

Evaluation of the influence of dental bleaching with 35% hydrogen peroxide in orthodontic bracket shear bond strength

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Objective: The purpose of this study was to evaluate, *in vitro*, the bond strength of brackets bonded to premolars previously subjected to bleaching with a 35% hydrogen peroxide.

Methods: Twenty one healthy premolars were selected and randomly divided into three groups (n = 7). Group I (G1) included teeth that were not submitted to bleaching. The enamel surfaces of Groups II (G2) and III (G3) were submitted to a bleaching process with 35% hydrogen peroxide (Whiteness HP Maxx). On Group II (G2), after bleaching, the teeth were stored for 24 hours in distilled water at 98.6 °F, and then, premolar metallic brackets were bonded using Transbond XT (3M) resin. Group III (G3) was submitted to the same procedure seven days after bleaching. After bonding, all teeth were stored in distilled water at 98.6 °F for 24 hours. All groups were submitted to a traction test using an EMIC DL2000 universal testing machine at a speed of 0.5 mm/min.

Results and Conclusion: The bracket resistance to debonding was compared between the groups by the Kruskal-Wallis nonparametric test ($p < 0.05$) and it was verified that the bleaching agent significantly reduced bracket adhesion when bonded 24 hours after bleaching. However, seven days after bleaching, there was no significant difference on the resistance to debonding among groups G1 (19,52 kgf) and G3 (18,44 kgf), meaning that it is necessary to wait longer after bleaching to bond brackets.

Keywords: Orthodontic brackets. Dental bleaching. Tensile strength.

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INTRODUCTION

Based on the current beauty standards, where beautiful is to have white and aligned teeth, the search for esthetic treatment is the desire of most patients that seek for a dental treatment.⁹

Dental bleaching is the most popular esthetic treatment with the purpose of modifying tooth color. Among the bleaching agents, hydrogen peroxide is the most used for treating intrinsic staining of healthy teeth, presenting or not endodontic treatment. Hydrogen peroxide presents several concentrations and periods of application.^{10,20}

There are evidences in the literature that the utilization of bleaching agents can interfere on the bond strength of orthodontic brackets. Prietsch¹⁴ concluded that dental bleaching with a 35% hydrogen peroxide reduces bond strength after 24 hours, suggesting that a period of seven days should be waited after bleaching. On the other hand, Matta¹¹ concluded that the bleaching agent with a 10% carbamide peroxide increases significantly the mechanical bond strength of orthodontic brackets, and that the elapsed time from the end of the bleaching treatment to the bonding of the orthodontic brackets did not interfere on the mechanical bond strength when it was performed after 24 hours or one week.

However, according to Bishara et al,³ bleaching with a 10% carbamide peroxide does not interfere on bond strength of dental enamel. Thus, despite researches reporting the effect of bleaching agents to the dental enamel, it is noticed that there is no consensus about the real interference on bond strength of orthodontic brackets.

Therefore, due to the increasing demand of adult patients for orthodontic treatment, associated to increasing care for dental esthetic, it is relevant to perform an evaluation of the influence of bleaching with a 35% hydrogen peroxide on the bond strength of orthodontic brackets.

MATERIAL AND METHODS

To perform the present study, twenty one healthy human teeth (premolars) were stored in distilled water at 98.6 °F for 24 hours. The teeth were, then, randomly divided into three groups (n=7), according to waiting period post-bleaching (24 hours and 7 days) (Table 1).

Table 1 - Description of the sample according to the procedures performed in each group.

Groups (n = 7)	Procedures	
	Bleaching	Bonding
G1	No	24 hours
G2	Yes	24 hours
G3	Yes	7 days



Figure 1 - Mounting the teeth with acrylic resin to the PVC bases.

Using self curing acrylic resin, each tooth was mounted in two PVC bases with different diameters, so that the buccal surface of each tooth formed a 90 degree angle with the acrylic base (Fig 1). This was necessary to standardize the traction tests in the universal testing machine.

