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Effect of Different Repolishing Procedures on The Color Change of Alkasite#

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Research Article

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History

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ABSTRACT

Objectives: An esthetic restoration with an unacceptable color is the main cause for the replacement of anterior tooth restorations. The aim of this study is to evaluate the effect of repolishing on the color change of the new material group of alkasite after exposure to coffee solution.

Materials and Methods: Alkasite material placed in Teflon molds with a diameter of 8 mm and a height of 2 mm was polymerized under the application of mylar strip and a total of 32 samples were obtained. The samples were randomly allocated to groups. Group R: Diamond grained polishing rubbers, Group D: Aluminum oxide discs are applied and the polishing process is completed. After the first color measurement was made, it was immersed in coffee and the measurement was repeated 1 week later. L was divided into two groups (n=8) and repolished with rubber (RR) and discs (RD). In the D group, re-polishing was done with rubber (DR) and disc (DD), and color measurements were repeated. Results were analyzed by using one-way ANOVA and Tukey test at 95% confidence interval.

Results: The greatest color change (ΔE_{00}) was in group R. At the end of seven days, similar color change values were found between the groups of R and D. There is no difference between the RR and RD groups. Significantly less color change was observed in the DD group than in the RR and RD groups. Similarly, the DR group showed less color change than the RR group.

Conclusions: The color stability of the alkasite was affected by the polishing procedure. The repolishing process reduced the color change, but not at a clinically acceptable level.

Keywords: Alkasite, Color Change, Repolishing.

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Introduction

Composite resins are popular restorative materials in contemporary dentistry with their aesthetic and physical properties.[1] A newly-introduced tooth-colored restorative material called "alkasite" is classified as a subgroup of composite resins.[2] It is a dual curing, bulk-fill restorative material consisting of a powder and liquid mixture. The powder part contains various alkaline fillers and calcium fluorosilicate glass fillers that release fluoride, calcium, and hydroxyl that neutralize acidic ions around the restoration in the oral cavity. The liquid part consists of monomers that increase the fluidity of the material and enable it to adapt to the smear layer.[3] The source of fluoride release is calcium barium aluminum fluorosilicate glass filler and calcium fluorosilicate glass filler.[4]

Thanks to the improvements made in the structures of the restorative materials, their clinical life has been prolonged and one of the most important factors that cause their renewal is the color incompatibility between the restored tooth and the material.[5] Therefore, the long-term color stability of resin-based materials has become important in the restorative material preference. Discoloration in composites can be caused by intrinsic and extrinsic factors. Intrinsic factors include self-discoloration of the resin material and oxidation or hydrolysis in the resin matrix.[6] External factors include coloration as a result of exogenous contamination exposure to coloring agents and their absorption by the material and the degree of staining may vary according to oral hygiene, nutrition, and smoking habits.[7] Among the factors that can affect the degree of external coloration are the surface roughness and the hydrophilicity of the material and the thermal stress and the pH value in the oral cavity.[1] The surface quality depends on the polishing technique.[8] Lu *et al.*[9] showed a positive relationship between surface roughness and external staining while Bagheri *et al.*[10] concluded that surface polishing was not important in determining the staining sensitivity.

The optical properties of dental composite resins are affected by restorative procedures such as finishing and

polishing.[11] There is a lack of knowledge in the literature regarding the coloring of the new alkasite material. The aim of this study is to evaluate the color change of the alkasite, which is a new material group caused by different re-polishing systems after exposure to coffee solution. The H_0 hypothesis of this study is that there will be no difference in the color change that will be caused by different polishing systems as a result of the repolishing process.

Materials and Methods

Approval for the study was obtained from the Cukurova University, Faculty of Medicine Clinical Research Ethics Committee (2021/108.43). Based on previous study[12] sample size was calculated eight for each group using the G*Power analysis package program (G*Power 3.1; Universität Düsseldorf) at 80% power and 0.05 significance level in the present study.

