***ISSN:* 1812–1217**

Reconditioning of Debonded Pure Titanium Bracket (Using Micro–etcher)

Hussain A Obaidi[1]
BDS, MSc (Prof)

Amer A Taqa[2]
BSc, MSc, PhD (Assist Prof)

Omar H AL-Luazy[1]
BDS, MSc (Assist Lect)

[1]Dept of Pedod, Orthod, and Prev Dentistry
College of Dentistry, University of Mosul

[2]Dept of Dental Basic Science
College of Dentistry, University of Mosul

ABSTRACT

Aims: To evaluate the degree of change that may occur in reconditioning the titanium bracket via micro-etcher. **Materials and Methods:** The sample consisted of (10**)** pure titanium bracket**s** for each of control and reconditioning brackets. The parameters of the reconditioned bracket (slot width, slot depth, inter–wing gap, labio–lingual angle and base curvature angle) were measured and compared with that of the control bracket. **Results:** The results showed no significant difference between the control and reconditioned brackets of the slot parameters (width, depth, inter–win gap, labio–lingual angle) and the bracket's base curvature angle. While, the tensile bond strength of the control brackets showed significantly higher mean value as compared with the recycled group. **Conclusions:** The reconditioning of pure titanium brackets is recommended for reuse in the orthodontic treatment after sterilization.

Key Words: Micro–etcher, width, depth, inter–wing, labio–lingual, base.

Obaidi HA, Taqa AA, AL-Luazy OH. Reconditioning of Debonded Pure Titanium Bracket (Using Micro–etcher). *Al–Rafidain Dent J*. 2008; 8(1): 6–10.
Received: 12/11/2006 ***Sent to Referees***: 12/11/2006 ***Accepted for Publication:*** 6/3/2007

INTRODUCTION

If the patient does have a true intra oral nickel allergy, pure titanium brackets which are nickel free can be used [(1)]. Recycling is considered as a solution of using the same bracket for another patient after the process of sterilization [(2)]. The manufacturers of micro–etching device have suggested the use of an air abrasive technique sandblast to improve the bond strength of metal braised brackets [(3–5)]. Kocadereli *et al*. [(6)] stated that an acceptable bond strength was achieved when the recycled bracket sandblasted by using the aluminum oxide particles. Recycling process consists basically of the removal of residual glue or remnant bonding material from debonded bracket without distortion of bracket slot dimension (width, depth) and the delicate mesh [(7–9)] Tavares *et al.*[(8)] used the sandblast to remove the adhesive from the bracket pad or base and found that the bond strength of recyclable bracket was not significantly different when compared with new attachment. Other authors [(10,11)] demonstrated that the sandblasted or recyclable brackets showed a significant reduction of bond strength when compared with a new bracket. Basudan and Al–Emran [(12)] studied the effect of sandblast on the slot's width, depth and inter–wing gap of the reconditioned bracket, and found no effect of sandblast on them.

The aims of this study are to evaluate the degree of changes in bracket slot (width, depth, labio–lingual inclination angle, and inter–wing gap) and bracket base curvature angle that may occur in reconditioning the titanium bracket via micro–etcher.

MATERIALS AND METHODS

The bracket samples consisted of (20) pure bicuspid titanium brackets (0.466 x 0.760 mm) with casted integral base. The brackets were classified into two groups, 10 brackets for each. The first group used

as control, the second group used for conducting the reconditioning technique. Twenty sound extracted human upper right first premolars were utilized to test the tensile strength of control group and reconditioned group.

The teeth were collected in orthodontic Department, Dental School at University of Mosul. The teeth were not subjected to any pretreatment, with no detectable caries or enamel cracks, no visible hyper–plastic pits and intact buccal enamel. They were additionally stored in normal saline 0.9 NaCl [8]. The second group was bonded on glass slide via light cure orthodontic composite (Transbond XT, 3M Unitek Co., USA).

The bonding procedure was performed under a standard force 500 gm [12], excess resin flash around the base was removed with a dental explorer. The brackets were de–bonded by using tweezers after one hour.

