International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 8; Issue 03 (E); March 2019; Page No.17865-17868
DOI: http://dx.doi.org/10.24327/ijcar.2019.17868.3404

Research Article

# COMPARISON OF TENSILE BOND STRENGTH OF NEW AND RECYCLED ORTHODONTIC BRACKET:- IN VITRO STUDY

**Radhakrishna Gogineni, Prasad Khudare*, Sanjay V.Ganeshkar, Vijaylaxmi BM, Ravichandra Handral and Pratiksha V**

Department of Orthodontics PMNM Dental College and Hospital Bagalkot, Karnataka

**A R T I C L E I N F O**

***Article History:***
Received 06th December, 2018
Received in revised form 14th January, 2019
Accepted 23rd February, 2019
Published online 28th March, 2019

***Key words:***

Tensile bond strength, shear bond strength, sandblasting, Transbond XT, recycling, aluminium oxide.

**A B S T R A C T**

**Aim:** This study proposes to compare the tensile bond strength of new and recycled orthodontic bracket.

**Method:** One hundred and twenty extracted premolars were collected for this study. All the specimen was standardized into two group. Group I was bonded with new orthodontic bracket and group II was bonded with recycled sandblasted bracket. Tensile bond strength of both the groups was recorded using universal testing machine. Results were analysed using unpaired t test.

**Results:** Tensile bond strength of both group were calculated. Comparison of mean and SD between two groups was done by using unpaired t test to assess whether the mean difference between groups is significant or not. Descriptive statistics of each variable was presented in terms of Mean, standard deviation, standard error of mean. The results showed that tensile bond strength of both the groups were statistically non-significant.

**Conclusion:** Within the parameters in the study, it can be concluded that tensile bond strength of new orthodontic bracket is comparable and acceptable clinically with tensile bond strength of recycled orthodontic sandblasted bracket.



## INTRODUCTION

From the inception of fixed appliance orthodontics, brackets have been welded to gold or stainless steel bands. The p and encompass the tooth circumferentially, requiring the creation of interproximal space to accommodate the width of the band material. This separation process which was accomplished initially by placing wires and later elastomeric, was time consuming for orthodontist and uncomfortable for the patient. At the conclusion of the treatment, these interproximal gaps had to be addressed again.[1]The development of acid etch technique led to direct bonding of orthodontic brackets by Newman GV in 1965.[2.]This procedure however was technique sensitive and if formed incorrectly, it could lead to increase in bond failure, particularly in the posterior teeth.[3] The prevalence of clinical bond failure should have been reduced as bracket base design has progressed.

Despite these advances, the rebonding of brackets may still pose a problem due to the adoption of pre-adjusted appliances which require inaccurately located brackets to be repositioned during treatment in order to take full advantage of the archwire slot values and sliding mechanics (McLaughlin and Bennett,1991).Recycling orthodontic brackets is an option available to practitioners, where brackets need to be rebonded back onto the tooth. The major advantage of recycling is the economic saving, which could be as 90 percent, due to fact that bracket can be reused up to five times. The disadvantage of recycling may include a reduction in bracket quality, loss of identification marks, lack of sterility and increase risk of cross infection[4].

The recycling process basically consist in removing bonding agent bonding agent remnants from bracket base, thus allowing the brackets to be reused without causing damage to the retention mesh and preserving its retentive characterstics[5].recycling of debonded bracket can be performed using silicon carbide stone grinding or aluminium oxide blasting, which enhances bracket bonding to tooth structure by producing micromechanical retention on bracket base surface. This process increases the area of composite bonding, which is essentially mechanical due to the micro-asperity of the bracket mesh.[6-7]Sonis[8]advocated that Sandblasting can also been used to recondition debonded brackets by holding debonded bracket approximately 5mm from tip of sandblaster and etching with 90um aluminium oxide at 90 psi until all visible bonding material was removed from the bracket base, which took 15-30 seconds.

As very less literature is available on tensile bond testing of new and recycled orthodontic bracket a need was felt to ascertain the tensile bond strength values of the new and recycled brackets in vitro to enamel.

**Corresponding author:* **Prasad Khudare**
Department of Orthodontics PMNM Dental College and Hospital Bagalkot, Karnataka

## MATERIALS & METHOD

One twenty maxillary and mandibular premolars extracted for orthodontic purpose were collected from department of oral and maxillofacial surgery at P.M.N.M Dental College and Hospital Bagalkot and stored in saline for a period not more than six months.

