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Effect of External Bleaching on Color Change of Single Shade Resin Composite Versus Nano-Filled Resin Composite in Class V (in Vitro Study)

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ABSTRACT

Aim: This study investigated the effect of bleaching on color change of the single shade universal composite (Omnichroma) versus nano-filled resin composite (Z350 XT). **Materials and Methods:** Twenty premolars of shade A3 were used for the study. Standardized class V cavities were prepared on the cervical third of the buccal surface of all teeth. After that, teeth were randomly divided into two groups of 10 teeth each according to the type of resin composite used. After composite application, all teeth were stored individually in distilled water for 24 hours. Evaluation of the restoration color was done using VITA Easyshade. The teeth were bleached and stored again for another 24 hours. Re-evaluation of the restoration color was done at 24 hours, one week and one month after bleaching. **Results:** There was no statistically significant difference between the two restorative materials at 24 hours and after one week. While there was a statistically significant difference between the two restorative materials after one month. **Conclusion:** Omnichroma single shade universal restorative material demonstrates structural color change post-bleaching procedure.

1. INTRODUCTION

2. INTRODUCTION

The aesthetic appearance of anterior teeth has become a major concern for patients. Discolored vital anterior teeth have been treated with different approaches, including polishing, micro abrasion, macro abrasion, bleaching, direct composite veneers, ceramic veneers and crowns [1]. Achieving optimal esthetics in restorative dentistry is a difficult task to complete. Beauty standards directly influence dental esthetics. Therefore, dental procedures that involve esthetics, such as restorations with direct light activated resin composite and bleaching treatments, are under constant development [2].

In recent years, there has been an increased demand for improvement in the appearance of natural teeth. The conservative technique of tooth bleaching has gained attention and acceptance from both patients and clinicians. Despite increased popularity, there is controversy surrounding the adverse effects of bleaching on dental restorative materials [3].

Therefore, studying the effect of bleaching on the color change of the single shade universal composite (Omnichroma) versus nano filled resin composite might be of interest. The null hypothesis of this study was that the bleaching will not change the color of the light activated resin composite either the single shade universal composite or the nano filled resin composite.

3. MATERIALS AND METHODS

Materials tested

Two types of light cured resin composite materials [Omnichroma (Single shade universal composite, Tokuyama Dental, Tokyo, Japan) and Z350 XT (Nano filled resin composite, 3M/ESPE, St. Paul, MN, USA.)], a universal adhesive system and chemically activated bleaching agent (Opalescence Boost 40%, Ultradent, South Jordan, UT, USA) were used in the current study.

Selection of teeth

Twenty caries-free human premolars of shade (A3), extracted for orthodontic treatment were used in this study. Each premolar was cleaned from any blood or soft tissue and scaled to remove any hard tissues deposits. Teeth shade were confirmed as (A3) using the CIE L*a*b* system based on L*, a* and b* parameters [4]. Teeth were stored in distilled water at room temperature for a maximum period of three months after extraction with a weekly change of the distilled water [5].

Grouping of teeth

Teeth were randomly divided into two groups (n=10) according to the type of resin composite tested (R). Group R1 for the single shade universal composite (Omnichroma), while group R2 for the nano filled resin composite (Z350 XT).

Teeth preparation

Standardized class V cavities with dimensions 6mm mesio-distal width, 2mm occluso-gingival height and 1.5mm depth located on the cervical thirds of each tooth were firstly traced using an indelible marker. After that, cavities were prepared in all teeth using a 330 carbide bur held in high speed contra angle handpiece under air/water coolant [6]. Cavity dimensions were then re-measured with a graduated periodontal probe to confirm standardized cavity dimensions [7]. A 45° bevel was done using a yellow color coded diamond tapered with round end finishing stone on the incisal margin of the preparation to increase the surface area for retention and improve esthetics.

Restorative procedure

Selective enamel etching using 37 % phosphoric acid etch for 15 seconds was done. Rinsing with water for 15 seconds was then done followed by drying the cavity with air [8]. Adhesive was then applied to the cavity according to the manufacturer instructions, followed by light curing for 20 seconds using light curing device with output intensity 600 MW/cm2. Omnichroma (R1) and Z350 XT (R2) were used to restore the prepared cavities incrementally. Light cured for 20 seconds after applying celluloid matrix strip to ensure composite adaptation and prevent the oxygen inhibited layer formation. Further, the restorations were finished and polished to achieve uniform and smooth surfaces using Sof-Lex discs held in low speed contra angle handpiece. All the restorative procedures were carried out by the same operator and then all specimens were stored individually in tightly sealed plastic containers wrapped with black tape containing distilled water for 24 hours till the bleaching procedure [9].

Pre-bleaching color measurement

Pre-bleaching assessment of the restoration color was done digitally using VITA Easyshade 4.0 spectrophotometer calculating L*a*b* values [10]. The single tooth measurement mode was selected, calibration was performed by placing the probe tip on the calibration port built in the machine before each measurement. The teeth were gently air dried and the color measurements were standardized by using the same black background, same operator and same lighting conditions [11].

Bleaching procedure

A rubber base mold was constructed to hold the teeth during bleaching procedure. The mold was designed to keep buccal surfaces of teeth at one mm below its surface to allow uniform bleaching gel application. After that, one mm thick layer of gel was applied to the buccal surface of each tooth following the manufacturer's instructions. Gel was remained on the teeth for 20 minutes then the whole procedure was repeated for another 20 minutes [12]. Teeth were placed again in the containers containing distilled water and maintained for another 24 hours, one week and one month before measurement [6].

