Original Article

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Evaluation the Effect of 40% Hydrogen Peroxide on the Color of Different Composites

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ABSTRACT

BACKGROUND AND OBJECTIVE: One of the most reasons for composite restoration replacement is their color change. Bleaching can effect of color of composite restorations' color. The aim of this study was evaluation the effect of 40% hydrogen peroxide on the color of 3 different composites

METHODS: In this in vitro study, 30 disk-shaped samples of Z250, Z350XT, and Heliomolar composites (10 mm diameter and mm thickness) were prepared in A3 shade (n=10). Then samples were kept in distilled water for 24 hours. After that samples were exposed to 40% hydrogen peroxide (Opalescence Boost PF) for 40 minutes .the color of samples was measured immediately after preparing, after 24h and after bleaching and ΔE was recorded. The ΔE above 3.3 was considered clinically significant.

FINDINGS: The amount of color change in Z250, Z350 XT and Heliomolar were (ΔE=2.72), (ΔE=3.08) and (ΔE=2.40) the amount of ΔE were lower than 3.3. There were no significant diferences between composites according to effect of 40% hydrogen peroxide on their color change (p=0.15). After completion of polymerization the amount of ΔE was (2.28±0.29), (2.62±0.23) and (2.27±0.12) which were lower than 3.3. There were no significant differences between color change of different composites after 24 hours.(p=0.4).

CONCLUSION: 40% hydrogen peroxide has no effect on the color change of compsites which were evaluated in this study. Completion of polymerization does not make significant change in color of these composites.

KEY WORDS: *Color*, *Composite Resin*, *Polymerization*.

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Introduction

Composite resin is one of the acceptable materials in restorative dentistry and use of these materials increases due to the development of composite and improvement of chemical and physical properties and beauty (1). Advantages of composites are included beauty, conservative cutting, and binding to tooth structure, low heat transfer and so on.

Disadvantages of composites are included shrinkage due to polymerization, secondary caries, and sensitivity after work, low abrasion resistance and … (2). The color of resin restorative materials is influenced by different foods over time (3). These color changes can occur due to internal or external factors. Internal factors that contribute to discoloration of resin material including incomplete polymerization or placement in the water for a long time.

But external factors are including coffee, tea, nicotine and alcohol products and more. Furthermore, the effect of these colored materials depends on interior features of resin composite such as chemical composition (1). It is clear that the process of polymerization of the composite resin continues sometime after hardening. Because of this and water absorption of composites in the first hour after polymerization, generally is recommended that patients to refrain color substance in the first hours or one day following the restoration (2).

Bleaching is a non-invasive method for the brightness of internal or external spots. Whitening products usually include some forms of peroxide (carbamide hydrogen peroxide and) in the form of a gel or liquid, depending on the type of substance used, for a few minutes to a few hours are in contact with the teeth. Reports indicate that the effect of bleaching is directly related to exposure time and concentration of active ingredient of bleach, and its etiology and kind of spots (3). Since high concentration of peroxide such as 40% peroxide is used in the office as bleaching, it is possible that this material has a greater effect on restorative materials in the mouth compared with bleaching at home.

Although progresses have been made in the formulation of resin composite, there are still concerns about the stability of the color of these materials in oral environment for a long time that have not been solved. Composite restorations is one the most common reasons for replacing these restorations (4). Several studies have examined the effects of bleach on composites. But the results in this area has been very inconsistent. A study stating that 10% carbamide peroxide causes the clearness of composite color (5). Monaghan and colleagues reported that 30% hydrogen peroxide had a great effect on color change of freshly cured composites (6). In addition, Hubbezoglu and his colleagues stated that carbamide peroxide 10%, 37% and 35% hydrogen peroxide cause great color change in the composite (3). Hafez and his colleagues indicated that in-office bleaching does not change color of composites (7). Changing the color of the composite can be due to incomplete polymerization or being in the water for a long time (1).

