

Impact Of The Home Bleaching On Shear Bond Strength Of Orthodontically Bonded Teeth

Dr. Akhil Karamshetty^{*1}, Dr. Seema Lahoti², Dr. Gurubachan Singh Choudhary³, Dr. Kirti Kardam⁴,
Dr. Gargi Singh⁵, Dr. Ahad Lakadkutta⁶

^{*1}Postgraduate Student, Department of Orthodontics & Dentofacial Orthopaedics, RKDF Dental College and Research Centre, Misrod, Bhopal, Madhya Pradesh, India

²Professor & Head, Department of Orthodontics & Dentofacial Orthopaedics, RKDF Dental College and Research Centre, Misrod, Bhopal, Madhya Pradesh, India

³Postgraduate Student, Department of Orthodontics & Dentofacial Orthopaedics, RKDF Dental College and Research Centre, Misrod, Bhopal, Madhya Pradesh, India

⁴Postgraduate Student, Department of Orthodontics & Dentofacial Orthopaedics, RKDF Dental College and Research Centre, Misrod, Bhopal, Madhya Pradesh, India

⁵Postgraduate Student, Department of Orthodontics & Dentofacial Orthopaedics, Bhabha College of Dental Sciences, Jatkhed, Bhopal, Madhya Pradesh, India

⁶Postgraduate Student, Department of Orthodontics & Dentofacial Orthopaedics, RKDF Dental College and Research Centre, Misrod, Bhopal, Madhya Pradesh, India

*Corresponding Author:

Dr. Akhil Karamshetty,

Email ID: drakhilkaramshetty@gmail.com

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ABSTRACT

Objective: To evaluate the impact of various home bleaching agents on shear bond strength of orthodontic brackets.

Materials and Methods: A total of 45 premolars were randomly divided into three groups of 15 each. GROUP-A has 15 sound human premolars which were not bleached before bonding (control group), GROUP-B has 15 sound human premolars which were bleached with 16 % carbamide peroxide bleaching agent, GROUP-C has 15 sound human premolars which were bleached with 35% carbamide peroxide bleaching agent. An LED light was used to cure the light-cured composite resin that was used to bond the orthodontic brackets. Following bonding, a Universal testing machine was used to test the brackets' SBS.

Result: The mean bond strength in Group A was 293.39 ± 61.48 while in Group B was 153.65 ± 16.63 and in Group C was 56.18 ± 24.72 . One way ANOVA test was applied. The test result showed statistically highly significant difference between groups with F value 136.98 and P value 0.001. The SBS of Group A is significantly higher than Group B and Group C, while the SBS of Group C is the least of all the three groups.

Conclusion: The SBS of orthodontic brackets on human enamel was considerably decreased by both home bleaching agents.

Keywords: Shear bond strength, home bleaching, orthodontic metal brackets, carbamide peroxide bleaching agent

1. INTRODUCTION

The teeth are made whiter with the use of bleaching techniques. The main bleaching processes are gel techniques, heat and light, and microabrasion. Among bleaching agents, hydrogen peroxide and carbamide peroxide are most frequently utilized¹. Teeth colour can change due to a number of circumstances. The home bleaching methods were initially described by Haywood and Heymann (1989)². Teeth stains can be effectively removed, and the dental tissues are kept secure and healthy². According to recently released research, utilizing bleaching solutions is generally harmless, however there is a risk to the hard tissues of the teeth³. Every study revealed that the shear bond strength of composite materials is greatly impacted by the application of 10–35% carbamide peroxide⁴.

Products for bleaching can be used both before and after orthodontic treatment. There is ongoing debate over the effects of bleaching on the morphology of the enamel surface, the strength of the bond between composite resins and bleached enamel, and the effects of the post-bleaching phase.

In orthodontics, where bleaching is sometimes thought of as a first step to improve the appearance of teeth prior to bonding orthodontic brackets, this dispute over the reduction in enamel bond strength has gained attention. So, the aim of this study is to assess and compare shear bond strength of the metal orthodontic brackets bonded to sound teeth and metal orthodontic brackets bonded to teeth bleached with 16% and 35% carbamide peroxide bleaching agents.

