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AN *IN VITRO* SHEAR BOND STRENGTH STUDY TO EVALUATE THE EFFECT OF ADHESION BOOSTERS ON REBONDING USING RECYCLED BRACKETS.

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INTRODUCTION

With great advantages like better aesthetics, good oral hygiene, minimum soft tissue irritation, no separators, no band space, attachment to partially erupted teeth, less decalcification, good caries detection etc. to its credit direct bonding to enamel began to see new horizons. Since inception bonding has undergone considerable improvement with time. Rapid strides in technology and material science coupled with endless search for the ultimate adhesive system have yielded a magnitude of adhesive that provide adequate bond strength. The sea of changes have brought us to the present century where we see thousands of chemical compounds with different chemistry and biology claiming excellent results.

Bond failures are a frequent clinical situation clinicians have to face. At points it results in poor results and huge emotional and financial trauma. Orthodontist have been trying to come over the situation by using better brackets and materials. With only one set of customized brackets in hand orthodontist resort to recycle the bonded brackets than to use new ones as it might cause heavy financial burden. Recycling invariably results in decreased bond strength due to contamination and loss of bracket mesh.

Adhesion boosters which are available in market are thin primers which have superior characteristics enabling better bonding particularly on compromised situations.

AIMS AND OBJECTIVES

A study was hence designed to evaluate the bond strength attained after recycling of failed brackets with and without the use of adhesion promoters.

Objectives included

To estimate and compare the shear bond strength of recycled brackets on bonded enamel surface using

A. Chemical cure composite without the use of adhesion boosters
B. Chemical cure composite with the use of adhesion booster.

MATERIALS AND METHODS

40 human premolar teeth that was extracted as a part of orthodontic treatment were randomly selected. Of the 40, 20 were upper and rest lower premolars. All samples were healthy without any carious lesions, with no evidence of surface defects or any developmental morphological aberrations all samples were embedded in a cylindrical acrylic block of (PMMA) so that only the coronal portion of the specimen was exposed [fig-1]. The crown were oriented along the long axis of the block and were stored in distilled water at room temperature in a closed airtight container. The samples in each group were randomly selected from the container. They were first pumiced then following the manufacturers direction for the adhesive, the surface of the tooth were etched, the primer was applied on the tooth surface and the adhesive was placed on the bracket base. After a reasonable time of half an hour the brackets were debonded using a plier. Excess resin from the tooth surface was removed by means of an ultrasonic scaler and was pumiced, the determination of complete resin removal was judged at the time of re-etching for the placement of brackets. If any part of the surface was not frosty white, the removal procedure was one again performed. The samples were stored in room temperature in a plastic container. The fluid media was changed at periodic intervals in order to prevent the growth of bacteria and subsequent contamination of the sample. The teeth were divided into 2 groups of 20 each.

Forty recycled stainless steel contoured Begg [Series 256-500] brackets with bondable base was used for the purpose. All the brackets were of uniform size. The brackets used for the purpose were manufactured by TP Orthodontics Inc. La Porte Indiana. The base of the bracket measured approximately 3.42mm in length and 3.31mm in width.

Recycled brackets were made by bonding with chemical cure composite resin [Rely A Bond] to an etched enamel surface. The excess bonding material was removed carefully and the brackets were allowed to cure for half an hour. The bonded brackets were debonded from the enamel surface using a debonding plier with pressure. A total of forty deboned brackets were generated. Subsequently the base of each of the debonded brackets were sand blasted using a micro etcher at 50 psi for 10 seconds with aluminium oxide of 50µm particle size. The bracket base was inspected under magnification to be certain that all the visible adhesive was removed. The sandblasted brackets base were wiped with acetone on a cotton pledget and dried with an air spray

Self-curing composite resin [Rely-a-bond™, no mix fluoride releasing orthodontic adhesive, Reliance Orthodontic Products, Inc., Illinois, Itasca] Adhesion booster [Enhance™ Chemical cure adhesion booster system by Reliance Orthodontic Products, Inc., Illinois, Itasca] [fig-2,3]. The samples were divided into 2 groups.

Facial surface of each bonded tooth was once again cleaned with non-fluoride oil free pumice paste. The tooth was rinsed with water and dried with oil free air spray. The enamel surface was etched with 37 percentage liquid phosphoric acid [Reliance, Itasca] for thirty seconds and rinsed with water for 30 seconds. For Group one enamel surface was dried with an air syringe and bonding of the recycled brackets were carried out in the conventional manner. For Group 2 the etched enamel was dried using burst of air and bonding was carried out after the application of adhesion booster to both tooth and bracket base. The tooth received the coat of primer and the bracket base received the adhesive. The bonded samples were stored in distilled water at room temperature in a sealed container lined with wet paper towel. After 48 hours they were tested in shear node using a Universal test machine manufactured by Schimadzu, cooperation Japan. [AG-1 Series]. The maximum machine capacity was one ton. The testing was done at a temperature of 28^{0}c. The acrylic block with the teeth embedded having bonded bracket were placed at the base of the test machine [fig-4]. The whole unit was stabilized using clamp tightened with the screw at the base. The blade was directed towards the bracket or the bracket adhesive interface. The blade was moved towards the bracket with a crosshead speed of 1mm/min. the maximum load were recorded in Newton and converted to Megapascals

Observations were evaluated statistically ANOVA test was done to know the distribution of the observations among groups. Levenes

test to test the homogeneity of the variance and the probability chart for testing the group wise normality was performed. As the data analysis showed that ANOVA couldn't be applied to the samples due to heterogeneity of the variance and the non-normality of the breakload observation, median and Kruskal Wallis ANOVA test were performed, A box chart was made to know the distribution of observation and for comparison. Comparison using the mean was not valid due to the wide range of observations.

