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Recycling of Brackets: Unleashing the Lucid Way

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Abstract

Background: Debonding is a common occurrence in orthodontic clinic and a considerable number of orthodontists prefer to rebond the debonded brackets because of economic issues.

The **aim of this study** was to evaluate the effect of a new method of in-office bracket reconditioning on shear bond strength (SBS) of stainless steel brackets.

Methodology: Thirty stainless steel brackets were divided in to two groups of 15 each. One control (Group I-fresh brackets) and experimental group (Groups II-recycled brackets).

Results: Even though the Recycled brackets showed slightly higher SBS compared to the new brackets, both the groups showed no statistically significant difference between them. The mean SBS was more than the recommendations by Reynolds in 1975.

Conclusion: Keeping the cost and the ease of availability of the basic required armamentarium in the dental clinic into consideration, recycled orthodontic brackets can be used as an alternative to new brackets in most cases.

Keywords: Recycling, Debonding, Air Abrasion, Ultrasonic Cleaning.

Introduction

In any form of life irrespective of whether it is engineering, medical or dental fields, normal human tendency is to simplify the technical procedures to reduce time and cost.

With respect to any orthodontic field, The failure of a bonded orthodontic bracket or inaccurately positioned brackets that require repositioning during the course of therapy is not an uncommon occurrence. Recycling appears to be an effective method for debonded brackets and facilitating the reuse of them.[1] Recycling is considered as one of the swift and cost effective[3] solution for using the same bracket for another patient after sterilization.[2] With known fact that a single bracket can be reused up to five times[4]. Advantage include a corrosion-resistant bracket after electropolishing. Even though a variety of recycling methods are available, they are tedious to perform at the chair side. As a result, several in office bracket reconditioning methods have been introduced,[5-7] which includes a variety of mechanical, thermal, chemical and a combination of these methods. Among these, recycling with sandblasting is the one of the easiest and efficient procedure. Ultrasonic cleaning can also be used as a method of recycling after flaming.[8]

So this study aimed at the combination of the ultra-sonic scaler and prophy jet used as a method of recycling which will be readily available in clinics and directly can be attached to the dental chair (which is an advantage over the other equipment used for recycling methods). Prophy jet is used for subgingival polishing after scaling and root planning and it uses micro particles of alumina for polishing the subgingival surface of the tooth which is also a method of sandblasting. This study was planned to evaluate the effect of this new method of in-office bracket reconditioning on shear bond strength (SBS) of stainless steel brackets.

Materials and Methods

Thirty freshly extracted human premolars were collected. Inclusion criteria for this study were as follows,

1. Teeth extracted for orthodontic purpose only.
2. The teeth were free of caries, cracks or gross irregularities of the enamel structure.

These teeth were stored in distilled water at room temperature and randomly divided into two groups each of 15, namely the control group(Group I) and study group (Group II:Air polishing group).

Bonding procedure

Metal Premolar PEA brackets from Ortho Organisers were used in this study. All the extracted teeth were polished with fluoride free pumice with a rubber cup at low speed and rinsed with water for 10 seconds and embedded horizontally in rectangular acrylic blocks. Etching was done to the buccal surfaces with 37% phosphoric acid (EZEE etch, mission dental, USA) for 30 seconds. The teeth were then sprayed with water for 20 seconds and dried with air spray further 20 seconds until the buccal surfaces appear frosty. A thin coat of light cure primer (Ormco, Orthosolo, Italy) was applied to the etched surfaces and the base of brackets using a micro brush. Light cure adhesive (Ormco, Enlight) was applied to each bracket base. The brackets were then firmly pressed with a plastic instrument onto the tooth surface and the excess flash was removed with an explorer. Polymerization occurred through LED light application on both the mesial and distal sides for 10 seconds each. The above procedure was used in both the groups (Group I & II).

Debonding procedure

Debonding was not performed in the control group (group I). Debonding was done with a bracket removing plier in Group II with caution not to distort the brackets.

Adhesive removal procedure for group II

Gross removal of the adhesive resin was done using hand scaler (figure 1) followed by air polishing using prophy jet of 50µm aluminium oxide abrasive powder at a distance of 5 mm from bracket base, with the nozzle tip sweeping in a mesiodistal direction under 5 PSI pressure. Micro-etching was stopped when the metal base appeared roughened and no resin remnants were detectable on visual inspection.

Rebonding procedure

Teeth were conditioned with 37% phosphoric acid and bonding procedure was done as mentioned above.

SBS determination

Groups I and II were subjected to a shear force with a universal testing machine (Brakes India Private Limited) until the bracket debonded with a crosshead speed of 1mm/min. The force was recorded in Newton (N), and the stress was calculated.

Results

The mean force required for debonding in Group I was 148.9145 with standard deviation of 49.34357 and in Group II it was 152.4331 with a standard deviation of 28.39928.