Group I (G1) or Control group included the teeth that were not submitted to bleaching. For this group bracket bonding was performed according to the same protocol adopted for the experimental groups. The enamel surfaces of Group II (G2) and III (G3) were submitted to bleaching with 35% hydrogen peroxide (Whiteness HP Maxx). The bleaching agent was applied for three times and activated by an halogen light, according to instructions from the manufacturer.

For Group II (G2), after bleaching, the teeth were stored for 24 hours in distilled water at 98.6 °F, then, the area to be bonded to the bracket in each tooth was bounded by a mask made from adhesive tape¹¹ (Fig 2A). After setting the mask, a prophylaxis with rubber cup

and pumice paste and water was performed during 10 second for each tooth (Fig 2B), rinsing and drying (Fig 2C), with subsequent etching with 37% phosphoric acid for 15 seconds (Fig 2D), followed by rinsing for 10 seconds and drying for 10 seconds¹¹ (Fig 2E). Metallic brackets (Abzil) for premolars were bonded using the same amount of Transbond XT (3M) resin light cured for 40 seconds. All accessories were bonded at the same cervical distance, using a Boone gauge (Morelli) with a 4.0 mm distance (Figs 2F to 2M).

Group III (G3) was also submitted to the same procedures above described, but in this group the bonding was performed seven days after bleaching. After bracket bonding, all teeth were stored in distilled water at 98.6 °F for 24 hours. Then, all groups were submitted to the traction test using an EMIC DL2000 universal testing machine at a speed of 0.5 mm/min.⁵ In this test the resistance values were obtained in kgf (kilogram-force) and registered by a printer attached to the machine (Fig 3A).

