

# Comparison Of Shear Bond Strength Of Debonded Ceramic Brackets Recycled By Burning Technique, Sandblasting And Application Of Silane Coupling Agent: An-Invitro Study

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**Abstract:** The study was done to evaluate the shear bond strength of the dental ceramic brackets using various recycling techniques like Sandblasting, Burning and Silane Coupling Agent.

**Materials and Methods** A total of 80 maxillary and mandibular premolar teeth were collected and stored in normal saline until use. The water was changed weekly to avoid bacterial growth. Teeth with intact buccal surfaces without any evidence of cracks, caries, hypoplastic areas or other enamel abnormalities were selected. Each tooth was then mounted vertically within self-curing acrylic resin. The mounted teeth were divided into 4 groups of 20 samples each.

Group I- Samples subjected to recycling with burning technique,

Group II- Samples subjected to recycling with burning technique and sandblasting.

Group III- Samples subjected to recycling with burning technique, sandblasting and silane primer application

Group IV -Non recycled brackets (Control Group).

The brackets were debonded and subjected to different recycling techniques mentioned above.

**Results:** The highest mean shear bond strength was in the Group-IV control group ( $9.8 \pm 0.8 \text{MPa}$ ), followed by Group III of burning, sandblasting and silane coupling agent ( $5.2 \pm 2.5 \text{MPa}$ ), then Group II with mean shear bond strength of ( $3.9 \pm 2.6 \text{MPa}$ ) and the lowest was the Group I where only burning was done with the mean shear bond strength of ( $1.8 \pm 0.3 \text{MPa}$ ). The data analyzed using paired 't' test revealed statistically significant difference within the groups.

**Conclusion:** This study concluded that Group IV (Control group) exhibited the highest shear bond strength and amongst the groups I, II and III shear bond strength of group III was the highest as compared to the group I and group-II but less than the control group. The value of shear bond strength reduces after recycling.

**Key Word:** Burning, Sandblasting, Silane coupling agent.

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## I. Introduction

Fixed orthodontic treatment depends on an effective optimum bond between enamel surfaces and brackets. Failure of bonding procedure is a common occurrence during orthodontic treatment. Bond failure may result from sudden force applied by patients to the attachments and due to improper bonding technique. Bond failure is also influenced by bracket base design and by the type of bracket<sup>1</sup>.

Recycling is to separate the stains and adhesive remnants, resulting in brackets that reached standards comparable to those shown by unused brackets<sup>2</sup>.

The Shear Bond Strength (SBS) of the recycled bracket is affected by many factors including microscopic damage to the base of the bracket, bracket base design and amount of remaining adhesive on the bracket base. Removal of the adhesive from the bracket base is conventionally done by gas torch (Burning Technique), sandblasting and silane primer application etc<sup>1</sup>.

The aim of the present study is to determine the effects of different recycling methods like gas torch (burning technique), sandblasting, application of silane primer agent on Shear Bond Strength (SBS) of re-bonded ceramic brackets<sup>1</sup>.

## II. Material And Methods

This Prospective comparative study was carried out in-vitro in Department of Orthodontics at Geetanjali Dental and Research Institute, Udaipur, Rajasthan. A total 80 extracted maxillary and mandibular Premolars were collected and divided into four groups of 20 Samples each.

**Study Design:** Prospective open label observational study

**Study Location:** This was a tertiary care teaching hospital based study done in Department of Orthodontics, at Geetanjali Dental and Research Institute, Udaipur, Rajasthan.

**Study Duration:** November 2022- January 2023.

**Sample size:** 80 Premolar Teeth.

### Subjects & selection method:

Inclusion criteria:

1. Intact Maxillary and Mandibular Premolar teeth

Exclusion criteria:

1. Premolar teeth with restoration, caries, cracks

### Procedure methodology

A total of 80 maxillary and mandibular premolar teeth were collected and stored in normal saline until use. The water was changed weekly to avoid bacterial growth. Teeth with intact buccal surfaces without any evidence of cracks, caries, hypoplastic areas or other enamel abnormalities were selected. Each tooth was then mounted vertically within self-curing acrylic resin. The mounted teeth were divided into 4 groups of 20 samples each.

