Effect of calcium hydroxide dressing on microleakage of composite restorations in endodontically treated teeth subsequent to bleaching

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Abstract
Objective: This study evaluates the effect of calcium hydroxide dressing on microleakage of composite restorations following non-vital bleaching. Methods: A total of 45 sound extracted human maxillary central incisors underwent endodontic treatment. The teeth were randomly divided into three groups (n=15). In group 1, access cavities were restored with composite. In group 2, the teeth underwent a bleaching procedure for one week before being restored with composite. In group 3, following a bleaching procedure, calcium hydroxide paste was placed in the pulp chamber for one week. The teeth were then restored with composite. The specimens were subjected to a dye leakage test. The data was analyzed using Kruskal-Wallis and Mann-Whitney U tests. Results: There were significant differences between the groups (P<0.0005). No statistically significant differences were found between groups 2 and 3, while the differences between other groups were significant. Conclusions: The bleaching agent increased microleakage of composite restorations in non-vital bleaching, whereas microleakage was not found to be increased by calcium hydroxide.

Key words: Calcium hydroxide, composite restorations, laboratory research, microleakage, non-vital bleaching.

Introduction
Intra-coronal bleaching agents have been used successfully to bleach endodontically treated teeth (1,2). Conventionally, 30% hydrogen peroxide alone, or along with heat or in combination with sodium perborate, is used to bleach root canal treated teeth (2,3). Despite the effectiveness of 30% hydrogen peroxide for tooth bleaching, external root resorption is a complication of the material (4,5). Placement of calcium hydroxide [Ca(OH)2] dressing in the pulp chamber is one of the methods to decrease the possibility of external root resorption (1). It increases environmental pH, resulting in a decrease in osteoclastic activity; therefore, the resorptive process is prevented (1,6). Despite various advantages attributed to calcium hydroxide, its role in microleakage of composite restorations has not been fully elucidated and it is believed that its remnants on access cavity walls lead to increased
microleakage of composite restorations (1), which can cause color changes and bacterial penetration (7).

Considering the limited number of studies on the influence of Ca(OH)₂ on microleakage, the aim of the present study was to evaluate the effect of Ca(OH)₂ as a temporary dressing on microleakage of composite restorations subsequent to non-vital bleaching.

Materials and Methods

The specimens consisted of 45 sound extracted human maxillary central incisors. The teeth were stored in 0.5% chloramin T solution. They had been extracted for periodontal reasons and did not have any resorptions, decalcifications and fractures mesiodistally and buccolingually as evidenced by periapical radiographs. Round diamond burs (SS White Burs, Lakewood Inc, USA) were used for access cavity preparation. Working length was determined by introducing a #10 K-file (Dentsply, Maillefer, Ballaigues, Switzerland) into each canal until the file tip was visible at the apex; working length was determined 1 mm short of this measured length. After introduction of hand files and establishment of a glide path, RaCe files (FKG Dentaire, Switzerland) were used to clean and shape the root canals. During preparation and between each file, 1 mL of 0.5% sodium hypochlorite was used as an irrigant. The canals were all prepared to a RaCe #35, 0.04 file. After completion of instrumentation all the canals were dried with paper points and filled with gutta-percha (Diadent, Cheongchong Buk Do, Korea) and AH26 root canal sealer (Dentsply, GmbH, Konstanz, Germany) using lateral condensation technique. Radiographs were provided to make sure that the canals had been properly obturated. Then a hot plugger was used to remove 3 mm of gutta-percha from the coronal third of each canal, later to be sealed with light-cured glass-ionomer (Fuji II LC, GC, Tokyo, Japan).

The teeth were randomly divided into three groups of 15 teeth each. In group 1 (control), dry cotton pellets were placed in the pulp chamber and the cavity was sealed with self-curing glass-ionomer (Fuji II LC, GC, Tokyo, Japan) for seven days. In the second group the same procedure as described for group 1 was carried out except for the fact that 30% hydrogen peroxide gel (Opalescence Extra, Ultradent Products, Inc, USA) was placed in the pulp chamber and was sealed with self-curing glass-ionomer (Fuji II) for one week. In the third group glass-ionomer and the bleaching agent were removed in the same manner as described after the bleaching procedure; then the pulp chamber was filled with Ca(OH)₂ (Produits Dentaires S.A, Vevey, Switzerland). Finally the access cavity was sealed with self-curing glass-ionomer. After one week of incubation in distilled water at 37°C glass-ionomer was removed with a carbide bur in a high-speed handpiece and Ca(OH)₂ was removed by irrigation; then the access cavities were restored in the same manner as described for group 1 after irrigation with water.

Prior to the evaluation of microleakage, the teeth were subjected to a thermocycling procedure of 500 cycles at 5 ± 2°C / 55 ± 2°C in a water bath with a dwell time of 30 seconds and a transfer time of 10 seconds. The apex of each tooth was sealed with utility wax and all tooth surfaces were painted with two layers of nail varnish except for the restoration and 1 mm around the restoration. Then the teeth were immersed in India ink for 72 hours and then rinsed under tap water. The teeth were buccolingually divided at the center of the restoration using a diamond disk (Diamant Gmbh, D & Z). Finally the specimens were evaluated by two observers under a stereomicroscope (Nikon, Tokyo, Japan) at magnification ×20.

The following grading system was used for microleakage evaluation:

Grade 0: No dye penetration.
Grade I: Dye penetration only into the enamel.
Grade II: Dye penetration into the enamel and dentin (8).

Kruskal-Wallis test was used to compare microleakage between groups and Mann-Whitney U test was used for the two-by-two comparison of the groups. Statistical significance was defined at P< 0.05.
Results
Microleakage grades are shown in Table 1. The results of Kruskal-Wallis test demonstrated statistically significant differences in microleakage between the groups ($\chi^2 = 21.13$, df= 2, P< 0.0005). Two-by-two comparison of the groups demonstrated statistically significant differences between groups 1 and 2, and groups 1 and 3 (P< 0.0005 and P= 0.001, respectively); however, no statistically significant differences were observed between groups 2 and 3 (P = 0.29).

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<th>Groups</th>
<th>Microleakage grades</th>
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Discussion
Increased microleakage of composite restorations subsequent to non-vital bleaching can jeopardize the long-term success of the bleaching procedure and endodontic treatment (3).

The use of hydrogen peroxide as a bleaching agent is the most important factor in inducing external root resorption among bleaching agents (9,10), because of its low pH and producing an acidic environment (11). Moreover, it increases the dentinal permeability to microorganisms subsequent to bleaching which might have a role in external root resorption (5). Therefore, hydrogen peroxide was used in this study.

Methylene blue and India ink are widely used for the evaluation of microleakage in root canal treated teeth (12). In the present study India ink was preferred to methylene blue because calcium hydroxide can decolorize methylene blue (13,14). Therefore, the results won’t be reliable.

The results of this study showed that non-vital bleaching with hydrogen peroxide leads to increased microleakage of composite restorations, which is consistent with the results of a previous study (1). One of the reasons for increased microleakage might be decreased bond strength of composite resin to tooth structure immediately after bleaching procedure (15).

References
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