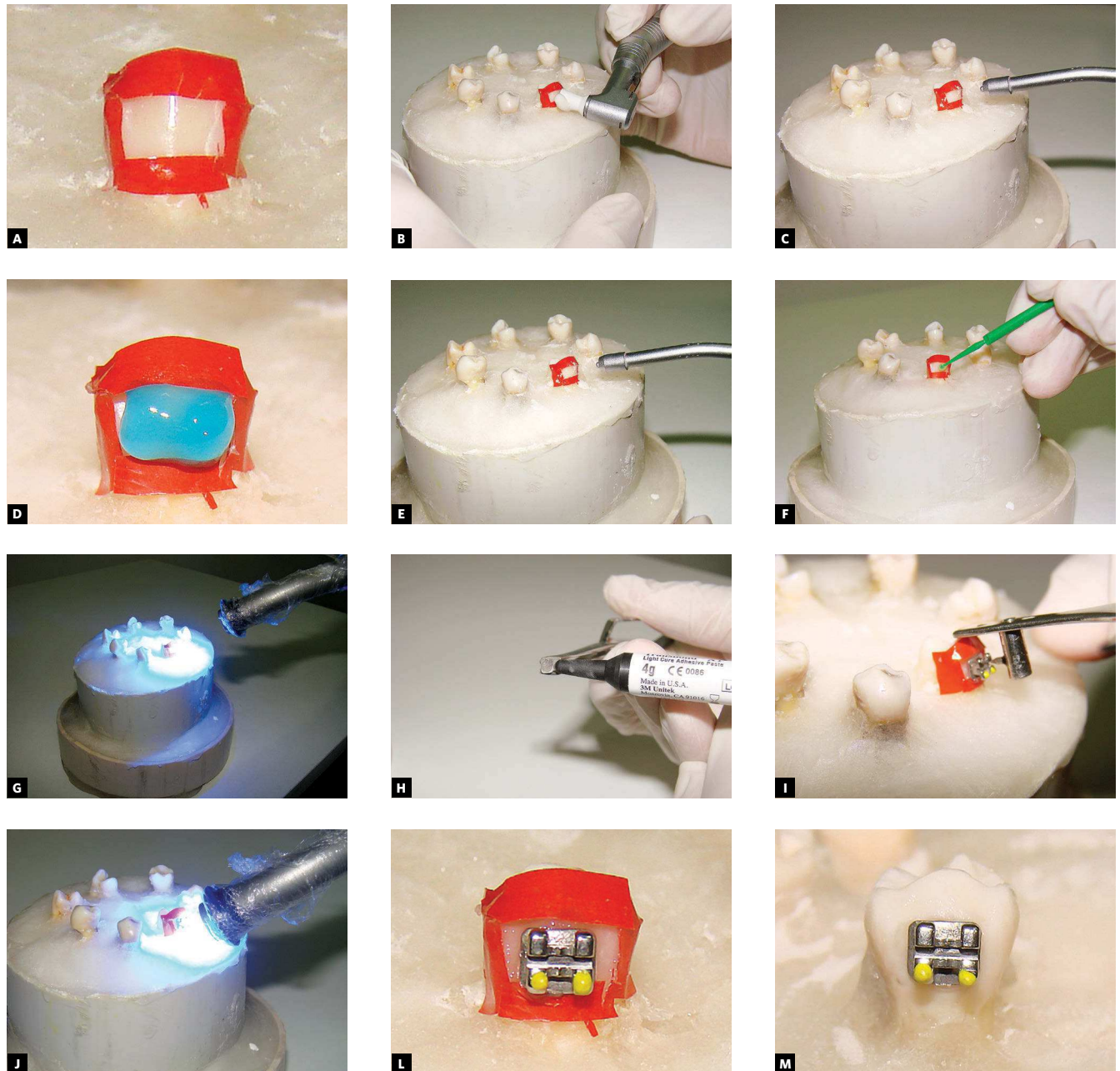


Figure 2 - A) Setting the mask. B) Prophylaxis (10s each tooth). C) Rinsing and drying. D) Acid conditioning (15s). E) Rinsing and drying (10s each tooth). F) Applying the primer. G) Photopolymerization of the primer. H) Applying the resin on the bracket base. I) Checking the distance of the accessory (4.0 mm). J) Photopolymerization. L) Bracket attached before removal of the mask. M) Bracket attached after removal of the mask.

Then, a descriptive analysis of the mean and standard deviation for the tensile resistance (kgf) was performed for all groups.

The influence of 35% hydrogen peroxide bleaching agent on the bonding strength of orthodontic brackets was evaluated comparing the traction force (kgf) results necessary to debond the accessories.

The Kruskal-Wallis nonparametrical test, with significance level of 5% ($p < 0.05$), using the SPSS 13.0 was applied.

RESULTS

The results (Table 2 and Fig 4) showed that there was a statistically significant reduction on the bond strength when compared to the Control group (19.52 kgf) and to the group where bonding was performed 24 hours after bleaching (12.31 kgf). When the bracket debonding strength was confronted with the Control group and the group where bonding was performed seven days after bleaching (18.44 kgf), it was noticed that there was no statistically significant differences.



Figure 3 - Emic DL2000 universal testing machine.

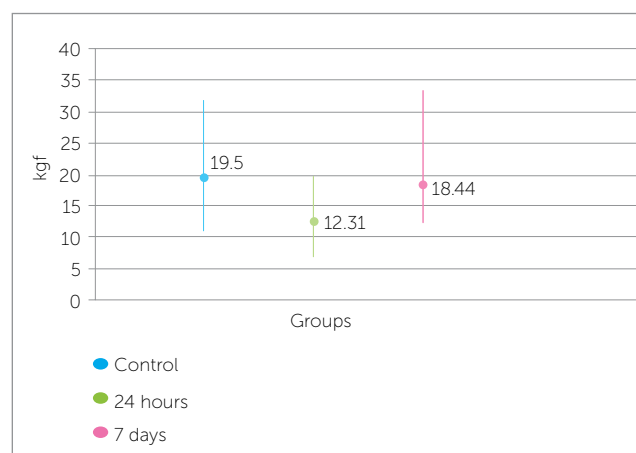


Figure 4 - Mean values and standard deviation of bond strength (kgf).