### *Material Used in the Study*

- Transbond XT primer (3M UniteK)
- Transbond XT adhesive(3M UniteK)
- Orthodontic bracket (0.022"x0.028" slot, geminiMBT,3MuniteK)
- Light Curing unit
- Sandblasting Machine with 50u of Aluminium oxide
- Universal testing machine (UTM)

### *Bonding Procedure*

In preparation of bonding, each tooth was cleaned ultrasonically and polished with pumice paste with a rubber cup on a slow speed hand piece for 5 seconds, rinsed and dried with a moisture and oil free air spray for 30 seconds. Buccal surface of the teeth was etched with 37% of phosphoric acid for 30 seconds, then the etchant was rinsed with copious amount of water and air dried. A thin coat of primer (Transbond XT$^{TM}$ 3M Unitek) was applied to both the tooth and the bracket base. The adhesive paste (Transbond XT$^{TM}$ 3M Unitek) was then applied to the bracket base and placed on the tooth surface with firm pressure and excess adhesive was removed around the bracket. Curing of the composite was done with a light curing unit for 30 seconds with an intensity of 450-480nm.

### *Air Abrasion of Brackets*

Out of one hundred and twenty samples sixty samples was selected and their brackets was debonded using debonding piler. All sixty debonded brackets base was subjected for sandblasting with 50um of Aluminium oxide for 20-30 second until all visible composite over the base was removed.

**The teeth will be divided into 2 groups**

| Sr.no. | Groups | Type of brackets bonded to tooth surfaces. | Types of groups |
|---|---|---|---|
| 1 | Group A | Bracket bonded with new brackets | Control (n=60) |
| 2 | Group B | Bracket bonded with recycled sandblasted brackets | Experimental (n=60) |

### *Bond Strength Test*

All the 120 sample will be mounted over acrylic block so that the load applied over the Centre of bracket is kept perpendicular to the bracket base so as to prevent the shear forces during loading in tension (The test was performed with universal testing machine). Tensile force was applied over the bracket having base surface area of 9.6mm$^2$ with a crosshead speed of 1mm/min till it gets debond from the tooth and tensile force is recorded by universal testing machine in Newton (N) and then converted into Mega Pascal's (MPa)**.**

***Statistical Analysis:*** Data was collected by using a structure proforma. Data entered in MS excel sheet and analysed by using SPSS 23.0 version IBM USA. Comparison of mean and SD between two groups was done by using unpaired t test to assess whether the mean difference between groups is significant or not. A p value of <0.05 was considered as statistically significant whereas a p value <0.001 was considered as highly significant.

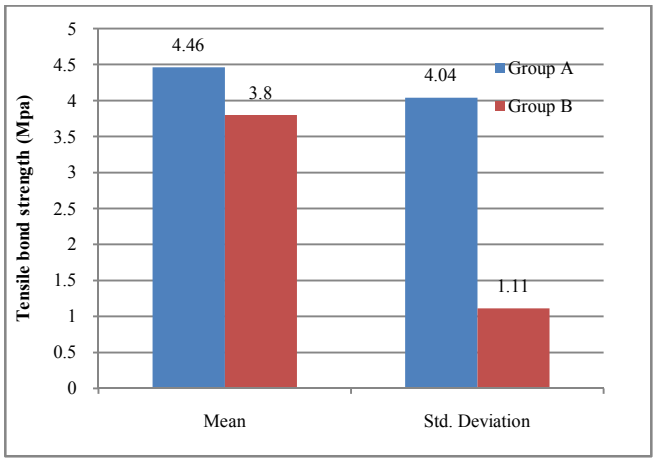
## RESULT

The mean and standard deviation of tensile bond strength (MPa) of new orthodontic bracket (4.46±4.04) was compared with tensile bond strength of recycled orthodontic bracket sandblasted with aluminium oxide (3.80 ±1.11)

The p value was 0.09 which was statistically non-significant.

**Table I** Comparison of Tensile bond strength between Group A and B

| | GP | N | Mean | Std. Deviation | t | p | Inference |
|---|---|---|---|---|---|---|---|
| Tensile bond strength (Mpa) | Group A | 60 | 4.46 | 4.04 | 1.20 | 0.09 (>0.05) | Not significant |
| | Group B | 60 | 3.80 | 1.11 | | | |




**Graph I** Comparison of Tensile bond strength between Group A and B

## DISCUSSION

Bond failure can occur clinically for many reasons and occasionally, it is desirable to intentionally debond a bracket and replace it in a more favorable position. Successful orthodontic bonding depends on the adequate bond strength of the brackets to the enamel. It is extremely important to obtain adequate bond strength with recycled metal bracket to reduce number of mid-treatment bracket debonding. Despite of advances in bracket design, rebonding of orthodontic bracket still pose a problem due to the acception of pre-adjusted edgewise appliance which require bracket to be inaccurately repositioned in order to take advantage of archwire slot values and sliding mechanics (Mc Laughlin and Bennet,1991) .

