Words: *SBS, Self-etching primer, Orthodontic adhesive.*

Introduction

SEPs have made bonding process of braces simpler, by minimizing clinical process and chair time and has enhanced patient comfort. **[**1,2,4-6**]** It has methacrylated phosphoric acid ester as functional agent that provides etching and priming the enamel surface at the same time. **[**1,6**]** SBS is one of the significant property of adhesives. **[**7**]** According to Reynolds 5.9–7.8 MPa resistance is adequate to resist chewing forces.**[**7**]** The strength of bonding in brackets ought to be high enough to resist orthodontic forces, used in the course of therapy. **[**7**]**

Fourth-generation system of bonding consisted of use of acidic etchant, primer agent and resin bonding agent while fifth-generation bonding system includes an etchant with primer and adhesive in one bottle. **[**1,8**]** Literature shows that Fifth generation bonding system has 15.49±2.55 MPa SBS, that is

greater than fourth generation i.e. 12.26±1.88 MPa.7 The sixth-generation consists of a self-etch primer having a SBS of 11.57±1.99 MPa. [1,7,9]

Further efforts were carried out to make a product with increased the SBS.7 Seventh generation was introduced and SBS in seventh generation is 13.51±2.45 MPa that was better than sixth generation but still less than fifth generation bonding system. [1,7]

Recent efforts were made to formulate a self- conditioning agent which contains different components mixed together in a flask to further ease the bonding procedure, resulting in the development of eighth generation.10Bonding agents usually are unfilled; but some contain small proportion of inorganic fillers.10 Nano fillers have the advantage of being dual cured.[10]

Studies have been conducted on the bonding efficiency of eighth generation bonding system for SBS when used for restorative purposes.[10] Insufficient research is accessible concerning SBS of eighth generation adhesives for braces attachment, in Pakistan. The mean value for eight generation in the literature for restorative purpose is 34.93 ± 2.53. [10] There is significant difference in literature regarding bonding efficiency of different adhesive agents.

Therefore the purpose of this research was to determine shear bond strength related to orthodontic bracket bonding via new eight generation nano-filled self-adhesive system and comparing the results with fifth generation. This study will help us to choose better option in the management protocols.

Material and Methods

60 extracted premolars that fall into inclusion requirements, were collected from OMFS clinic, FMH and randomly distributed into two groups (30 each) by toss method. These teeth had their roots detached at 5mm beneath the CEJ, remaining tooth was placed in acrylic, and complete crown portion, was over and parallel to base of acrylic.

Facial surfaces of teeth were used for bracket placement, with composite and 20 seconds curing was done by light source, using Transbond XT (fifth generation) and Futurabond DC (eighth generation) as bonding agents.

GROUP- 1 Fifth generation: Transbond XT (3M UNITEK) adhesive was used for bracket bonding.

GROUP- 2 Eighth generation: Futurabond DC (Voco, Germany) was used for bracket bonding.

SBS was calculated by Universal Testing Machine, from COMSATS. The specimens were positioned inside and when it is turned on, it starts to exert gradual force on the braces, until it is detached from

the buccal surface. Same operator carried out universal testing process to minimize bias. All the information was entered in a predesigned data form.

SPSS 20 was used for data evaluation. Quantitative variable; age and shear bond strength, were assessed with mean and standard deviation. To compare average SBS between groups, Independent t-test was used and p-value ≤0.05 was taken as significant. Qualitative variables; gender were demonstrated in form of frequency and percentage. Stratification was done with regards to age and gender.

Results

Subjects included in this research had age range of 12 - 35 years, and average age 21 years.

Group 1 (fifth generation) had 16.40 ± 3.47 MPa mean SBS of orthodontic brackets, while in Group 2 (eight generation) it was 34.9 ± 4.02 MPa as shown in Fig.

Stratification of mean SBS with respect to age and gender is depicted in Table II & III respectively. It displayed substantial dissimilarity in average SBS amid age groups and genders.

Age (years)	**Group 1 (n=30)**		**Group 2 (n=30)**		**Total (n=60)**	
	No. of patients	%age	No. of patients	%age	No. of patients	%age
12-25	20	66.67	24	80.0	44	73.33
26-35	10	33.33	06	20.0	16	26.67
Mean ± SD	**22.87 ± 6.08**		**20.67 ± 5.20**		**21.77 ± 5.71**	

Table- I: Distribution of age between groups (n=60).