Group I- Samples subjected to recycling with burning technique.

Group II- Samples subjected to recycling with burning technique and sandblasting.

Group III- Samples subjected to recycling with burning technique, sandblasting and silane primer application.

Group IV -Non recycled brackets (Control Group).

The brackets were debonded and subjected to different recycling techniques mentioned

### Recycling by burning (Group I):

The previously debonded ceramic brackets were exposed to torch flame, the process was continued till the bracket base became cherry red. After that, the bracket was immersed in cold water immediately. The composite detached from the base with a crackling sound and a gentle cleaning was done using the explorer to complete the recycling process.

### Recycling by burning and sandblasting (Group II)

The previously debonded brackets were exposed to the torch flame as mentioned above and then were sandblasted via Micro-etcher for 20-30 seconds with aluminium oxide abrasive powder, maintaining a 5 mm distance between ceramic brackets and hand piece head. Sandblasting was done until no composite was visible on the bracket mesh with naked eyes.

### Recycling by burning, sandblasting and application of silane coupling agent (Group III)

Debonded and sandblasted ceramic brackets were silanated with conventional silane coupling agent for 60 seconds. Light cure bonding adhesive was applied on the bracket bases. Brackets were seated onto the sandblasted and silanated ceramic specimens with a light cure adhesive.

The samples prepared (Fig.1) were subjected for shear bond strength measurement to a universal testing machine in a manner that the buccal surfaces of the teeth were parallel to the shearing force. A custom-made rod was connected to the machine and an occluso-gingival force with a crosshead speed of 1.25 mm/min was exerted onto each sample.



**Figure 1. The prepared sample with bonded ceramic brackets**

The SBS value for each sample was determined and the data obtained was statistically analysed using ANOVA. Fig 2. depicts the materials used during the above mentioned study.



**Figure 2. The Material used during the Research**

Fig 3.depicts the Universal Testing Machine which was used to measure the shear bond strength before and after recycling .



**Figure 3. Universal Testing Machine**

### III. Statistical analysis

Descriptive statistics including the mean, standard deviation, and minimum and maximum values were calculated for each of the various groups of teeth tested.

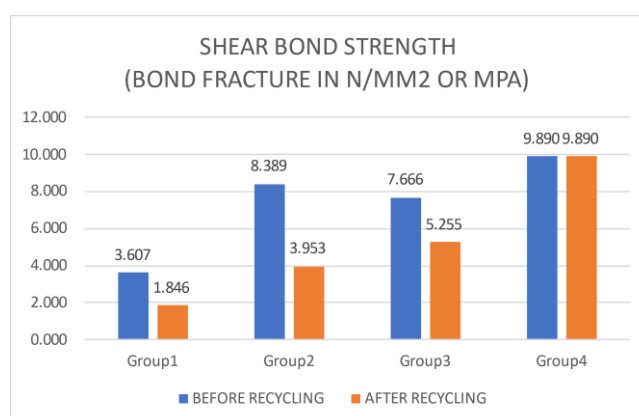
Paired T-Test was used to perform intergroup comparison among all four groups.

