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Evaluation of shear bond strength of orthodontic brackets bonded on the tooth surface after internal bleaching

Avaliação da resistência ao cisalhamento de briquettes ortodônticos colados na superfície dentária após clareamento interno

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Resumo

Introdução: O apelo estético de pacientes que possuem dentes escurecidos é grande, pois atualmente os padrões estéticos se tornaram rigorosos e muitos pacientes antes ou durante o tratamento ortodôntico, realizam o procedimento de clareamento dental. **Objetivo**: Avaliar a adesão de braquetes ortodônticos em molares humanos que receberam clareamento interno. **Material e método**: Quarenta coroas de molares humanos foram divididas em quatro grupos, de acordo com o agente clareador utilizado: SP) perborato de sódio + água; SP) peróxido de carbamida; CP+SP) peróxido de carbamida + perborato de sódio; Cont) água (grupo controle). Os agentes clareadores colocados no interior das câmaras pulpares foram substituídos a cada 7 dias por 2 semanas, e a colagem dos braquetes foi efetuada após 30 dias do final do clareamento. O teste de resistência ao cisalhamento foi realizado em máquina de ensaios universal (Emic). **Resultado**: O teste estatístico ANOVA com nível de significância de 5% ($p > 0,05$), mostrou que não houve diferença estatística significante entre os grupos ($p = 0,1214$). **Conclusão**: Concluiu-se que os diferentes agentes clareadores estudados não interferem na resistência de adesão dos braquetes ao esmalte dentário e a colagem dos braquetes 30 dias após o clareamento interno é um procedimento seguro.

Descritores: Clareamento dental; esmalte dentário; resistência ao cisalhamento; braquetes ortodônticos.

Abstract

Introduction: There is great demand for esthetic treatment by patients who have discolored teeth, because currently aesthetic standards have become stricter and many patients have tooth bleaching procedures performed before or during orthodontic treatment. **Objective**: To evaluate the bonding of orthodontic brackets to human molars after internal tooth bleaching. **Material and method**: Forty molars were divided into four groups according to the bleaching agent used: PS) sodium perborate + water; PC) carbamide peroxide; PC + PS) carbamide peroxide + sodium perborate; Cont) water (control group). Bleaching agents placed inside the pulp chambers were replaced every 7 days for 2 weeks, and the brackets were bonded 30 days after the end of bleaching. The shear strength test was performed in a universal testing machine (Emic). **Result**: ANOVA with a significance level of 5% ($p > 0.05$), showed no statistically significant difference between groups ($p = 0.1214$). **Conclusion**: It was concluded that the different bleaching agents studied did not interfere with the bond strength of brackets to enamel and bonding the brackets 30 days after internal bleaching is a safe procedure.

Descriptors: Tooth bleaching; dental enamel; shear strength; orthodontic brackets.

INTRODUCTION

Bleaching darkened teeth may avoid invasive treatments, such as prosthetic procedures that require the wear of a large quantity of dental tissue when they are performed, so that bleaching is considered a more conservative alternative, which significantly changes the appearance of the teeth and increases the patient's self esteem[1,2]. Especially in patients who will be submitted to orthodontic treatment, the prosthetic procedure should be avoided or delayed until after tooth movement has been performed. Thus, bleaching is a frequently used procedure in these cases.

The bleaching agents most used for internal tooth bleaching are carbamide and hydrogen peroxide, and sodium perborate[3-6]. Bleaching agents promote changes in the chemical composition of the tooth[7] and may promote failures in the bond to dent and enamel[6,8]. It has been suggested that the quality of the resin composite bond to dentin may be harmed when restorations are performed immediately after bleaching treatment[9,10].

Similarly, bleaching may influence the bond strength of brackets[1,11,12]. However, no studies were found, which evaluate the effects of different bleaching agents on the bond strength of

brackets when internal bleaching is performed in patients who will be submitted to orthodontic treatment.

Therefore, the aim of this study was to determine the shear bond strength of orthodontic brackets bonded to the dentin surface of molars, 30 days after internal bleaching performed with different bleaching agents.

The hypothesis of this study was that bleaching agents would diminish the bond strength of brackets.