The reconditioning of the de–bonded brackets was performed with a Micro–etcher. The nozzle of the micro–etcher was held 3 mm away from the bracket base [13]. The tip of the nozzle moved in a mesiodistal direction (sweep technique) by using a holder designed to make the nozzle move for 6 mm in mesiodistal direction, and the base of each de–bonded bracket was etched for 12 seconds with aluminum oxide 50 microns particle size [14].

Photographic views were taken for all the brackets under the stereomicroscope at a constant quality. The bracket's slot width was measured by reading the distance between two internal points: at the gingival and occlusal wings. The slot depth was measured by reading the distance between two internal points of the wing at the base of the bottom and at the top of the slot. The inter–wing gap was measured by reading the distance between two points at the internal corners of mesio–occlusal and disto–occlusal of the gingival wings. The labio–lingual angle was measured by the intersection of the tangent line at the internal side of mesial wing and the tangent line at the floor (occluso–gingivally) of slot, the bracket base curvature angle was measured by the angle formed by the interaction of the line drown at mesial slope with the line at distal slope of the base of the bracket Figure (1).

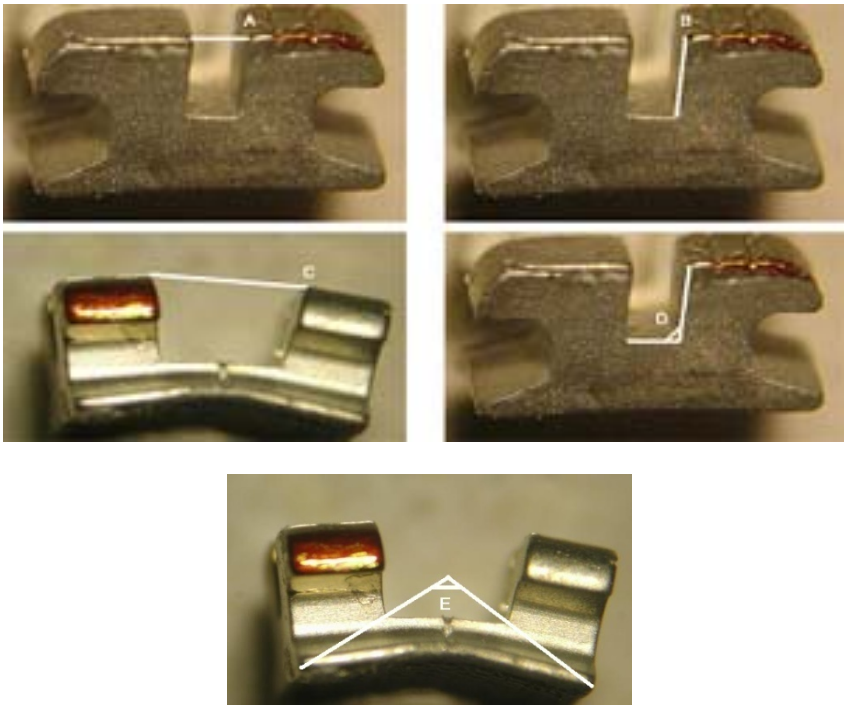

Figure (1): Ttanium bracket's dimensions: (A) slot width , (B) slot depth , (C) Inter–wings gap, (D) labio–lingual angle, (E) bracket base curvature angle.

All the measurements were conducted on magnified photographs (X20) and were converted to original values. The Preparation of the control and reconditioned bracket groups for testing the tensile bond strength were achieved via mounting the crown of the tooth in metal ring. The middle third of buccal surface was oriented to be parallel with the analyzing rod of the surveyor [15,16]. After that, all samples were immersed in normal saline in order to prevent dehydration of the teeth. The brackets were bonded to the buccal surface of enamel with adhesive according to the instructions of the manufacturer. The bonding procedure was achieved under a standard force 500 gm [13], and then left for 24 hours in incubator at 37 centigrade degrees.