In present study metal brackets were used, as bonding of adhesive to a metal bracket is typically accomplished by mechanical retention[9]. Recycling or rebonding metal bracket generally result in lower bond strength compared to new brackets[10-11]. Sandblasting (micro-etching or air abrasion) of failed metal brackets, however, produce satisfactory bond strength[12].

In present study enamel etching was carried out with 37% phosphoric acid for 30 sec as no difference between bond strength were detected in this range of time. This finding were in agreement with the findings of study conducted by M.S. bin Abdullha *et al*[12]and Sheen DH[13]. As acid etching selectively

dissolves the non-organic parts of the enamel, the organic area left in place might play a role in remineralization of the etched enamel[14].The goal of reconditioning of orthodontic bracket is to remove the bonding material from the bracket completely without damaging or weakening the base or distorting the dimension of bracket slot. Postlethwaite reported that as many as 75percent of American orthodontist were recycling their brackets in their early 1990s. The major advantage of recycling is the economic saving, which could be as 90 percent, due to fact that bracket can be reused up to five times. Bracket reconditioning may have disadvantages like loss of identification mark reduce bracket base quality, lack of sterility and reduce risk of cross infection.

In our study the tensile bond strength of recycled sandblasting brackets was comparable to new orthodontic brackets as there was no statistical difference between the tensile bond strength values of the between these two groups. These finding that we got in our study is not in correspondence with the findings obtained by Montero MMH *et al*[15] in which their study concluded that bond strength values of recycled orthodontic bracket are comparable less for sandblasting method as compared to the industrial recycling method as less composite resin remnants is seen on bracket base recycled by industrial method.

Our current study when tensile bond strength of recycled sandblasted brackets was compared with new brackets, there was no statistical difference found in tensile bond strength between these brackets, this finding were in accordance with the findings of Quick AN[16]who conducted study to compare bond strength using several in office method of reconditioning stainless steel orthodontic brackets. Among all methods, sandblasting was the most effective method in removing composite without a significant change in the bond strength compared with the new attachment.

In present study recycling of brackets was done with 50µm of aluminium oxide particles for 15-30 seconds till all composite resin is removed from bracket base, this method of sandblasting was in accordance with the study conducted by Sonis AL[8],Qucik AN [16] to evaluated shear bond strength of air abraded brackets. Arici S, Ozer M, Arici N, Gencer Y[17]carried out study to evaluate effect of sandblasting on the bond strength of bracket base and concluded that sandblasting time, distance and size of aluminium oxide particles have important effect on the bond strength.

Tensile and shear loading modes are valid test for studying orthodontic bonding[18]. As most of the studies conducted in past are related to shear bond strength estimation[37,38,39,40.42,43]. our present study aimed to compare the tensile bond strength (TBS) of new and recycled brackets, which was subjected for recycling using sandblasting method. The tensile bond strength (TBS) were measured using universal testing at a cross head speed of 1mm/minute till bracket get debond form tooth and tensile forces was recorded in Mega Pascal's (MPa) as described by Wright LP[10] and Regan D[19].

There was no significant difference between the maximum load (N) of new and recycled brackets with mean value and standard deviation of maximum load (N) on new orthodontic bracket (37.79± 13.10) and recycled orthodontic brackets (36.61± 10.69). There was no significant difference between mean value and standard deviation of tensile bond strength (MPa) of new orthodontic bracket (4.46± 4.04) and mean and standard deviation of recycled orthodontic bracket (3.80± 1.11) these finding were in agreement with previous report by.Quick AN[16], Aksu *et al*[20], Shetty V *et al*[21] in which TBS obtained using sandblasting was comparable with normal orthodontic attachment.

This study could be criticized for not fully creating the oral condition in vitro. However, this creation of an oral cavity is a very complex area as clinically bonded brackets are subjected to a whole range of different forces acting at different temperatures in different level of humidity. The forces may dislodge the brackets in single traumatic incidents or as a result of repeated stresses[22]. many studies had tried to reproduce these clinical conditions in the laboratory with cyclic stressing, use of ball mill to introduce varied forces and thermocycling. However, their applicability is still questionable[23].

## CONCLUSION

Within the limitation of the present study, following conclusion can be finally emphasized.

