ORIGINAL ARTICLE

Can intracoronally bleached teeth be bonded safely?

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Introduction: Our objective was to determine the effects of intracoronal bleaching on the shear bond strength and failure side location of metallic brackets at 2 times (bleaching immediately before bonding and 30 days before bonding). **Methods:** Sixty freshly extracted mandibular incisors were randomly divided into 3 groups; each group contained 20 teeth. After finishing canal preparation and root canal filling, the root fillings were removed to a level 2 mm apical to the cementoenamel junction. Glass ionomer base (Vitrabond, 3 M Dental Products, St Paul, Minn) was placed approximately 2-mm thick. Bleaching agent (Whiteness Perfect, FGM Dental Products, Joinville, Brazil) was placed into the rest of the cavity for 4 days at 2 times. Shear bond strength of these brackets was measured in megapascals. The adhesive remnant index (ARI) scores were determined after the brackets failed. Data were analyzed with analysis of variance (ANOVA), Tukey, and chi-square tests. **Results:** The bond strengths of the group with no bleaching (mean, 20.25 ± 7.06 MPa) were significantly higher ($P > 0.001$) than those of the group that had bleaching immediately before bonding (mean, 4.85 ± 3.22 MPa) and the group that had bleaching 30 days before bonding (mean, 8.70 ± 4.93 MPa). The results of the chi-square comparisons indicated significant differences among the 3 groups. In the group with no bleaching, there was a higher frequency of ARI scores of 2 to 4, indicating cohesive failures in the resin. In the other 2 groups, the failures were mostly adhesive at the resin-enamel interface (ARI scores of 4 and 5). **Conclusions:** Intracoronal bleaching with carbamide peroxide adversely affected the shear bond strength and changed the site of failure during debonding when bonding was done immediately or 30 days after bleaching. (Am J Orthod Dentofacial Orthop 2009;136:689-94)

Discolored teeth, especially in the anterior region, can cause considerable cosmetic impairment. When the pulp is injured, blood extravasations from ruptured vessels can invade the pulp chamber, and erythrocytes can penetrate the dentinal tubules. The erythrocytes undergo hemolysis and liberate hemoglobin; this releases iron.[1] The iron is combined with hydrogen sulfide to form iron sulfide, a black compound that gives teeth the dark discoloration.[2]

In addition to invasive therapies, such as crowning or veneers, whitening of teeth is an alternative therapeutic method. The discoloration of teeth with nonvital pulp requires an effective treatment with chemical bleaching agents.[3] This chemical bleaching can be achieved with both extracoronal and intracoronal bleaching techniques.

Based on clinical experience and research, extracoronal tooth bleaching is considered safe and effective, and the most conservative method of improving the esthetics of discolored teeth.[4,5] However, several studies reported that extracoronal bleaching has some disadvantages, including tooth sensitivity, gingival irritation, and recurrent discoloration after bleaching.[6,7] In addition, alterations in enamel surface morphology and reductions in bond strength of adhesives after bleaching have been reported.[8-11] These adverse effects are clinically critical when bonding resin composites, porcelain veneers, and orthodontic brackets to bleached enamel surfaces.[12]

Previous studies have shown a change in enamel structure, composition, and bond strength when exposed to the bleaching agents used for extracoronal bleaching.[8,13,14] Torneck et al[9] identified a substantial reduction in bond strength to enamel shortly after its exposure to concentrated aqueous solutions of a bleaching agent. In addition, intracoronal (nonvital, devital) bleaching has been found to reduce the microhardness of dentin and enamel[15] and weaken the mechanical properties of the tooth structures.[16] Perinka et al[17]

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showed a relationship between the microhardness and calcium concentration and bond strength.

In restorative dentistry, several studies have evaluated the shear bond strength of composite resins on enamel and dentin after intracoronal bleaching, but there is no consensus on its effects on bond strength.[18-21] Some studies showed that the bonding strength of enamel decreases after intracoronal bleaching with carbamide peroxide in various concentrations,[18,20,21] and some concluded that permanent restoration can be accomplished safely immediately after intracoronal bleaching.[19]

In the orthodontic literature, various study designs were used to evaluate the effect of extracoronal (vital) bleaching on the bond strength of orthodontic brackets.[22-27] Cacciafesta et al[26] evaluated the effects of bleaching on the bond strength values of resin-modified glass ionomer cements and found that bleaching before bonding significantly lowered the bond strength of the resin-modified glass ionomer, Fuji Ortho LC. In a recent study, Uysal and Sisman[27] found that the use of a carbamide peroxide bleaching agent immediately before bonding significantly reduced the shear bond strength values of orthodontic self-etching primer systems.