### IV. Results

GROUP-I (BURNING TECHNIQUE)	GROUP-II (BURNING AND SANDBLASTING TECHNIQUE)	GROUP-III (BURNING SANDBLASTING AND SILANE PRIMER APPLICATION )	GROUP-IV (CONTROL GROUP)
1.57	4.57	1.78	10.21
1.78	5	5.71	9.07
2.28	4.28	11.3	11.78
2.28	2.28	5.71	9.57
1.78	9.07	4.57	9.78
1.57	4.28	5.71	9.57
1.57	4.28	5.71	9.57
1.78	2.28	5.71	9.57
2.28	2.28	4.57	11.78
1.57	2.28	4.57	9.57
1.57	2.28	11.3	9.07
2.28	4.57	1.78	9.07
1.57	4.28	4.57	9.57
1.57	2.28	5.71	9.57
1.78	4.57	5.71	9.78
2.28	2.28	1.78	9.78
2.28	2.28	1.78	9.57
1.78	2.28	5.71	9.57
1.78	4.57	5.71	11.78
1.57	9.07	5.71	9.57

**Table.1**

The descriptive statistics, including the mean, standard deviation, range, minimum and maximum values of shear bond strength for each of the two groups are presented in Table 1 and the shear bond strength values of both the groups are shown in Graph 1.



## V. DISCUSSION:

A total of 80 maxillary and mandibular premolar teeth were collected and stored in normal saline until use. The water was changed weekly to avoid bacterial growth. Teeth with intact buccal surfaces without any evidence of cracks, caries, hypoplastic areas or other enamel abnormalities were selected. Each tooth was then mounted vertically within self-curing acrylic resin. The mounted teeth were divided into 4 groups of 20 samples each.

Group I- Samples subjected to recycling with burning technique.

Group II- Samples subjected to recycling with burning technique and sandblasting.

Group III- Samples subjected to recycling with burning technique, sandblasting and silane primer application

Group IV -Non recycled brackets (Control Group).

The brackets were debonded and subjected to different recycling techniques mentioned above.

Group-1 The present study suggested that the Shear bond Strength reduces after recycling with burning technique with a mean value of  $1.8 \pm 0.3$ MPa. The results were similar to the study conducted by AL-Lwezy OH, Mukhtar AM, Salih SS which stated that lowering in shear bond strength might be due to removal of the Zirconium Layer at the base of the bracket when the composite is cracked during burning Technique. This is also similar to the study conducted by Venugopal A, Tejani H, Manzana P, Vergara RG(2016)<sup>2</sup>, in which there is reduced shear bond strength after recycling which can be due to loss of surface properties of bracket base during the procedure of burning.

Group-II Recycling with Burning and Sandblasting: The Present Study suggested that the Shear Bond Strength reduces after recycling with Burning and Sandblasting technique with a mean of  $(3.9 \pm 2.6)$ MPa. Its similar to study conducted by Kumar M et-al in which Shear Bond Strength is reduced after recycling with Burning and Sandblasting. Also a comparison was made by Singh R, Chaudhary V, Lahoti S, Lahot K(2016)<sup>3</sup> and was concluded that shear bond strength was less when recycled with burning and sandblasting.

Group-III Recycling with Burning, Sandblasting and Silane Primer Application the present study shows significant difference in the results obtained from the shear bond strength ( $5.2 \pm 2.5$ MPa) after recycling with Burning, Sandblasting and Silane Primer application with highest value of shear bond strength of after the Control Group. Sandblasting is more efficient in removing the adhesive residue from the orthodontic bracket base compared to burning Venugopal A, Tejani H, Manzana P, Vergara RG(2016)<sup>2</sup>. Also shear bond strength of silane coupling agent recycled brackets are high which is similar to study conducted by Falkensammer F, Jonke E, Bertl M, Freudenthaler J, Bantleon HP.

Group-IV Control Group: present study shows highest shear bond strength ( $9.8 \pm 0.8$ MPa), in relation to this Group. It is similar to the study conducted by Venugopal A, Tejani H, Manzana P, Vergara RG (2016)<sup>2</sup> which is showing highest shear bond strength of control group.

## VI. Conclusion

From the results of the study, the following conclusion can be drawn

The Group IV(Control group) exhibited the highest shear bond strength.

Amongst the groups I, II and III shear bond strength of group III was the highest as compared to the group I and group-II but less than the control group

Compared to the value of shear bond strength before and after recycling the shear bond strength values reduces after recycling.

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