1. Sandblasting method for recycling of debonded orthodontic bracket appear to be more practical in clinical application.
2. A comparison of the tensile bond strength between new orthodontic brackets and recycled sandblasted orthodontic brackets were statistically non-significant.
3. -Tensile bond strength of recycled brackets, sandblasted with 50um of aluminium oxide have tensile bond strength comparable to new orthodontic bracket
4. Recycled sandblasted brackets can be used in clinical situations with affecting its tensile bond strength

## References


1. Newman GV.Current status of bonding attachment. J Clin Orthod 1973;7425-449
2. Gange P. The evolution of bonding in orthodonticsAm J Orthod Dentofacial Orthop 2015;147:S56-63
3. Faltermeier A and Behr M. Effect of bracket base conditioning. Am J Orthod Dentofacial Orthop 2009;135:12.e1-12.e5.
4. Unkel T. Recycling of orthodontic products. J. Clin Orthod. 1987;21:871-72
5. MasciaVE,Chen SR. Shearing strengths of recycled direct bonding brackets. Am J Orthod 1982;82;211-216.
6. Milllet D. Mccabe JF, Gordon PH. The role of sandblasting on retention of metallic brackets applied with gleass ionomer cement. Br J Orthod. 1993;201:117-22.
7. Senay C, Liken K, Ela A. The effect of enamel air abrasion on the retention of bonded metallic orthodontic bracket Am J Orthod Dentofacial Orthop. 2000;117:15-9.
8. Sonis AL. Air abrasion of failed bonded metal brackets: a study pf shear bond strength ans surface characterization as determined by scanning electron micrpscopy. Am J Orthod Dentofacial Orthop 1996;110:96-98.
9. Powers JM, Kim HB, Turner DS. Orthodontic adhesives and bond strength testing. Semin Orthod 1997;3:147-156.

10. Wright LP, Powers JM. IN vitro tensile bond strength of reconditioned brackets. Am J Orthod. 1983;87(3):247-252.
11. Ireland AJ, Sherriff M. Use of adhesive resin for bonding orthodontic brackets. Eur J Orthod 1994;16:27-34.
12. Abdullah MSB, Rock WP. The effect of etch time and debond interval upon the shear bond strength of metallic orthodontic brackets. Br J Orthod. 1996;23:121-124.
13. Sheen DH, Wang WN, Tarng TH. Bond strength of . Bond strength of younger and older permanent teeth with various etching times. Angle Orthod 1993;63:225-230.
14. Wandela L *et al*. The air-abrasion technique versus the conventional acid-etching technique. A quantification of surface enamel loss and a comparison of shear bond strength. Am J Orthod Dentofacial Orthop. 2000;117:20-26.
15. Montero MMH *et al*.Comparison of shear bond strength of brackets recycled using microsandblasting and industrial methods. Angle Orthod 2015;85:461-467.
16. Qucik AN *et al*. Office reconditioning of stainless steel orthodontic attachments. Eur J Orthod 2005;27(3):231-236.
17. Arici S, Ozer M, Arici N, Gencer Y. Effects of sandblasting metal bracket base on the bond strength of a resin-modified glass ionomer cement: an in vitro study.J Mater Sci: Mater Med 2006;17: 253–258.
18. Powers JM, Kim HB, Turner DS. Orthodontic adhesives and bond strength testing. Semin Orthod 1997;3:147-156.
19. Regan D, LeMansey B and Van Noort R. The tensile bond strength of new and rebonded stainless steel orthodontic brackets. Eur J Orthod. 1993;15:125-135.
20. Aksu M *et al*. Influence of two different bracket base cleaning procedures on shear bond strength reliability. J Contemp Dent Pract. 2013;14(2):250-4.
21. Shetty V *et al*.Bond efficacy of recycled orthodontic brackets: Acomparative in vitro evaluation of two methods. Indian J Dent Res2015;26:411-5.
22. Zachrisson YO and Zachrisson BU. Surface preparation for orthodontic bonding to porcelain. Am J Orthod Dentofacial Orthop,1996;109:420-430.
23. Pickett KL, Sadowsky PL, Jacobson A, Lancefield W. Orthodontic In vitro bond strength: Comparison with in vitro results. Angle Orthod 2001;71:141-148



**How to cite this article:**

Radhakrishna Gogineni *et al* (2019) 'Comparison of Tensile Bond Strength of New and Recycled Orthodontic Bracket:- in Vitro Study', *International Journal of Current Advanced Research,* 08(03), pp. 17865-17868.
DOI: http://dx.doi.org/10.24327/ijcar.2019.17868.3404


*******