2. MATERIAL AND METHODS

Forty five extracted human premolars were collected, debrided and washed in tap water, and stored at room temperature. The inclusion criteria for selecting the teeth were intact enamel; no pretreatment by chemical agents, such as derivatives of peroxide, acid or alcohol; no caries; and no restorations. The extracted premolars were divided randomly into three groups.

GROUP A – 15 sound human premolars which are not bleached before bonding (control group) (Fig.1).

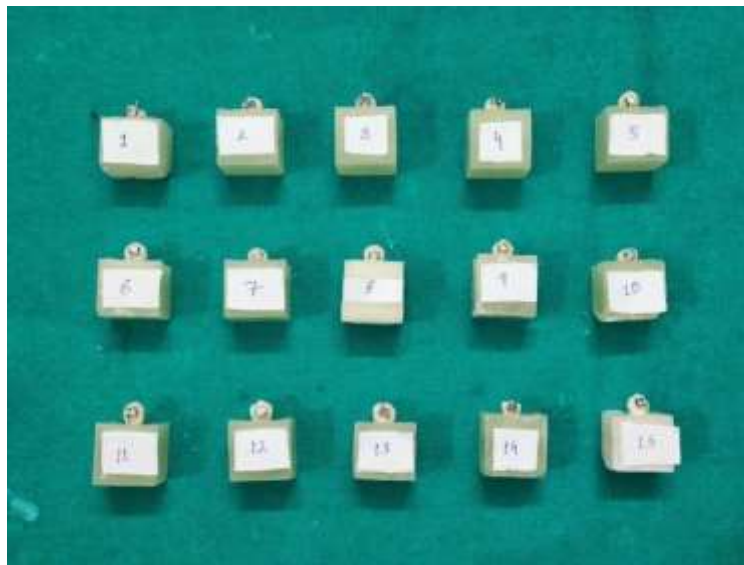


Figure 1: GROUP A

GROUP B – 15 sound human premolars which are bleached with 16 % carbamide peroxide bleaching agent (Fig.2)



Figure 2: GROUP B

GROUP C – 15 sound human premolars which are bleached with 35% carbamide peroxide bleaching agent (Fig.3).



Figure 3: GROUP C

Bleaching is performed for 30 minutes for each tooth at room temperature and then the teeth were washed under running tap water for 30 seconds. Then they were etched with 37% orthophosphoric acid for 30 seconds and then bonded with metal brackets. Prior to composite bonding, the teeth were kept in normal saline (0.9% NaCl) at 37° C for 24 hours. Universal Instron testing machine (Fig.4) was used for debonding and the shear bond strength was measured of all 3 GROUPS (Fig.5).



Figure 4: Universal Instron testing machine



Figure 5: Measuring Of Shear Bond Strength.

SHEAR BOND STRENGTH (SBS) TESTING:

It is believed that shear stress better captures the clinical scenario. According to Farik et al. (2002), bond strength is the force per unit area needed to rupture a bonded assembly when the failure takes place in or near to the adhesive/adhesive interface. There have also been reports of decreased resin-to-dentin bond strengths following bleaching treatment. According to Toko and Hisamitsu, changes in the dentin's organic composition may be connected to a decrease in adhesion⁵.

3. RESULT

The study compared shear bond strength of the metal orthodontic brackets bonded to sound teeth with metal orthodontic brackets bonded to teeth bleached with 16% and 35% carbamide peroxide bleaching agents. The samples were divided into three groups.

GROUP-A – 15 sound human premolars which are not bleached before bonding (control group).

GROUP-B – 15 sound human premolars which are bleached with 16 % carbamide peroxide bleaching agent.

GROUP-C – 15 sound human premolars which are bleached with 35% carbamide peroxide bleaching agent.

The mean bond strength in Group A was 293.39 ± 61.48 while in Group B was 153.65 ± 16.63 and in Group C was 56.18 ± 24.72 . One way ANOVA test was applied. The test result showed statistically highly significant difference between groups with F value 136.98 and P value 0.001. (Table 1)

Graph 1 represent the graphic representation of Bond strength in different groups. The mean bond strength in Group A was 293.39 ± 61.48 while in Group B was 153.65 ± 16.63 and in Group C was 56.18 ± 24.72 .

