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Effect of the In-Office Bleaching on the Shear Bond Strength of Orthodontic Brackets.

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الخلاصة

اهداف البحث: تهدف الدراسة المختبرية إلى تَقييم تأثير (ألقصر ألحي لطبقة ألميناء باستخدام بيروكسيد ألهيدروجين بتركيز ٣٥٪ و الغمس بمحلول أللعاب الصناعي بين ألقصر وعملية ألتثبيت) على قوة القصّ للحواصر التقويمية المصنوعة من مادة (التيتانيوم) والمثبتة (بألراتنج ألتقويمي). **المواد و طرائق البحث:** صنفت عينات ألدراسة الى ثلاث مجاميع رئيسة : ألقصر ، الغمس، فضلا عن مجموعة الضبط ، كل مجموعة تكونت من عشرة أسنان بشرية (ألضاحك ألعلوي ألأيمن ألأول) والمثبت عليها الحاصرة ألتقويمية (مادة ألتيتانيوم، نوع ROTH،(وبحجم ٠.٠١٨ انج). في مجموعة القصر تم تثبيت الحواصر مباشرة بعد القصر ، اما في مجموعة الغمس فقد تم تثبيت الحواصر بعد مدة شهر من القصر حيث غمست العينات في محلول اللعاب الصناعي ، وأخيرا ففي مجموعة الضبط فقد تم تثبيت الحواصر بدون القصر.هذا وقد قيست قوّة القصّ باستخدام جهاز(Unconfined Shear Testing Machine). **النتائج:** أظهرت نتائج ألدراسة أنّ مجموعة ألقصر قد حازت على قوة ألقص ألأقل ، بينما حازت مجموعة الضبط على القيمة ألأعلى ، وقد وجد ان لافرق معنوي بين مجموعة الغمس و مجموعة الضبط عند مستوى معنوية ($p \leq 0.05$). **الاستنتاج:** لقد أستنتج من هذة الدراسة أنّ ألقصر ببيروكسيد ألهيدروجين بتركيز ٣٥٪ قد قلل بصورة معنوية من قوة القص للحاصرات ألتقويمية . كذلك استنتجت ألدراسة أن الغمس بمحلول أللعاب الصناعي لمدة شهر كان قادرا على تحسين قوة ألقص القليلة.

ABSTRACT

Aims: To evaluate the effect of In-Office enamel vital bleaching with (35% H2O2) and the effect of immersion in artificial saliva following bleaching on the shear bond strength of titanium orthodontic brackets bonded with an orthodontic composite adhesive. **Materials and Methods:** The samples of the study were categorized into three main groups; bleaching, immersion and control group. Each group was consisted of 10 teeth (Human upper right first premolars). Specimens in bleaching group were bonded immediately after bleaching; immersion group specimens were bleached, then immersed in artificial saliva and held for 1 month before bonding. All specimens were bonded with titanium orthodontic brackets (ROTH, slot size 0.018 inch). The shear bond strength was measured by using the unconfined shear testing machine. **Results**: Bleaching group had the lowest shear bond strength whereas the control group had the highest one. No significant differences were noted between the immersion and control group (at $p \leq 0.05$). **Conclusions**: In-Office enamel bleaching was significantly reduced the shear bond strength of orthodontic brackets. Immersion in artificial saliva (following bleaching) was able to improve the reduced shear bond strength.

Key words: : bleaching, bracket, bonding, shear bond.

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INTRODUUCTION

Discoloration of anterior teeth is an esthetic problem which requires effective treatment. Currently, many treatment modalities are available such as whitening toothpastes, professional cleaning by scaling and polishing, internal bleaching of non-vital teeth, external bleaching of vital teeth, micro abrasion of enamel, crowns and veneers. [1, 2] Bleaching is the simplest, most common, least expensive means for eliminating stains since there is no need to prepare the teeth so that the enamel and dentin structures remain largely untouched. [3,4]

There are three techniques of bleaching: In-Office, at Home, and Over-the-Counter. In-office use high concentrations of carbamide peroxide (35-37%) and hydrogen peroxide (30-35%), while 20%

carbamide peroxide and 10% hydrogen peroxide are used for at-home bleaching. Over-the-counter products are available to consumers as strips, wraps, and paints-on containing hydrogen peroxide. [5]

Because some adults seeking for orthodontic treatment might also want bleaching, it is important to determine whether bleaching significantly affects the bond strength of orthodontic bracket adhesives to the enamel surface. [6]

MATERIALS AND METHODS

Thirty recently extracted Human upper right first premolars were collected according to selection criteria's which include intact buccal

surface with no caries, cracks, restorations or fissures. No history of any pretreatment with chemical agents like alcohol or H2O2. [7,8] The teeth were stored in a distilled water at room temperature [9] which changed weekly to avoid bacterial growth. [10] The teeth were prepared so; the labial surface would be parallel to the force during the shear bond test. [11] The ring filled with cold cure acrylic resin till the cemento-enamel junction. [12] After the set of resin, the teeth were polished for 10 seconds then rinsed for 10 seconds. [13]The teeth were randomly divided into three groups. In the control group the specimens were bonded without bleaching. In bleaching group, the Specimens were subjected to three applications of bleaching agent. Each application extended for 20 minutes. The (35% H2O2) gel was applied on the buccal surface in a layer of 1 mm thickness and activated for 10 seconds in every 2.5 minutes by using Blue Led Light with intensity of (600 mW/cm2). [14] At the end of bleaching, the teeth were copiously rinsed for 1 minute to remove the bleaching gel. [15] In immersion group, after bleaching, the Specimens were immersed in artificial solution and stored in the incubator at 37 0C. [15] The formula of preparation of artificial saliva was include: (0.4) gm NaCL, (1.21)gm KCL, (0.78)gm NaH2PO4.H2O, (0.005)gm Na2S.9H2O, (l)gm urea [CO(NH2)2] and (1000) ml distilled and deionized water. [16]

