Original Article

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A. Jamilian,
M. Ali Saghiri,
M. Ghasemi,
A. Ghasemian,
N, Borna,
Z. Kamali.

Author affiliations:

Contributors:

Abdolreza Jamilian, Department of Orthodontics, Islamic Azad University, Fellow of orthognathic surgery, Tehran, Iran.

Mohammad Ali Saghiri, Department of Dental Materials, Faculty of Dentistry, Islamic Azad University, Tehran, Iran.

Mahmood Ghasemi, Department of Periodontics, Islamic Azad University, Tehran, Iran.

Anooshe Ghasemian, Department of Orthodontics, Islamic Azad University, Tehran, Iran.

Neda Borna, Department of Orthodontics, Islamic Azad University, Tehran, Iran.

Zinat Kamali, Shahid Beheshti University, Tehran, Iran.

Corresponding address:

Prof. Abdolreza Jamilian
No = 2713, Valiasr st
Tehran 1966843133
Tel: 00982122011892
Fax: 00982122022215
Email: info@jamilian.net

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The effects of two mouth rinses on shear bond strength of orthodontic brackets - An In-vitro study

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The effects of two mouth rinses on shear bond strength of orthodontic brackets - An In-vitro study

Abstract:

Aims: The purpose of this study was to evaluate the effects of two commercial mouth washes and artificial saliva on the shear bond strength (SBS) of metallic orthodontic brackets bonded to teeth.
Methods and subjects: To this aim, 45 human premolars were divided into three equal groups. The samples of all three groups were stored in artificial saliva for two weeks. Group II and III samples were rinsed in Orthokin® and Oral B® mouth rinses for 60 seconds per day. SBS and adhesive remnant index (ARI) of all three groups were evaluated and compared with each other. In order to assess SBS the brackets were debonded using a shear-peel load on a universal testing machine (Instron Corporation, Canton, MA, USA) at a crosshead speed of 1 mm/min. The load was recorded at bond failure and used to calculate the bond strength.
Results: Artificial saliva was found to have the highest SBS for 15.27±0.58 MPa, followed by Oral B® group for 10.11±0.94 MPa. Orthokin® group had the lowest SBS for 7.59±0.59. One-way ANOVA showed that these differences were statistically significant.
Conclusion: Chemical ingredients of three groups might be the reason of SBS differences.

Key words: Shear Bond Strength, Mouthwash, Adhesive remnant index, Orthodontics brackets, Orthodontics.

Introduction

The success of fixed appliance therapy in orthodontics vastly depends on bonding strength of orthodontic brackets to the tooth enamel. This significant problem of bond failure during treatment has been reported to vary between 0.5 and 16 percent [1-2]. A number of possible causes have been mentioned, including poor operator technique, saliva contamination[3], variation in the enamel surface[4], masticatory forces[1], and even some food stimulants and soft drinks[5]. In a recent study it has been found that there is a direct relationship between the initial pH of some drinks and the shear bond strength (SBS) of the orthodontic brackets after exposure to the drinks [5-6].

Nowadays, application of mouth wash is growing for hygienic purposes, especially in orthodontic patients. The number of commercial mouth washes is increasing by passage of time. These products chiefly vary in their alcohol levels and pH. It has been reported that the alcohol content in mouthwashes can soften composite resin [7-8].

The purpose of this study was to evaluate the in vitro effects of two commercial mouth rinses named Orthokin® and Oral-B® on shear bond strength and its comparison with a control group for the first time in literature.

Materials and Methods:

Forty Five human premolar teeth which were extracted for orthodontics purposes were collected and stored in physiological saline solution. The patients were informed of the research and required consent forms were obtained. Teeth with hypoplastic areas, decalcifications, caries, cracks, or gross irregularities of the enamel structure were excluded from this study. The tissue remnants of all the teeth were removed. All the teeth were stored in a solution of 0.1 % (weight/volume) Thymol for one week.

The buccal surface of each test tooth was cleaned with fluoride-free pumice and rubber cup for 10 seconds. The teeth were then washed using a 3 in 1 (air/water) syringe for 15 seconds, and dried with compressed air for 15 seconds, and etched for 60 seconds on the buccal surface using 37 per cent phosphoric acid. The buccal surface was then washed for a further 60 seconds using water syringe, and dried with oil-free compressed air.

The teeth were bonded with No-Mix Bonding system, Advantage™ Paste (ORTHO ORGANIZERS, CA 92069 - 5198, U.S.A.). A thin uniform layer of sealant was applied on the etched enamel by a microbrush. A thin coat of sealant was also painted on the metal base of Standard edgewise

0.018, stainless steel brackets (Dentaurum, REF 713-018-50, ULTRATRUMM, Germany) before applying the paste. The paste was applied to the bracket base using a syringe tip, and the brackets were positioned on the tooth with the help of a force gauge, in order to eliminate the unexpected differences in bond strength. The brackets were all placed in the middle of the buccal surface of the tooth. Excess adhesive was removed with a sharp scaler.

The teeth were randomly distributed into two experimental groups and one control group, each containing 15 teeth.

Group I: Control group- The samples were stored in artificial saliva for two weeks.

Group II: Orthokin® group- The samples were rinsed twice per day in Orthokin® (Kin Laboratories, Kin, S.A.) for 60 seconds and rinsed with water for 10 seconds. The rest of the time the samples were kept in artificial saliva. This process lasted two weeks.

Group III: Oral-B® group- The samples were rinsed twice per day in Oral-B® (Boots, England) for 60 seconds and rinsed with water for 10 seconds. The rest of the time the samples were kept in artificial saliva. This process lasted two weeks.