The tensile bond strength of the control and the reconditioned bracket specimens were tested by using the universal tensile testing machine (Zweigle Co., Germany). The tensile strength performed at speed 0.5 mm/minute. The reading was taken through the gauge. This force was measured in kilogram, then the force was converted to mega–Pascal (MPa).

The statistical analysis of the data included, descriptive statistics (mean, standard deviation, minimum and maximum values) and analysis of variance (students t–test at $p \leq 0.05$).

RESULTS

The descriptive statistics of the data (mean, standard deviation, minimum & maximum values) are demonstrated in Table (1).

Table (1): Descriptive statistics of the parameters of control and recycled titanium brackets.

Bracket	Bracket's Parameters	No	Mean	± SD	Min.	Max.
Control	Slot width*	10	0.466	0.000	0.466	0.466
	Slot depth*	10	0.760	0.000	0.760	0.760
	Inter–wing gap*	10	1.400	0.000	1.260	1.400
	Labio–lingual angle**	10	90.000	0.000	90.000	90.000
	Base angle**	10	160.000	0.000	110.000	160.000
	Tensile strength#	10	19.247	0.662	17.390	19.600
Recycled	Slot width*	10	0.466	0.000	0.466	0.466
	Slot depth*	10	0.760	0.000	0.760	0.760
	Inter–wing Gap*	10	1.400	0.000	1.400	1.400
	Labio–lingual angle**	10	90.000	0.000	90.000	90.000
	Base angle**	10	160.000	0.000	160.000	160.000
	Tensile Strength#	10	14.864	3.406	10.480	19.600

* Measurement in millimeter; **Measurement degrees; # Measurement in mega– Pascal; No: Number of brackets; Min: minimum value; Max.: maximum value.

The variation analysis between the control and reconditioned bracket groups showed insignificant differences (P> 0.05) for the slot's parameters (width ,depth, labio–lingual angle, inter–wing gap) and the bracket base curvature angle. While, the tensile bond strength displayed significant increase in the control group as compared with reconditioned bracket group at 0.05 level Table (2).

Table (2): Analysis of t–test for the control and recycled titanium brackets.

Bracket's Parameters	Sample Brackets	No.	Mean ±SD	t value	Sig.
Slot width*	Control	10	0.466±0.00	0.000	N
	Recycled	10	0.466±0.00		
Slot depth*	Control	10	0.760±0.00	0.000	N
	Recycled	10	0.760±0.00		
Inter–wing gap*	Control	10	1.400±0.00	0.000	N
	Recycled	10	1.400±0.00		
Labio–lingual angle**	Control	10	90.00 ± 0.00	0.000	N
	Recycled	10	90.00 ± 0.00		
Base angle**	Control	10	160.00 ± 0.00	0.000	N
	Recycled	10	160.00 ± 0.00		
Tensile strength#	Control	10	19.247± 0.662	1.860	S
	Recycled	10	14.864± 3.406		

* Measurement in millimeter; **Measurement in degree; #Measurement in mega–pascal; No: number of brackets; N: not significant at 0.05 level; S: significant at 0.05 level.

DISCUSSION

There was no significant difference in the slot's width, depth and inter–wing gap of the pure titanium bracket that were treated according to the etcher method when compared with control group. This can be explained by the fact that the bracket's slot was not affected by the micro–etching (sand–blasting) process, because the top surface of the bracket was away from the blowing of the micro–etcher's nozzle. This recycling method can be recommended for recycling the metal brackets, and this is in agreement with Basudan and Al–Emran [12] who found that the micro–etching (sand–blasting) have no effect on slot's width, depth and inter–wing gap.

There was no significant difference for labio–lingual angle of slot and for the bracket's base curvature angle of the pure titanium brackets reconditioned by micro–etcher, when compared with control brackets. This can be attributed to the fact that the slot of the bracket was away from the blowing of nozzle of the micro–etcher and because the base of the metal bracket is fabricated from alloy that has enough resistance to the influences applied by micro–etching procedure. A significant reduction of tensile bond strength of the recycled pure titanium brackets when treated with micro–etcher method was detected when compared with the control group. This can be explained on the grounds that the retentive base of the recycled brackets treated with micro–etcher method lost some of its retention area when compared with that of the base of control group. Moreover, the results concerning the comparison of reconditioned bracket with control brackets agreed with many researchers [8,9,12] who found that the bond strength of recycled metallic brackets decreased when compared with the bond strength of control brackets. In spite of that, the recycled brackets showed an acceptable mean value of tensile bond strength.