Table 2 - Bond strength values (kgf) obtained for each group according to tensile test.

Group	N	Minimum	Maximum	Mean	Standard Deviation
control	7	11.67	32.74	19.52 ^a	6.537
24 hours	7	8.01	18.17	12.31 ^b	3.240
7 days	7	11.42	35.78	18.44 ^{a,b}	9.722

Kruskal Wallis nonparametrical test $p < 0.05$. Distinct letters (a/b) represent that there was statistical difference. Control X 24 hours - $p = 0.025^*$. Control X 07 days - $p = 0.098$. 24 hours X 07 days - $p = 0.338$.

Table 3 - Evaluation of the influence of bleaching agents on the bonding strength of orthodontic brackets, according to existent studies.

Author	Type of tooth	Bleaching agent	Test	Resistance
Matta, Maia, Chevitarese ¹¹	Bovine	10% carbamide peroxide	Shear	Increase
Prietsch et al ¹⁴	Bovine	35% hydrogen peroxide	Shear	Decrease
Uysal et al ²¹	Humans	35% hydrogen peroxide	Shear	No alteration
Dishman et al ⁶	Humans	25% hydrogen peroxide	-	Decrease
Quintella ¹⁶	Humans	35% hydrogen peroxide	Shear	Decrease
Miles et al ¹²	Humans	10% carbamide peroxide	Traction	Decrease
Homewood, Tyes, Woods ⁷	Humans	Hydrogen peroxide	Shear	No alteration
Van der Vyver et al ²²	-	Hydrogen peroxide	-	Decrease
Bishara et al ²	Humans	10% carbamide peroxide and 25% hydrogen peroxide	Traction	No alteration
Bello, Souza ¹	Humans	10% carbamide peroxide	Traction	Increase
Kraether, Souza ⁸	Humans	10% carbamide peroxide	Traction	Increase

DISCUSSION

According to the literature on the influence of bleaching agents on the bonding strength of orthodontic brackets, there is still some doubt if these substances interfere negatively on bonding strength or not, since in some works there is a reduction on the adhesion, in others there is an increase and yet in some others there is no alteration (Table 3). A careful observation of these studies allows to number a series of variables that can explain the great variation in the results, such as: Type of bleaching agent, bleaching technique, type of enamel (human or bovine) and type of debonding tests (traction or shear).

The values obtained from the present study indicate a decrease on the bond strength of orthodontic brackets immediately after bleaching. These results were confirmed by others works,^{6,12,14,16,22} which also obtained a reduction on the bond strength depending on the waiting period post-bleaching. However, some authors^{1,8,11} presented different results and obtained an increase on the bond strength. The results found by Homewood et al,⁷ Uysal et al²¹ and Bishara et al² showed no alteration on adhesion.

The reduction of bond strength can be explained by a significant decrease on the calcium/phosphorus relation on the enamel bleached with hydrogen peroxide, affect-

ing adversely the dental hard tissues.¹⁷ Another reason for this decrease on the adhesion can be the fast decomposition of the residual bleaching agent, releasing oxygen into the porosities on the tooth surface. This oxygen has the capacity to inhibit the polymerization of the resinous material used in the procedures of bracket bonding, compromising the conversion degree of monomer to polymer and consequently, the union of the material with the enamel structure.

Therefore, the results of the present study suggest a waiting period of about seven days after bleaching to bond any accessory on the enamel surface, in order to minimize possible adverse effects of bleaching to adhesion.

CONCLUSION

From the results obtained in this *in vitro* study, it can be concluded that the dental bleaching with a 35% hydrogen peroxide, reduced significantly the bond strength of orthodontic brackets when bonding was performed 24 hours post-bleaching. However, after seven days from bleaching, differences were not noticed on bond strength, being recommended a longer waiting period when bonding of any accessory on the enamel surface submitted to bleaching agents is necessary.

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