The bonding procedure was done by using a 37% phosphoric acid liquid to etch the enamel surface for 60 seconds. [17] The buccal surface was rinsed with water for 10 seconds and dried until a chalky appearance was observed. [18] The bracket was transferred to the center of the buccal surface under a load of (200)gm. The excess composite resin was removed by dental explorer before curing with halogen light curing machine with (400-500 nm) wave length and (400 mW/cm2) intensity.[19] The curing light was applied for 20 seconds on the occlusal, gingival, mesial and distal aspects respectively. The shear bond strength (SBS) was measured by using the Unconfined Shear Testing Machine. The force was applied to the bond interface in an occluso-gingival direction [20,21] at a crosshead speed of 5mm/min. [22] The shear bond strength was calculated and expressed in (MPa) According to the following equation. [23]

$$\text{Shear Bond Strength(Mpa)} = \frac{\text{Force in Newton's unit}}{\text{Surface area of bracket in mm2}}$$

RESULTS

The Descriptive analyses of the SBS (Mpa) for the 3 groups are listed in Table (1). The findings showed that control group (CG) gave rise to the highest mean while the bleaching group (BG) gave rise to the lowest one. The student t-test was used to compare the SBS values between the (CG) and (BG) groups and it showed significant difference at ($p \leq 0.05$) as in Table (2).

Table (1): Descriptive Analysis of (SBS)* in (Mpa)

No.	Group	N	Min.	Max.	Mean	SE	SD
1	**Control**	10	16.00	19.00	17.7500	.3594	1.1365
2	**Bleaching**	10	6.5	9.00	7.8500	.2693	.8515
5	**Immersion**	10	14.50	18.50	16.8500	.3804	1.2030

SBS; shear bond strength, MPa; megapascal.

Table (2):Student t-test for SBS of control and bleaching Groups

Group	Mean Difference	SD	SE	95% Confidence		Sig.
				Lower	Upper	
CG----BG	9.9000	1.8900	.5977	8.5480	11.2520	< .001

SD; standard deviation, SE; standard error, Sig.; significant

The analysis of variance (ANOVA) was used to compare the SBS values for the BG, CG and BMWG groups. This test showed significant difference at ($p \leq 0.05$) as in Table (3).

Table (3): ANOVA test for SBS of (BG, BMWG, and CG) Groups

	Sum of Squares	df.	Mean Square	F	Sig.
Between Groups	606.533	4	151.633	86.716	< .001
Within Groups	78.688	45	1.749		
Total	685.220	49			

The results of Duncan multiple range tests revealed that the control group (CG) had the highest mean of SBS value followed by immersion group (BMWG). However, (BG) group had the lowest mean of SBS value with significant difference from other groups as shown in Table (4).

Table (4): Duncan`s test for SBS of (BG, BMWG, and CG) Groups

Group	N	Mean $\pm$ SE	Duncan groups*
CG	10	17.7500 $\pm$ 0.35	**C**
BMWG	10	16.8500 $\pm$ 0.38	**C**
BG	10	7.8500 $\pm$ 0.26	**A**

***** Different letters mean significant difference at $p \leq 0.05$

DISCUSSION

The present study showed that the In-Office bleaching was significantly reduced the SBS of orthodontic brackets. These results reflect the effects of bleaching on the enamel surface morphology which include big areas of enamel destruction, surface porosity, etching like appearance which related to the removal of organic matrix of enamel and surface minerals. [24] Bleaching causes reduction in enamel microhardness due to loss of mineral from the enamel after bleaching. It had been found by using a SEM that after bleaching, the concentrations of (Ca) and (P) of enamel was lowered; in addition the (Ca:P) ratio was lowered and there was some (Ca) and (P) in the bleaching gel after use. [25] Another reason might be the lower pH value of most of H2O2 bleaching products which potentiates the erosion of the enamel surface and produces the observed surface softening. This lower pH is necessary to maintain long-term stability of H_2O_2 bleaching products. [26, 27]

This lower pH can potentiate the enamel demineralization, erosion and surface softening. The concentration of the bleaching agent used might also affect the bonding. In this study a concentration of 35% of H2O2 was used. The higher the concentration the more effect on the enamel microhardness. (28)

In addition, the bleaching agents release free radicals as the nascent oxygen and hydroxyl or peri-hydroxyl ions when they are applied to the dental structure. This property could be deleterious to the bonding of resinous materials by interfering with the polymerization process of the adhesive materials especially if we remember the fact that the bleached enamel is more porous and therefore, has more water containing oxygen. (29-31)

The results of the study also showed that the immersion of teeth in the artificial saliva after bleaching and before bonding resulted in significant improvement in the SBS values. This improvement action of saliva could be attributed to ability of saliva to neutralize any possible adverse effect of residual H2O2 during the storage period. (8) In addition to buffering and remineralization actions (calcium, phosphor and fluorides). (32)

CONCLUSIONS

It is concluded that the in-Office enamel bleaching with 35% H2O2 was significantly reduced the shear bond strength of orthodontic brackets if the bonding performed immediately after bleaching.

It also found in this study that Delaying bonding for one month after bleaching and before bonding, significantly improved the reduced shear bond strength. It is better to delay enamel bleaching until the termination of orthodontic treatment with fixed appliance.

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