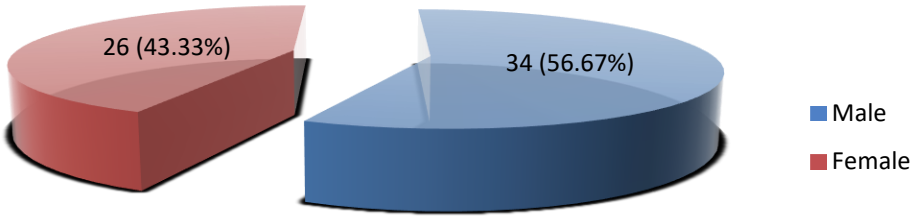
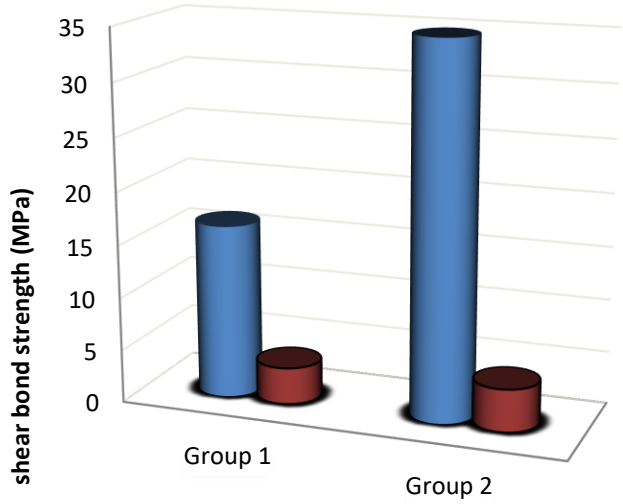


Figure I: Distribution of patients according to Gender (n=60).



	Group 1	Group 2
Mean	16.4	34.9
Standard Deviation	3.47	4.02

Figure II: Mean shear bond strength of brackets in both groups.

Age of patients (years)	**Group 1 (n=30)**		**Group 2 (n=30)**		**P-value**
	Shear bond strength		**Shear bond strength**		
	Mean	SD	Mean	SD	
12-25	16.10	3.34	34.75	4.48	**0.0001**
26-35	17.00	8.30	35.50	0.84	**0.0001**

Table II: Stratification of shear bond strength (SBS) according to age groups.

Gender	Group 1 (n=30)		Group 2 (n=30)		P-value
	Shear bond strength		Shear bond strength		
	Mean	SD	Mean	SD	
Male	16.00	2.93	36.06	3.97	**0.0001**
Female	17.00	4.22	33.57	3.78	**0.0001**

Table III: Stratification of shear bond strength with respect to gender.

Discussion

The study conducted assessed the SBS of SS brackets on enamel surface with two different bonding generations i.e. fifth generation Transbond XT 3M and eight generation Futurabond DC.

This hypothesis was supported as the SBS of brackets that were attached with eighth generation was greater than fifth generation. Results showed 16.40 ± 3.47 MPa mean SBS of fifth generation. Mean SBS using eighth generation was 34.9 ± 4.02 MPa. Shear bond strength measurements are clinically acceptable and it is suggested to bond with fifth generation rather than eight generation bonding agents in clinical practice.**[**11**]**

The cost of eighth generation bonding agent is a lot more than fifth generation bonding agent. The increased shear bond strength was responsible for inducing enamel cracks on debonding given the material has increased shear bond strength. Fifth generation is easily available in practice and is more preferable by the clinicians. But the eighth generation is superior in terms of generating higher bond strength but has chances of generating enamel cracks.

Recent advancements in restorative field has bought about evolution of nanocomposites that have fillers particles which are of Nano size. They provide improved shelf life, stress absorption and bond strength. **[**14**]**

It is noted there was increased bond strength in vitro with filled bonding agents. In recent times, Nano adhesives (Futurabond DC, Voco, Germany) were termed 8th generation agents.**[**15**]** Usually used parameter to calculate the efficacy of any adhesive is tensile bond strength & micro shear bond strength.**[**16**]**

In 2010, Voco Germany marketed 8th generation bonding agent formulated with Nano size filler particles as voco futurabond DC.116 The addition of nano-fillers in these new agents through a mean size of particle of 12 nm, enhanced hybrid layer and infiltration of monomers, which enhances the mechanical features of various adhesives.[18,19] Nano-bondings are formed of mixture of nano-fillers producing improved stress absorption, enhanced bond strength with enamel and dentin and longer shelf life.[19]

New advance like Er, Cr, YSGG LASER in dentistry is new and more importance should be given to it as it has immense potential to generate results. But the cost and its clinical availability and skill of the operator should be there to ensure good results.

Conclusion

This research established:

- The average SBS of orthodontic braces attached by eight generation is significantly higher than with fifth generation.
- SBS values for fifth generation was 16 ± 3.47 MPa while for eight generation was 34.9 ± 4.02 MPa.
- Eighth generation adhesives should not be used as a main adhesives in order to achieve better SBS.
- SBS of brackets applied with eight generation is high enough to cause enamel fracture when debonded.

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