MATERIAL AND METHOD

Forty molars recently extracted at the Surgery Clinic of the Dental School of São José dos Campos were selected. After collection, the teeth were submitted to manual scaling with a periodontal curette, to remove organic residues. The roots were sectioned in the horizontal direction using a double faced diamond coated disc (KG Sorensen, Barueri, São Paulo, Brazil) at low speed, at 2 mm from the amelocement junction. Coronal openings were performed on the occlusal surface with spherical diamond-coated bur number 1012 (KG Sorensen, Brazil) and the remaining pulp tissue from the pulp chamber was completely removed with a Hedströen (Dentisply Maillefer – Ballaigues – Switzerland) type file, followed by irrigation with saline physiological solution. A 2mm thick buffer was made with glass ionomer cement (Vidrion F – SS White) sealing the entrance of the canal, and this buffer was placed right below the amelocement junction and the apical extremity was externally isolated with light polymerized resin composite (TPH – Dentsply – USA).

The teeth were divided into three experimental groups according to the bleaching agent used, and a control group, each containing 10 specimens.

- Group PS: Teeth bleached with sodium perborate (Farmácia Byofórmula – São José dos Campos – SP) + water;
- Group PC: Teeth bleached with 16% carbamide peroxide gel(Opalescence Endo, Ultradent – South Jordan – Utah – USA);
- Group PC+PS Teeth bleached with 16% carbamide peroxide gel (Opalescence Endo, Ultradent – South Jordan – Utah – USA) + sodium perborate (Farmácia Byofórmula – São José dos Campos – SP, Brazil);
- Control Group (n=10): deionized water.

After preparation of the tooth crowns, the bleaching agents were applied, filling the pulp chamber and the bleaching agent was protected with cotton wool. After this the access cavities were sealed with glass ionomer cement (Vidrion R – SS White) and the teeth were kept immersed in artificial saliva[13] in an oven at 37°C.

After 7 days, the glass ionomer seal was removed, and the cavity was irrigated with deionized water in order to change the bleaching agents, which would remain in the pulp chambers for another 7 days. At the end of the period of 14 days of bleaching, neutralization was performed with calcium hydroxide P.A. for another 7 days.

After 30 days from the end of bleaching, the orthodontic brackets were bonded on the vestibular surface of the specimens. With the aid of a laboratory silicone mold (Silibor) the specimens were embedded in colorless acrylic resin (Jet, Artigos Odontológicos Clássico, São Paulo, SP, Brazil) maintaining the vestibular surface positioned on the bottom of the base. The acrylic resin of the test specimens was polished in a polishing machine with 200, 400 and 600 grit water abrasive papers (3M Brasil). Thus the test specimens attained appropriate dimensions to allow them to be fixed to the appliance to perform the shear test.

Forty brackets (Morelli, SP - Brazil) with a base area of 17.64 mm^2 were used in all the groups. For bracket bonding, prophylaxis of the specimens was performed . After this, they were acid etched with 37% phosphoric acid (Alpha Etch gel - DFL). Next, the primer of the Transbond XT kit (3M Unitek) was applied to the vestibular surface and light polymerized for 20 seconds. After this the brackets were bonded with Transbond XT (3M Unitek). The resin excesses were removed with an exploratory probe and the resin was light polymerized for 40 seconds.

The shear bond test was performed in a Universal Test Machine EMIC DL2000 (EMIC Equipamentos e Sistemas de Ensaio Ltda., Paraná – Brazil), with a 50 kg load cell, at a speed of 1.0 mm/min.

The specimens were individually fixed on a metal base and the specimen/metal base set was placed on the bottom portion of the test machine base with the object of avoiding any movement. On the top mobile portion of the machine, a metal tip with the shape of a beveled knife blade was fixed, which fell on the interface of the bracket and tooth enamel surface.

The load necessary to debond or initiate fracture of the test specimen was recorded in kilograms of force per square millimeter (Kgf/mm^2), by means of a computer connected to the EMIC universal test machine, in a program managed by Windows 2002, and the value obtained on the surface at the base of the bracket was converted into MPa.