Post Hoc Tukey test was applied to find out the difference between various pairs of groups. The mean difference in Mean between Group A and Group B was 139.74 with statistically significant difference between them. The mean difference in Mean between Group A and Group C was 237.21 with statistically significant difference between them. The mean difference in Mean between Group B and Group C was 97.47 with statistically significant difference between them. (Table 2)

There the result concluded that Bond strength in

Group A > Group B > Group C

Table 1: Comparison of Bond Strength between Groups

Groups	N	Mean	Std. Deviation	F value	P value
A	15	293.39	61.48	136.98	0.001**
B	15	153.65	16.63		
C	15	56.18	24.72		



One way ANOVA, *Highly significant

Graph 1: Comparison of Bond Strength between Groups

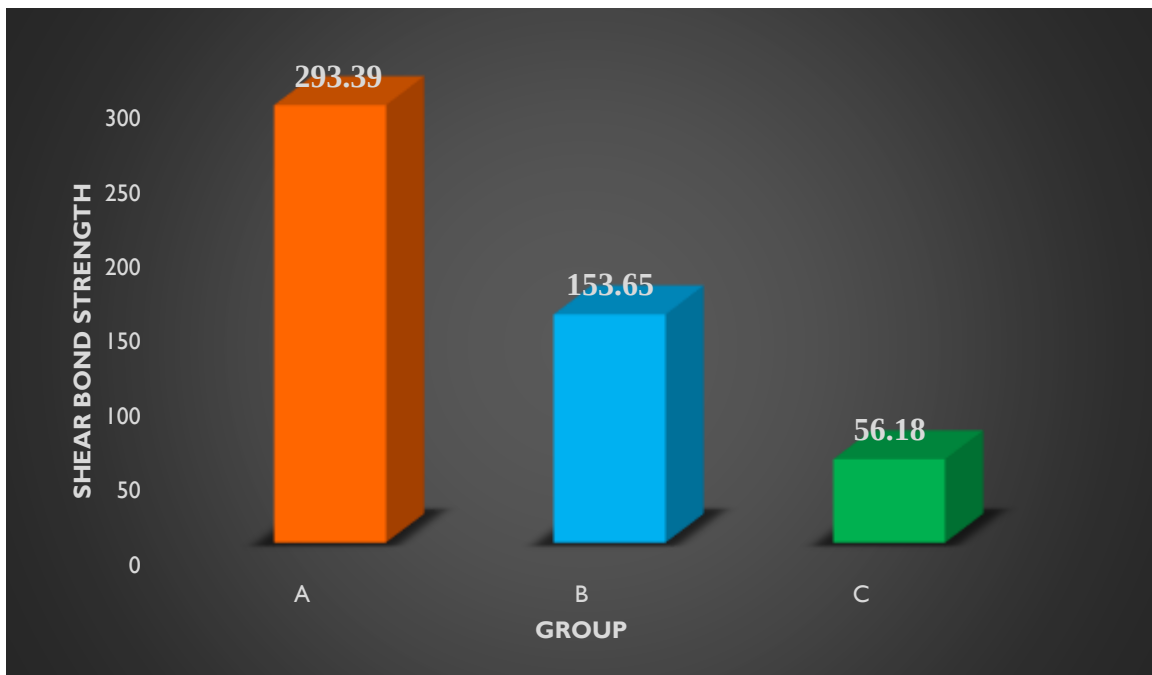


Table 2: Post Hoc Tukey Tests

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
A	B	139.74	14.41	.001*
	C	237.21	14.41	.001*
B	C	97.47	14.41	.001*



* Highly Significant

4. DISCUSSION

Due to the biomechanical significance of a robust bracket–adhesive interference to transfer the loads generated from the engagement of an activated archwire to the tooth, bracket bonding has been a crucial concern since the advent of direct bonding. When assessing the bonding effectiveness of orthodontic systems, in vitro bond strength testing is crucial because it helps clinicians choose novel adhesive and bracket combinations. As the need for adult orthodontic treatment grows,

orthodontists frequently see patients who desire whiter teeth in addition to properly aligned dentition. Nowadays, the dentist has access to a variety of bleaching agents and methods that have a contentious impact on how well orthodontic brackets adhere to bleached enamel ((Bishara et al., 1993; Miles et al., 1994; Hintz et al., 2001; Homewood et al., 2001; Uysal et al., 2003; Bishara et al., 2005; Bulut et al., 2006)^{6,7}.