It has been reported that about 70% of the polymerization takes place in the first 15-10 minutes after curing (12), but the polymerization process continues until hours later as the maximum polymerization occurs after 24 hours (8 and 1). Time is a factor in changing the color of composite. Composite color change was observed after 24 hours in distilled water in several studies (8). But the color change during the first 24 hours after curing is unknown. Since the composite properties depends on matrix components and their filler and filler size, it is possible that a variety of bleaching have a different effect on composite materials.

There is no study about the effects of high concentrations hydrogen peroxide, such as 40% hydrogen peroxide used to whiten teeth in the office on color composites nanofilled, Microhybrid and microfilled. If 40% hydrogen peroxide had a great effect on the color of composites in the mouth, the possibility of replacing these restorations after treatment should be considered. Taken together, the aim of this study was to evaluate the effect of 40% hydrogen peroxide and completing the polymerization on the composite color stability.

Methods

In this study, three types of composites, including microhybrid Z250 (3M ESPE, USA), Nanofilled composite Z350 XT (3M ESPE, USA) and microfilled (Vivadent, USA) Heliomolar were used (table 1). All three composite were selected as A3 color. Out of each composite 10 samples with discs shape and thickness of 3 mm with a diameter of 10 mm was molded using plastic generators. After placing the composite into the generator, transparent tape was placed on it and a glass slab was laid and according to the manufacturer's instructions were cured for 20 seconds using light cure device (ivoclarvivadent, liechtenstion). Following the withdraw of the samples from generator, exposure of

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surface of samples was carried from each side for 20 seconds. Surface of samples was paid using 400 to 1200 grit silicon carbide paper.

The effect of complete polymerization: after payment of samples, the primary color of all samples was recorded by Vita Easyshade compact (Vident, USA) based on CIEL * a * b systems. Before the use, the device was calibrated according to the manufacturer's instructions. Then samples were stored in distilled water for 24 hours at °C37. After 24 hours, the color of the samples was re-measured and recorded.

The effect of 40%hydrogen peroxide: after 24 hours to complete the polymerization, according to the manufacturer's instructions samples were exposed to hydrogen peroxide 40% (Opalescence Boost PF, Ultradent, USA). The samples twice, each time for 20 minutes (40 minutes total) have been exposed to bleaching materials and every time were washed with running water for one minute and then the color of samples were measured again. The change in the L, a and b were measured, and ΔE was measured according to the following formula:

$$\Delta E=[(L_1- L_0)^2+ (a_1-a_0)^2+ (b_1-b_0)^2]^{1/2}$$

E above 3.3 was considered as clinically significant. Data were analyzed by SPSS 20 software. ANOVA was used to determine the effect of hydrogen peroxide and completed polymerization and $p< 0.05$ was considered significant.

Results

In this study the effect of 40% hydrogen peroxide on color change of Nanofilled, Microhybrid and microfilled composites were investigated. In microhybrid Z250 (ΔE=2.72), Nanofilled composite Z350 XT (ΔE=3.08) and microfilled Heliomolar (ΔE=2.4) the Δe was less than 3.3, and the color change was clinically acceptable (table 2).There was no significant difference between on the color change of composite based on the effect of 40% hydrogen peroxide. After completing the polymerization (24 hours) in all composites, ΔE was less than 3.3 that are clinically acceptable (table 3). There was no significant difference between color change of composites after polymerization.

Table 1. Characteristic of consumables used in this study

Manufacturer	Composition	Type of Material	Name of consumer
3M-ESPE	Bis-GMA, Bis-EMA, UDMA, TEGDMA, Zirconia (4-11nm)/silica (20nm) (78.5%wt)	Nanofilled composite	Z350
3M-ESPE	Bis-GMA, Bis-EMA, UDMA, Zirconia/silica(0.01-3.5µm) (77.5% wt)	Microhybrid composite	Z250
Ivoclar-vivadent	Bis-GMA, UDMA, DDMA/colloidal silica(0.04-0.2µm), copolymer (46%wt)	Micrifilled composite	Heliomolar
Ultradent	40% Hydrogen peroxide, Potassium nitrate, Fluoride	Tooth bleaching materials for office	Opalescence Boost PF