After the shear test, all the teeth and brackets were examined at 10X magnification. Any remaining resin after removal of the bracket was evaluated and scored according the ARI[8] scale that has the following scores: 5 – indicates that no resin remained on the enamel; 4 – less than 10% of the resin remained on the specimen; 3 – more than 10% but less than 90% of the resin remained on the specimen; 2 – more than 90% of the resin remained on the enamel and 1 – all the resin remained on the enamel, with the impression of the bracket bases.

The results were submitted to descriptive statistical analysis. The means and standard deviations were obtained, and the one-way ANOVA test was performed.

RESULT

Table 1 shows the descriptive statistics for the shear bond strength values of the different groups.

After the Kruskall-Wallis statistical test with a level of significance of 5%, it could be observed that there was no statistically significant difference among the groups (p=0.3102).

The frequency of distribution of the scores is listed in Table 2. It may be observed that the larger portion of the specimens presented scores between 1 and 3, indicating that greater adhesive failure between the bracket and resin occurred.

Table 1. Descriptive statistics for the shear bond strength values (in MPa) of the different groups

Groups	Mean	Standard Deviation	Minimum	Maximum
SP	30.12	8.93	11.57	48.94
CP	39.95	14.56	17.36	60.15
CP+SP	37.65	14.06	13.14	64.92
CONTROL	33.84	21.72	11.87	73.35

Table 2. Frequency of distribution of scores (%)

Groups	Scores				
	1 (All the resin on the enamel)	**2 (Over 90% of the resin on the enamel)**	**3 (over 10% but less than 90% of the resin on the enamel)**	**4 (Less than 10% of the resin on the enamel)**	**5 (no resin on the enamel**
SP	9 (90%)	1 (10%)	0 (0%)	0 (0%)	0 (0%)
CP	5 (50%)	1 (10%)	4 (40%)	0 (0%)	0 (0%)
CP + SP	5 (50%)	3 (30%)	1 (10%)	0 (0%)	1 (10%)
Control	2 (20%)	3 (30%)	4 (40%)	1 (10%)	0 (0%)

DISCUSSION

Alterations in the bond strength are of significant importance with respect to clinical procedures that involve the bond of resin composites, bracket bonding, and porcelain veneers, among others[3,4]

Previous studies have shown that there is a change in the structure of enamel, in its composition and bond strength when it is exposed to bleaching agents[14-16]. The bleaching procedure may reduce the microhardness of dentin and enamel[17], weaken the mechanical properties of the tooth[18], and reduce the bond strength of brackets to the tooth surface[2], suggesting that bracket bonding should be performed 2 to 3 weeks after bleaching.

Turkkahraman et al.[5], verified that alterations occur in enamel, caused by the bleaching agent, even with the use of a desensitizing agent[19], significantly affecting the shear bond strength of orthodontic brackets to human tooth enamel.

However, Mishima et al.[20] revealed that the bleaching agent altered the enamel surface, however, did not interfere in the shear bond strength. Uysal et al.[1] showed that in office bleaching with hydrogen peroxide did not affect the bond strength of brackets bonded immediately after bleaching, or 30 days later. Uysal, Sisman[3] showed that the use of carbamide peroxide immediately before bracket bonding significantly reduced the shear bond strength values, irrespective of the period of bonding, whether immediately or 30 days after bleaching. However, in the present study, it was verified that bracket bonding 30 days after bleaching was not affected, indeed some bond strength values were higher.

Furthermore, in the present study the specimens were kept in artificial saliva during the experiment. The immersion of specimens in distilled water, artificial saliva or even saline solution enables the reversal of the bond capacity of enamel[4,14,21-24]. Probably, the fact of the groups with bleaching agents obtained the best results, irrespective of the time of bleaching agent used, was due to the fact that the immersion of the specimens in artificial saliva removed the residual oxygen from the bleaching material, leading to the dental structure regaining its bond properties to the level it had before bleaching[25].

One observes that studies are still somewhat divergent about the interference of bleaching agents in bond strength. A common point observed is the consensus that favorable results are not observed when bracket bonding is performed immediately after bleaching, recommending a waiting time of 30 days after the procedure.

CONCLUSION

It was concluded that the different bleaching agents studied did not interfere in the bond strength of brackets bonded to enamel 30 days after bleaching.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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