The physiologic solution used in this study was prepared with inorganic ion concentrations similar to saliva[9]. The solution consisted of 0.400 g NaCl, 0.690 g NaH2PO4_H2O, 0.400 g KCl, 0.005 g Na2S_9H2O, 0.795 g CaCl2_H2O, 0.300 g KSCN, and 1.000 g urea dissolved in 1,000 mL distilled H2O.

The artificial saliva was exchanged every 24 hours in all three groups. After two weeks, all teeth were mounted vertically in acrylic blocks. The specimens were then stored in distilled water at 37°C for 24 hours before

bond strength testing. The brackets were debonded using a shear-peel load on a universal testing machine (Instron Corporation, Canton, MA, USA) at a crosshead speed of 1 mm/min. The load was recorded at bond failure and used to calculate the bond strength. The values of failure loads (N) were recorded and converted into megapascals (MPa) by dividing the failure load (N) by the surface area of the bracket base. The bracket base surface area was measured with a digital caliper (Mitutoyo, Japan) as 11 mm^2. The location of adhesive failure was determined under 20× magnification by a reflective microscope (Olympus FloView, Melville, NY, USA). The images were analyzed by the image processing, measurement and analysis software of ImagingPlanet-Rincon™. Any adhesive remaining after debonding was assessed and scored according to the modified adhesive remnant index (ARI) [10]. The scoring criteria of the index are as followings:

1 = All of the composite, with an impression of the bracket base remained on the tooth

2 = More than 90% of the composite remained on the tooth

3 = More than 10% but less than 90% of the composite remained on the tooth

4 = Less than 10% of composite remained on the tooth

5 = No composite remained on the tooth

One way ANOVA was used for evaluation of the differences among the three groups. Moreover, LSD test was used for comparison between any two groups. ARI scores were analyzed statistically by Chi-square test (χ^2). Statistical software of SPSS, Version 16 was used in order to examine the data.

Results:

The results showed that SBS was the highest in artificial saliva 15.27±0.58 (mean ± SD) MPa, and the lowest in Orthokin® group 7.59±0.59 MPa. The SBS of Oral-B® group was 10.11±0.94 MPa. One-way ANOVA showed that there are statistically significant differences between the three groups. (P≤0.001) LSD test also showed that there is a statistically significant difference between each two groups. (P≤0.05) (Table 1)

Table 1: Mean shear bond strength value in three different groups.

Group	Shear Bond Strength Mean ±SD (MPa)*	Confidence interval 95%	P Value
Artificial Saliva	15.27± 0.58[a]	14.9-15.6	0.001
Orthokin ®	7.59 ± 0.59[b]	7.2-7.9	0.001
Oral B®	10.11±0.94[c]	9.5-10.7	0.001

*MPa= Megapascals

Superscript letters a, b, and c show significant difference based on LSD test at p≤ 0.05

Table 2: ARI in three different groups

Groups	ARI=1	ARI=2	ARI=3	ARI=4	ARI=5	Number
Artificial Saliva	-	1	14	-	-	15
Orthokin ®	-	12	3	-	-	15
Oral B ®	-	-	15	-	-	15

Table 2: ARI in three different groups

$\chi^2 = 25.1$, P value ≤ 0.001

The amounts of residual adhesive on the enamel surfaces as evaluated by the ARI scores are given in Table 2. χ^2 showed that there were statistically significant differences present among the various groups ($P \leq 0.0001$). In artificial saliva and Oral B® groups, there was a higher frequency of ARI score of 3; while, the ARI score was 2 in Orthokin® group. Significance level was predetermined at the $p \leq 0.05$.

Discussion:

This study showed that SBS was the highest in control group and both Orthokin® and Oral-B® groups were lower than that. One possible reason for the significant difference

between artificial saliva and the other two groups might be due to the ingredients of chemical solutions which are not present in artificial saliva.

The ARI score of Oral-B® group was found to be 3. And the ARI score of Orthokin® group was 2. In artificial Saliva group the ARI was found to be 3.

It has previously been reported by Wu and McKinney[11] that alcoholic food simulants have a softening effect upon the surface micro-hardness of dental composites. Lee *et al.*[12] examined the effect of 75% ethanol on shear bond strength of a number of dentine bonding composites. They found that shear bond strength was reduced by between 30 and 50 percent in comparison with specimens stored in water. Lee *et al*.[13] proposed that the effect was caused by the diffusion of ethanol into the composite, which resulted in micro-cracking. Weiner *et al.*[8] found that composites soaked in mouthwashes containing alcohol gained significantly more weight than the ones soaked in nonalcoholic mouthwashes. The results of another study indicated that the alcohol content in mouthwashes can reduce composite hardness[7].

Human saliva is a complex fluid secreted by the major and minor salivary glands and the secretion is under the control of the autonomic nervous system. The three major salivary Glands are parotid, sublingual and submandibular. Daily secretion of saliva in human is about 1.5 liters and its normal pH is slightly alkaline (7.4). Saliva contains organic and inorganic substances suspended in an aqueous medium. Besides glycoproteins, like mucin, it contains digestive enzymes like lipase, amylase etc. It also contains other compounds such as lactoferrins, cystatin, histatin, thiocyanate ion and immunoglobulins.

Two week interventions were chosen in this study because periodontists suggest the

usage of mouthwash for approximately two weeks.

Conclusions:

Although this experiment could not completely replicate the complex oral environment, it seems to confirm the chemical ingredients of mouth rinses can affect the SBS. The artificial saliva had the highest SBS in comparison with two other groups.

Orthokin® was found to have lower amount of SBS in comparison with Oral B® group.

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