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ORIGINAL ARTICLE

Effects of different bleaching agent concentrations on surface roughness and microhardness of esthetic restorative materials

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KEYWORDS

Bleaching;
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Abstract *Objectives:* The study assessed the changes in surface roughness and microhardness of three esthetic restorative materials after bleaching with 10%, 20% and 35% carbamide peroxide (CP).

Methods: Standardized cylindrical specimens (n = 210) of 3 esthetic materials (nano composite resin (NC), resin modified glass ionomer (GI), feldspathic porcelain (FP) were fabricated (n = 70). They were divided into 3 groups (n = 20) and a control group (n = 10). Each group was bleached with different concentrations of CP. The specimens of group 1 and 2 (10% CP and 20% CP) were immersed in the bleaching gels for 6 h daily, while group 3 (35% CP) was immersed for 30 min weekly. The control group was stored in artificial saliva. After 21 days, the morphological changes of the specimens were investigated with surface texture analyzer, while the hardness was assessed by performing superficial microhardness analysis. The data were analyzed with one-way ANOVA, and Scheffe test at α = 0.05.

Results: No significant differences in roughness average (Ra) were recorded among the control group and 10% CP bleached groups of all tested restorative materials (NC (p = 0.1495), GI (p = 0.0761), FP (p = 0.2848)). However, there were significant differences in Ra among the control group, 20% CP, and 35% CP ($p < 0.05$). There were no significant differences in the microhardness of feldspathic porcelain (10% (p = 0.0786), 20% (p = 0.1041), and 35% (p = 0.2066). While nano composite resin and resin modified glass ionomer specimens were significantly affected by concentration of 20% and 35% CP ($p < 0.05$).

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Conclusion: The effect of bleaching depends on the concentration of CP. The higher surface roughness was produced by 35% CP. Bleaching with different concentrations did not reduce the microhardness of the feldspathic porcelain. However, microhardness of nano composite resin and resin modified glass ionomer specimens was affected by 20% CP and 35% CP.

1. Introduction

The achievement of optimal esthetic restorations is the most stressful procedure that is concerned by dentists.[1] Although esthetics can be improved using a variety of techniques, bleaching is considered a safe, conservative, low cost and effective esthetic procedure for treatment of discolored teeth.[2,3] Numerous bleaching agents have been marketed but the commonly used active ingredient is carbamide peroxide (CP).[4]

Researchers[5,6] have reported that proper bleaching depends on the bleaching time, concentration of active bleaching ingredient, type and intensity of stain. Bleaching process includes oxidation which causes chemical modification of the discolored molecules.[7] CP bleaching gels (10% and 16%) may cause a significant increase in the surface roughness of microfilled and hybrid composite resins.[8] However, there is controversy about the effect of low concentrated 10–16% carbamide peroxide gels on surface microhardness of composite materials. Turker and Biskin found application of home-bleaching gels caused softening of composite resins.[9] However others reported that application of home-bleaching gels increased the surface hardness.[8,10]

It has been reported that when highly concentrated bleaching agents were applied for 5 days, they induced surface degradation, softening of modified composite resin,[11] while three bleaching sessions of 30 min for one week intervals did not affect the surface finish of compomers, resin-modified glass ionomer cements or glass ionomer cements.[12] Cehreli et al. claimed that after treatment with 10–16% CP bleaching gels, increased surface roughness of some brands of those materials were noted, while other gels had decreased surface roughness.[13] They concluded that the effects of the gels seem to be material dependent.[13]

Conventional dental ceramics are inert dental restorative materials, and acidulated fluoride gels or other solutions can result in ceramic surface deterioration.[14] Turker and Biskin[8,10] observed that 10% CP and 16% CP gels were able to significantly decrease surface hardness of the porcelain material tested. It was also reported that surface roughness may result in more plaque accumulation or change the ceramic texture if exceeds 0.2 μm.[15] Few literature addressed the possible alteration of the surface properties of esthetic restorative materials at different concentrations of carbamide peroxide.[8,10–14,16,17]

The null hypothesis of the current study was that the surface roughness and the microhardness of the selected materials would not be affected by different concentrations of carbamide peroxide of the bleaching agents. The purpose of the study was to evaluate the effect of different concentrations of carbamide peroxide on the surface roughness and microhardness of the esthetic restorative materials.

2. Material and methods

Three different esthetic restorative materials (nano composite resin, resin modified glass ionomer, feldspathic porcelain) of shade A2 (Vita shade guide, Vita Zahnfabrik, Germany) were used (Table 1). Three carbamide peroxide (CP) bleaching products were selected (Table 2). Two at-home bleaching system (10% and 20% CP) (Opalescence, Ultradent, USA), and one in-office system (35% CP) (Opalescence, Ultradent, USA).

2.1. Preparation of specimens

Seventy cylindrical specimens were prepared for each type of the tested restorative material. All materials were prepared according to the manufacturers' instructions. The control group ($n = 10$) was stored in Fusayama artificial saliva[18] (KCl (0.4 g/l), NaCl (0.4 g/l), $CaCl_2$ (0.6 g/l), NaH_2PO_4 (0.690 g/l), and urea (1 g/l) for 21 days). The other test specimens ($n = 60$) were divided into three groups ($n = 20$ in each group) according to different bleaching agents (10%, 20%, and 35% CP).

2.2. Composite resin and resin modified glass ionomer

Campos et al.[11] mold was prepared; 4×2 mm cylindrical acrylic matrixes were fabricated. They were filled with the restorative material. Composite resin or glass ionomer material was placed incrementally. A polyester strip and glass slide was then placed over it with a constant pressure of a weight of 500 g for 30 s. The specimens were cured for 20 s by a LED curing light system (Lume LED 5, Ultradent Products Inc., South Jordan, UT, USA). The light intensity was 650 mW/cm^2. The light tip was 1mm away from the specimen. The specimens were then polished (Sof-Lex, 3M ESPE, USA), and stored in distilled water at 37 °C for 24 h.

2.3. Feldspathic porcelain

A stainless steel mold consisting of two plates was prepared.[7] It had 4 holes which were 10 mm in diameter. The metal mold was duplicated and porcelain specimens were prepared similar to Turker et al. technique.[7]

2.4. Bleaching process

The specimens were placed in a plastic box and immersed in the bleaching gel. The first and second group (10% and 20% CP) were left for 6 h daily. The third group (35% CP) was left for 30 min weekly. All specimens were washed with distilled water then kept immersed in Fusayama artificial saliva at