Since some adults who are interested in orthodontic treatment might have also had their endodontically treated teeth bleached or might want bleaching, it seems important to determine whether this procedure would significantly influence the bonding strength of orthodontic bracket adhesives to the enamel surface.

So far, to our knowledge, no studies have investigated the effect of intracoronal bleaching on the bond strength values of metallic brackets.

The purpose of this in-vitro study was to determine the effects of intracoronal bleaching on the shear bond strength and the adhesive remnant index (ARI) scores of metallic brackets at 2 times (bleaching immediately before bonding and 30 days before bonding). The null hypotheses to be tested were that there are no statistically significant differences in (1) bond strength and (2) failure site locations of intracoronal bleached and unbleached teeth at the 2 times.

MATERIAL AND METHODS

Sixty noncarious freshly extracted single-rooted mandibular incisors were used in this study. Teeth with hypoplastic areas, cracks, or gross irregularities of the enamel structure were excluded. The criteria for tooth selection dictated no pretreatment with a chemical agent such as alcohol, formalin, or hydrogen peroxide, or any other form of bleaching. Immediately after extraction, the teeth were scraped of any residual tissue tags and washed under running tap water. The teeth were stored in distilled water, and the water was changed weekly to prevent bacterial growth. The teeth were randomly divided into 3 groups of 20 teeth each. All teeth were mounted vertically in self-cure acrylic so that the crowns were exposed. The buccal surfaces were cleaned and polished with a rubber cup and slurry with pumice and water, followed by rinsing with water spray and drying with compressed air.

Endodontic access cavities were prepared with ISO (International Organisation of Standardization) 12 round diamond bur (Diatech, Coltene Whaledent, Altststten, Switzerland) with a high-speed handpiece under water cooling. The root canals were made by using Protaper nickel-titanium rotary instruments (Dentsply-Maillefer, Ballaigues, Switzerland), and 1 mL of 2.5% sodium hypochloride irrigation was provided between each file. Final irrigation was applied with saline solution, and the root canals were dried with sterile paper points. The canals were filled with an epoxy-resin root canal sealer AH 26 (Dentsply, De Trey, Konstanz, Germany) and gutta-percha (SPI Dental, Inchon, Korea) by using a cold lateral condensation technique. Then the root fillings were removed 2 mm apical to the cementoenamel junction. Light-cured glass ionomer base (Vitrabond, 3M Dental Products, St Paul, Minn) was placed approximately 2 mm thick. All specimens for bracket bonding were prepared with 1 of the following procedures.

Group A (control): the access cavity was rinsed with distilled water and dried, and final composite restoration was finished. A 37% phosphoric acid gel (3M Dental Products) was used for the acid etching of the 20 incisors for 30 seconds The teeth were then rinsed with water from a 3-in-1 syringe for 30 seconds and dried with an oil-free source for 20 seconds.

Group B: intracoronal bleaching was performed according to the manufacturer's instructions. The bleaching agent (16% carbamide peroxide, Whiteness Perfect, FGM Dental Products, Joinville, Brazil) was placed into the rest of the cavity and closed by a temporary filling material (Cavit, AG, D-82229, 3M ESPE, Seefeld, Germany). After 4 days, this procedure was repeated to simulate the clinical conditions when 1 more bleaching sequence is needed. After 4 days, the temporary filling material was removed, and, to neutralize the bleaching agent, calcium hydroxide was placed for 1 more week. Then the access cavity was rinsed with distilled water, and final composite restoration was placed. The bracket bonding area was etched with 37% phosphoric acid gel for 30 seconds.

Group C: this group was treated the same as group B, except that, after bleaching and before etching, the teeth were stored in artificial saliva for 30 days at room temperature. The artificial saliva was changed daily.