RESULTS

SPECIMEN GROUP G-11 [TABLE-1]

Shear bond strength of recycled bracket samples rebonded on enamel surface without adhesion booster in Newton's and Mpa

SP.NO.	MAXIMUM LOAD	BREAK LOAD IN NEWTON	BREAKLOAD IN MPa
1	150.56	123.54	11.03
2	182.07	173.60	15.5
3	188.01	183.26	16.36
4	209.34	208.81	18.64
5	104.10	102.78	9.35
6	223.84	222.48	19.86
7	250.20	239.42	21.38
8	150.96	148.87	13.25
9	326.57	323.03	28.84
10	52.64	50.71	4.52
11	224.67	219.12	19.56
12	120.40	116.25	10.37
13	215.67	202.60	18.09
14	190.40	187.17	16.71
15	199.60	189.59	16.92
16	204.20	196.76	17.53
17	127.76	126.65	11.30
18	190.98	185.12	16.52
19	110.89	109.34	9.76
20	220.89	211.56	18.86
Mean	**182.18**	**176.03**	**15.71**
Std. dvtn	**60.72**	**60.08**	**5.53**
Maximum	**326.57**	**323.03**	**28.84**
Minimum	**52.54**	**50.71**	**4.52**
Range	**273.93**	**272.32**	**24.32**

SPECIMEN GROUP G-12 [TABLE-2]

Shear bond strength of recycled brackets rebonded on to enamel surface with adhesion booster in Newton's and Mpa

SP.NO.	MAXIMUM LOAD	BREAK LOAD IN NEWTON	BREAKLOAD IN MPa
1	205.89	203.53	18.17
2	229.87	212.01	18.91
3	159.15	151.42	13.51
4	267.23	264.96	23.65
5	111.92	105.89	9.45
6	198.93	197.20	17.60
7	207.25	200.45	17.89
8	187.60	179.56	16.03
9	107.40	103.18	9.21
10	177.26	163.67	14.61
11	289.34	283.80	25.33
12	178.89	175.84	15.70
13	208.42	198.68	17.73
14	205.12	196.26	17.52
15	235.62	227.71	20.33
16	155.62	108.89	9.72
17	248.62	237.14	21.17
18	215.35	214.26	19.13
19	111.96	89.93	8.02
20	222.56	213.70	19.08
Mean	**196.2**	**186.40**	**15.68**
Std.dvt	**49.47**	**53.10**	**4.74**
Maximum	**289.34**	**283.80**	**25.33**
Minimum	**107.40**	**103.18**	**9.21**
Range	**181.94**	**180.62**	**16.12**

DISCUSSION

As the manufacture of brackets become increasingly precise and the design of brackets more complex and tooth specific, use of new brackets for rebonding bracket breakage could be prohibitory. Bond failures is not an uncommon finding orthodontist face in their daily practice. This could be due to wide range of reasons. Rebonding a bracket is a common procedure in orthodontic treatment. To rebond a bracket orthodontist may face three choice, one to rebond other to use a new bracket or last to band. Rebonding warrant cleaning up of the bracket and the tooth surface and attach the same bracket after removal of adhesive by physical or chemical treatments. Studies have shown that such procedures always resulted in weaker bond strength. This study wanted to analyse whether the use of adhesion booster along with conventional adhesive gave a better bond strength.

Chung[4] et al found that sandblasting of the bracket base increased the bond strength of the recycled brackets to enamel by removing the unfavourable oxides, contaminants on the base and increase the surface roughness and the surface bonding area. Gragouski[5] et al reported no significant difference in bond strength between the new and the sandblasted rebonded brackets. Mascia and Chen[6] et al reported decrease in retentive strength in all type of recycled brackets.

In the present study the mean shear bond strength of the recycled brackets on enamel without the use of adhesion booster was 15.71 MPa. 25-75% of the value fell in a range of 11-17 MPa. This finding correlates to the one obtained by Chung et al[4][14.2 MPa]. Recycling of brackets surely will bring down the maximum attainable bond strength if otherwise done with fresh brackets.

The samples bonded with recycled brackets with the use of adhesion boosters recorded a mean shear bond strength of 16.63MPa, greater than one obtained by Chung et al [4]This value was not found to be statistically significant when compared with no adhesion booster sample. This shows that the use of adhesion booster did not result in significant enhancement of the shear bond strength value. The possible explanation could be due to the fact that the adhesion booster fail to improve bond strength on an already bonded enamel surface. Thus the finding of this study do not recommend conclusively the use of adhesion booster for rebonding recycled brackets. Mode of action of adhesion booster still remains unavailable. Possibly a SEM study of the enamel and bracket surface after using adhesion booster could shed some light on this area

SUMMARY AND CONCLUSION

The present study which aimed at attempting to find the use of adhesion promoters in an area clinicians often encounter, bracket failures.

The use of recycled brackets on bonded enamel surface resulted mostly in clinically adequate bond strength.

Use of adhesion boosters with recycled brackets on rebonded enamel surface did not result in significant enhancement of shear bond strength value.

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