Post-bleaching color measurement

Post-bleaching assessment of the restoration color were evaluated at 24 hours, one week and one month after bleaching. In between the testing intervals, the teeth were stored in distilled water and maintained at room temperature. Distilled water was renewed daily [13].

Sample size

This study was designed to assess a continuous response variable from independent control and experimental subjects with one control(s) per experimental subject. In a previous study done by **Elhoshy, A.Z. et al., in 2018** [7] the response within each subject group was normally distributed with a standard deviation of 0.9. If the true difference in the experimental and control means is 1.3, we will need to study 10 experimental subjects and 10 control subjects to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05.

Statistical analysis

The mean and standard deviation values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, data showed parametric (normal) distribution. Repeated measure ANOVA test was used to compare between more than two groups in related samples. Paired sample t-test was used to compare between two groups in related samples. Independent sample t-test was used to compare between two groups in non-related samples. Two-way ANOVA was used to test the interaction between variables. The significance level was set at ($p \leq 0.05$). Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

4. RESULTS

Results of repeated measure ANOVA test for color change in Omnichroma showed that the effect of different storage time periods on the color change (ΔE) of Omnichroma group (R1) after bleaching at different time intervals showed that there was a statistically significant difference between one month and 24 hours groups were (p=0.0002) and between one month and one week groups were (p=0.0314). Further there was no statistically significant difference found between 24 hours and one week groups were (p=0.106).

Results of repeated measure ANOVA test for color change in Z350 XT group (R2) after bleaching at different time intervals revealed that there was no statistically significant difference between (24 hours) and (one week) groups were (p=0.837) and 24 hours and one month groups were (p=0.088).

Results of independent sample t-test for the effect of each group at different storage time on color change (ΔE) showed that there was no statistically significant difference between the two restorative materials at 24 hours and after one week at p-value= 0.292 and p-value= 0.647 respectively. While there was a statistically significant difference between the two restorative materials after one month at p-value= 0.0001.

Table 1:

The mean, standard deviation (SD) values of color change (ΔE) of each group at different storage time

	Color change				
Variables	Omnichroma		Z350 XT		p-value
	Mean	SD	Mean	SD	
(T1)	3.79	1.56	4.73	2.24	0.292ns
(T2)	5.35	2.41	4.86	2.29	0.647ns
(T3)	7.66	1.97	3.53	1.49	0.0001*
p-value	0.009*		0.025*		

*; significant (p<0.05)

ns; non-significant (p>0.05)

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5. DISCUSSION

Results of the current study regarding the effect of different storage time periods on the color change (ΔE) of Omnichroma group (R1) is due to the changes in enamel and dentin of teeth which greatly influence the efficiency of the Omnichroma's color stability [14]. Also, during the in office teeth bleaching with high concentration hydrogen peroxide agent, free radicals are released and combine to yield oxygen molecules and water which leads to restorative materials hydrolytic degradation [15].

Moreover, oxidation of amine groups of polymerized monomers may occur which compromise color stability over time [15]. Besides, it is stated that composite resins whose main monomer content is Bis-GMA shows less water sorption than composites containing TEGDMA and more than composites containing UDMA and Bis-EMA. Composite resins with TEGDMA showed more color changes. TEGDMA monomer is present in the structure of the single shade composite resin (Omnichroma) which showed the most color change in our study [16]. This is in agreement with Aydin, N. et al in 2021 who stated that Omnichroma shows more color changes than multi shade composite resins after evaluating the color change of single shade composite resin compared with multi shade composite resin systems [16].

Results of the effect of different storage time periods on the color change (ΔE) of Z350 XT group (R2) after bleaching can be explained that the Z350 XT (nanofilled composite) is more resistant to the bleaching procedure due to its fine particle size and the presence of nano silica filler and Zirconia/Silica Nano-cluster. Consequently, providing more cross linking with the organic matrix enhancing the resistance to chemical softening by peroxide gel which is responsible for the observed color change caused by the bleaching agent [7].

In addition, as the filler loading increases, the degree of conversion increases and the water sorption decreases. Thus, the greater color stability of the nanocomposite may be associated to its higher filler content (comprised of 20 nm silica and 4–11 nm zirconia particles) [17]. These findings match the findings of Elhoshy, AZ. et al, in 2018 who concluded that nanofilled resin composite (Z350 XT) was more resistant to color change after using bleaching gel [7]. Also, Della Bona, A. et al in 2019 agreed that nanofilled composite presents appropriate color stability [17].

Regarding the effect of different restorative materials either Ominchroma (R1) or Z350 XT (R2) on color change (ΔE), these results were explained by the resistance of the nanofilled composite resin to the effect of the bleaching gel and Omnichroma's hydrolytic degradation [15]. These findings match the findings of AlHamdan, EM. et al in 2021 who assessed the color stability of a single shade resin based composite (Omnichroma) in comparison to a conventional dental composite and the results showed that the color stability of the single shade resin composite (Omnichroma) was more compromised than the conventional resin composite [14].

Finally, the null hypothesis of the present study was rejected as there was significant color change in the Omnichroma composite after bleaching.

6. CONCLUSION

1. Omnichroma single shade universal restorative material demonstrates color change with the surrounding tooth structure post-bleaching procedures.
2. Nanofilled composite Z350 XT has a higher color stability even after bleaching procedures.

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