Table 2. Values of color change of the specimens examined in the study after bleaching

Composite Z350 Mean±SD	Composite Z250 Mean±SD	Composite Heliomolar Mean±SD	P-value
3.08±0.68	2.72±0.54	2.4±0.38	0.15

Table 3. Values of color change of the specimens examined in the study after the completion of polymerization

Composite Z350 Mean±SD	Composite Z250 Mean±SD	Composite Heliomolar Mean±SD	P-value
2.28±0.29	2.62±0.23	2.27±0.12	0.4

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Discussion

ThAccording to the findings of this study, complete polymerization of the composite causes color change, but the color change is not clinically detectable (ΔE<3.3). 40% hydrogen peroxide has no effect on the clinical color change of composites (3.3>ΔE). There are also systems for color evaluation, such as colorimetry, spectrophotometric and digital image analysis. According to reports, spectrophotometry is the most reliable techniques in dental studies (9).

VITA Easyshade is a spectrophotometer device that was used in this study. According to the report of KIM-Pusateri et al accuracy and reliability of VITA Easyshade in the color measurement is greater than 90% (10). Easyshade system reports color of the samples based on CIE L *, a *, b *. Color system CIE L *, a *, b * is the most common international method for dental purposes that defines color by three factors, L, a and b that L represents the color transparency (value) and a represents the green –red colors and b represents the yellow-blue colors (12, 11).

There was no similar study to investigate the effect of distilled water color change of composites during the first 24 hours after curing. In a study by de Alencar and colleagues to investigate the effect of different drinks on the color change of Nanocomposites, it was observed that color change of these composites was clinically acceptable 8,4,2,1 and 12 weeks after exposure to distilled water (13).

The results of this study are in line with the results of studies of Bagheri et al (14). In this study it was shown that water alone cannot cause clinically unacceptable discoloration of the composites. In contrast, in a study conducted by Malekipour and colleagues an unacceptable discoloration has been shown in composite after 24 hours exposure to distilled water attributed to increase water absorption and exit of soluble materials from composite (15).

The difference in the results of this study with the present study may be due to differences in the type of composite and chemical composition of the composite. Several studies have examined the effect of whitening on composites. But results have been inconsistent. A study stating that 10% carbamide peroxide causes bright color of composites (5). Monaghan and colleagues reported that 30% hydrogen peroxide has a great influence the color change of freshly cured composites (6). Canay and colleagues showed that 10% hydrogen peroxide causes more color change than 10% carbamide peroxide (16). Hubbezoglu and colleagues reported that 10% carbamide peroxide, 37% and 35% hydrogen peroxide caused a large color change in the composites (3).

Hafez and his colleagues reported that in-office bleaching has no effect on color change of composites (7). In the present study, hydrogen peroxide had no effect on clinically discoloration of studied composites. Hydrogen peroxide is a very strong oxidative material which is able to destroy the polymeric matrix composite (17). In addition to the very high reactivity, hydrogen peroxide has a high penetrating power. Peroxide can cause oxidative breakdown of the polymer chain that in this condition non- reactive monomers are most affected. The peroxide-induced free radicals can affect the junction between the resin-filler and decouples filler from the matrix. Whatever the cross-linked polymer networks are denser, the color change will be less. In this study the used polymer network of composites were highly cross-linked (18).

Hence it seems because hydrogen peroxide had no effect on their color. Therefore, it should be reminded for patients that composite restorations will not change as much as the tooth during bleaching treatment, and patients should consider the replacement of composite restorations after teeth whitening for beauty. Since oral conditions, particularly the presence of saliva can have a significant impact on the properties of restorative materials, it is recommended that further studies should be done in this regard, as in vivo or storage in the saliva in order to be closer to clinical conditions.

Due to the limitations of this study, it was determined that hydrogen peroxide 40% had no effect on the color of Nanofilled, Microhybrid and microfilled composites examined in this study, and keeping in water for 24 hours after curing, does not have notable clinically color change.

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