Allison et al. demonstrated that the regular prism boundaries were lost in the topography of the acid-etched enamel of teeth bleached with carbamide peroxide, compared to a control⁸. Under SEM analysis, Scherer et al. showed that using a brush-on carbamide peroxide gel method for up to 30 days had no influence on surface structure⁹. Before bonding, a prophylactic cup or bristle brush is used to apply a pumice slurry as part of standard clinical practice. The enamel surface has been mechanically abraded to average depths of 5.0 μm and 10.7 μm , respectively, using a rubber cup or bristle brush¹⁰.

Alcohol-based dental bonding agents were suggested by Sung et al. (1999) as a way to reduce or entirely eliminate the negative effects of residual oxygen on the composite bonding process¹¹. Some authors have suggested that a delay of at least 1–2 weeks is needed after bleaching for the tooth structure to regain its prebleaching adhesive properties. The results of our study demonstrated that the shear bond strength values of 16% and 35% carbamide peroxide bleached teeth vary drastically when bonding is performed immediately after bleaching when compared to shear bond strength of metal brackets bonded to sound teeth which are not bleached. The results are in accordance with the results of Ahmet Yalcin Gungora; Erhan Ozcan; Huseyin Alkisc; Hakan Turkkahraman¹².

Peroxide's potential effects on dental tissues have sparked a lot of research. Numerous authors have demonstrated that bleaching gels can change the chemical composition, microhardness, and surface roughness of dental tissue. They can also change the adhesive system's bond strength with the enamel following bleaching. Changes in microhardness may be associated with demineralization or remineralization, or the loss or gain of minerals in the dental structure. According to certain research, microhardness testing can detect minute variations in the surface of the enamel that may result from the action of bleaching gels, acids, and colas²⁰.

Oxygen ions react weakly with other free chemicals or substrates, have a short half-life, and are unstable. Its high electro-negativity, which fosters a vigorous reaction marked by ions pursuing molecule stability, makes this possible. This process most likely results from the redox mechanism or a straightforward reduction facilitated by the oxygen ion, which combines with the tooth-staining molecules to make them simpler, whiter, or disappear. It is thought that the permeability of the tooth structure to the bleaching chemicals can decrease the size of the chromogenous molecules, even though the precise mechanism of dental bleaching isn't entirely clear²⁰.

According to a few researchers, the bleaching agents residual oxygen prevented resin polymerization and hampered resin adhesion¹³. The majority of authors advise waiting two to four weeks after bleaching before bonding of brackets¹².

It has been demonstrated that bleaching the teeth prior to orthodontic bracket bonding reduces the bond strength^{14,15}. Reactive oxygen species or leftover peroxide on the tooth surface after the procedure have been blamed for this decrease, which stops orthodontic adhesives from polymerizing later¹⁶. Additionally, resin tags created in bleached enamel exhibit deformities and diminished strength, resulting in weak bonds¹⁷. Having said that, prior research has demonstrated that bleaching solutions with hydrogen peroxide concentrations of 8% and 10% successfully enhance tooth colour^{18,19}. If at all possible, the practitioner should avoid utilizing higher concentrations.

5. CONCLUSION

1. Shear bond strength (SBS) of orthodontic metal brackets bonded to teeth is significantly affected by bleaching with 16% and 35 % carbamide peroxide bleaching agents.
2. SBS of metal orthodontic brackets bonded to sound teeth (GROUP-A) is higher than SBS of metal orthodontic brackets bonded to 16 % carbamide peroxide bleached teeth (GROUP-B).
3. SBS of metal orthodontic brackets bonded to 16% carbamide peroxide bleached teeth (GROUP-B) is higher than the SBS of metal orthodontic brackets bonded to 35% carbamide peroxide bleached teeth (GROUP-C).
4. SBS of metal orthodontic brackets bonded to sound teeth (GROUP-A) is higher than both GROUP-B and GROUP-C.
5. If bleaching is necessary for the patient it is advised to get carbamide peroxide bleaching after orthodontic treatment.

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