CONCLUSIONS

The micro–etcher (sandblasting) did not perfectly affect the dimensions of the pure titanium brackets, and it can perform an acceptable removal of the adhesive remnants on the base of the bracket. Therefore, the reuse of recycled brackets is strongly recommended.

REFERENCES

1. Ireland AJ and McDonald F. The orthodontic patient: treatment and biomechanics. Oxford University Press**.** 2003; Pp: 223–227.
2. MacColl GA, Rossouw PE, Titley KC, Yamin C. The relationship between bond

strength and orthodontic bracket base surface area with conventional and micro-etched foil–mesh bases. *Am J Orthod Dentofacial Orthop*. 1998; 113: 276–281.

3. Sonis AL. Air abrasion of failed bonded metal brackets: a study of shear bond strength and surface characteristics as determined by scanning electron microscopy. *Am J Orthod Dentofacial Orthop*. 1996; 110: 96–98.
4. Wood DP, Paleczny GJ, Johnson LN. The effect of sandblasting on the retention of orthodontic bands. *Angle Orthod.* 1996; 66: 207–213.
5. Brosh T, Kaufman A, Balabanovsky A, Vardimon AD. In vivo debonding strength and enamel damage in two orthodontic debonding methods. *J Biomechanics.* 2005; 38: 1107–1113.
6. Kocadereli I, Canay S, Akca K. Tensile bond strength of ceramic orthodontic brackets bonded to porcelain surfaces. *Am J Orthod Dentofacial Orthop.* 2001; 119: 617– 620.
7. Graber TM and Vanarsdall RL. Orthodontics current principle and techniques. 3rd ed. St Louis: C.V. Mosby. 2000; Pp: 557–559, 592.
8. Tavares SW, Consani S, Nouer DF, Magnani MB, Neto JS, Romano FL. Evaluation in vitro of the shear bond strength of aluminum oxide recycled brackets. *Braz J Oral Sci.* 2003; 2: 378–381.
9. Quick AN, Harris AM, Joseph VP. Office reconditioning of stainless steel orthodontic attachments. *Eur J Orthod.* 2005; 27: 231–236.
10. Sharma–Sayal SK, Rossouw PE, Kulkarni GV, Titley KC. The influence of orthodontic bracket base design on shear bond strength. *Am J Orthod Dentofacial Orthop.* 2003; 124: 74–82.
11. Schmage P, Nergiz I, Herrmann W, özcan M. Influence of various surface–conditioning methods on the bond strength of metal brackets to ceramic surfaces. *Am J Orthod Dentofacial Orthop.* 2003; 123: 532– 537.
12. Basudan AM and Al–Emran SE. The effects of in–office reconditioning on the morphology of slots and bases of stainless steel brackets and on the shear/ peel bond strength. *Bri J Orthod.* 2001; 28: 231–236.
13. Gaffey PG, Major PW, Glover K, Grace M, Koehler JR. Shear/peel bond strength of repositioned ceramic brackets. *Angle Orthod.* 1995; 65: 351–357.
14. Chung C, Fadem BW, Levitt HL, Mante FK. Effects of two adhesion boosters on the shear bond strength of new and re-bounded orthodontic brackets. *Am J Orthod Dentofacial Orthop.* 2000; 118: 295–299.
15. Knight JS, Draughn R, Evan MD. Effects of handpeice lubrication on resin–based composite bond strength to enamel. *Am J Orthod Dentofacial Orthop.* 1999; 12: 116–118.
16. Tecco S, Traini T, Caputi S, Festa F, Luca V, D'Attilio M A. New one–step dental flowa ble composite for orthodontic use: an in vitro bond strength study. *Angle Orthod.* 2005; 75:672–677.