The mean shear bond strength in Group I was 13.2016 with a standard deviation of 4.37443 and in Group II it was 13.5136 with a standard deviation of 2.51767.

Mean force required for debonding and SBS were higher in group II when compared to Group I. All the measurements showed no statistically significant differences between both Groups.

Table 1, Descriptive Statistics

	GROUP	N	MEAN(in MPA)	S.D	S.E MEAN
Debonding FORCE	Group I	15	148.9145	49.34357	12.74045
	Group II	15	152.4331	28.39928	7.33266
SBS	Group I	15	13.2016	4.37443	1.12947
	Group II	15	13.5136	2.51767	0.65006

Table 2: Comparision Of Shear Bond Strength

Variable	Group	Mean+S.D	P-VALUE	INFERENCE
SBS	Group I	13.2016 ± 4.37443	0.813	No statistical significant difference at 5% confidence interval
	Group II	13.5136 ± 2.51767		

Discussion

Several in-office recycling methods are available for the recycling of the brackets. The disadvantage of thermal method is that the bracket discolours, unless it is electropolished. Furthermore, the metal is softened by the heating process, and is thus more vulnerable to masticatory forces. Regan et al. (1993) reported a 41 percent decrease in bond strength of flamed brackets, which was equal to the decrease seen with brackets that had been roughened with greenstone(mechanical method).[9]

Recycling with sandblasting is reported to be the easiest and efficient procedure among the in-office methods. It also enhances the bracket bonding by producing micromechanical retention on the bracket base surface due to an increase in the area of composite interlocking. But the equipment is costly and is not readily available & also the time needed to remove the entire residual composite is relatively long & also the undercut area might get too abraded and adversely effects the bond strength.

Studies had shown that the bond strength of recyclable bracket was not as significant when compared with new brackets.[10,11] Researchers like Chug, disagreed with this finding.[12] The current study shows that using recycled-sandblasted brackets provide a sufficient SBS which was in agreement with other studies.[1.13,14,15.] Air abrasion removes bonding material from the failed bracket base (resulting in a roughened and irregular surface of mesh) thinning the oxide layer of stainless steel and has been suggested as a way to improve the bond at the bracket

base. This probably resulted in the increased mechanical retention of previously failed brackets.[16,17] There was no significant reduction in shear bond strength of the recycled SS bracket when compared with control group. However, our study results disagree with Basudan and Al–Emran who found that bond strength decreases significantly when compared with control group brackets.[7] Reynolds in 1975 reported the average biting force to be 70 kg ranging from 10 to 100 kgs and the average force transmitted to the bracket during mastication is about 4.5 to 12 kg. So 0.6- 0.8 kg/mm^2 of bond strength is needed to withstand the occlusal forces & to overcome the intraoral and orthodontic forces, SBS in range of 5.9 to 7.8 Mpa was required.[18] The mean SBS of both our study groups were more than his recommendations. Hence use of this technique of air polishing method, without compromising on the retention or mechanical prescription will be adequate to resist the forces exerted during the entire orthodontic treatment.

Conclusion

This method of recycling with prophyjet will give sufficient amount of shear bond strength to withstand the masticatory and orthodontic forces. Hence this method can be successfully recommended for recycling the de–bonded stainless steel brackets and reuse them in orthodontic treatments.

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List Of Abbrevations

1. **SBS:** Shear Bond Strength
2. **PEA:** Pre Adjusted Edgewise Appliance

Fig. 1: ultra sonic scalar for the gross removal of the residual resin

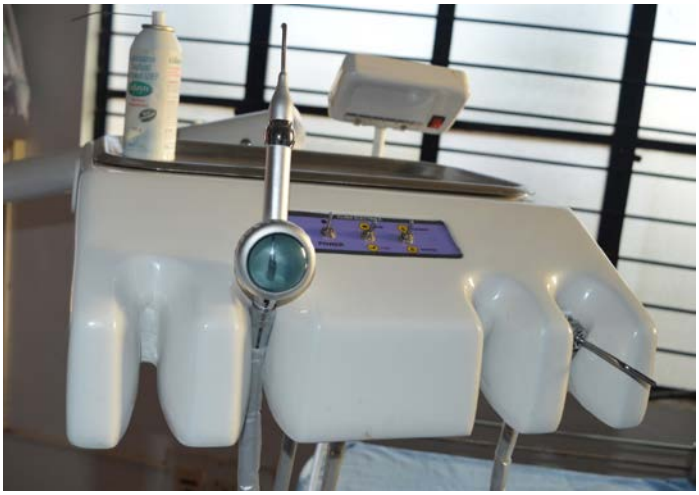

Fig. 2: prophyjet which can be directly attached to the dental chair

Fig. 3: Air polishing with prophy jet for residual resin romval,minimum of 5 mm distance was maintained during recycling process.