Samples of alkasite (Cention N, Ivoclar Vivadent, Liechtenstein) material used in color A2 were prepared in Teflon molds with a diameter of 8 mm and a height of 2 mm. According to the manufacturer's instructions, the material was mixed with a spatula until a smooth consistency was obtained. Mixing time completed within 60 seconds. The material was placed in the mold with a spatula, mylar strip and 1 mm thick glass were placed, respectively, and excess material was allowed to overflow. Samples were allowed to harden for 5 min.

A total of 32 samples were prepared from the material and according to the polishing system, firstly, they were divided into 2 groups, and then each group was divided into 2 subgroups (n=8).

Group R: Polishing rubbers with diamond grain

Group D: Aluminum oxide discs

The unpolished bottom surfaces of the samples are numbered. After polishing, the samples were kept in distilled water at 37°C for 24 hours in an incubator (FN 500, Nüve, Turkey). The first color measurements were made using a spectrophotometer (Vita Easyshade, Vita Zahnfabrik, Bad Sackingen, Germany). Group R was divided into two subgroups and repolished with rubber (RR) and discs (RD) polishers. In group D, repolishing was done with rubber (DR) and disc (DD) polishers, and color measurements were repeated.

CIE L (lightness), C (chroma), and H (hue) values were determined at baseline and day 7 on a white background using the CIE D65 illuminator and the CIE 2° standard colorimetric observer.[13] The coffee used in this study was prepared by dissolving 10 g of coffee (Nescafe Classic, Nestle, Switzerland) in 400 ml of hot water. Each batch of samples was stored in an incubator at 37°C for one day and seven days. The coffee solution was freshly prepared and replenished daily. Color measurements were repeated at the end of the seventh day. Before each measurement, the samples were washed with distilled water for 1 minute and dried. Three measurements were made on the upper surface for each sample and the average was taken. Color change values between baseline and seven days later were calculated using the $CIEDE_{2000}$ formula:

$$\Delta E_{00} = \left[\left(\frac{\Delta L'}{K_L S_L}\right)^2 + \left(\frac{\Delta C'}{K_C S_C}\right)^2 + \left(\frac{\Delta H'}{K_H S_H}\right)^2 + R_T \left(\frac{\Delta C'}{K_C S_C}\right)\left(\frac{\Delta H'}{K_H S_H}\right)\right]^{1/2}$$

Statistical analyzes were performed using the SPSS program (IBM SPSS for Mac 26; Chicago, USA). The Shapiro-Wilk test was used to determine the normality distribution of the data. Results were evaluated by using one-way ANOVA and Tukey test at 95% confidence interval.

Results

The mean and standard deviations of ΔL, Δa, Δb, Δc, ΔH values of alkasite after repolishing with different systems are presented in Table 1. While ΔL and Δa values were in parallel with the ΔE values between the groups, the DD group showed the highest Δc and the lowest ΔH values.

The mean color change (ΔE_{00}) and standard deviations after 7 days calculated with the $CIEDE_{2000}$ formula are shown in Figure 1. The greatest ΔE00 was in the R group. At the end of seven days, similar color change values were found between the R and D groups ($p > .05$). There was no difference between the RR and RD groups. Significantly less color changes were observed in the DD group than in the RR and RD groups (p=0.003, p=0.042, respectively). Similarly, the DR group showed less color change than the RR group (p=0.015).

Table 1. Mean and standard deviation values of ΔL, Δa, Δb, Δc, ΔH of color indexes of the experimental groups

Groups	ΔL	Δa	Δb	Δc	ΔH
RR	16.5±4.1^{a}	-2.35±1.3^{a}	1.6±1.1^{a}	1.4±1.2^{a}	7.3±3.2^{a}
RD	13.8±3.5^{ab}	-3.35±2.01^{a}	1.2±1.1^{a}	1.4±1.32^{a}	5.9±3.5^{ab}
DD	9.3±3.3^{c}	0.16±0.8^{b}	2.7±1.5^{b}	3±0.9^{b}	-0.2±2.1^{b}
DR	10.7±3.4^{bc}	-0.75±0.8^{b}	2.3±0.81^{ab}	2.3±0.9^{ab}	2.6±2.1^{bc}
p	0.008	0.000	0.037	0.03	0.000

R: Rubber, D: Disk, L: lightness, a: red-green, b: blue-yellow, c: chroma, H: hue

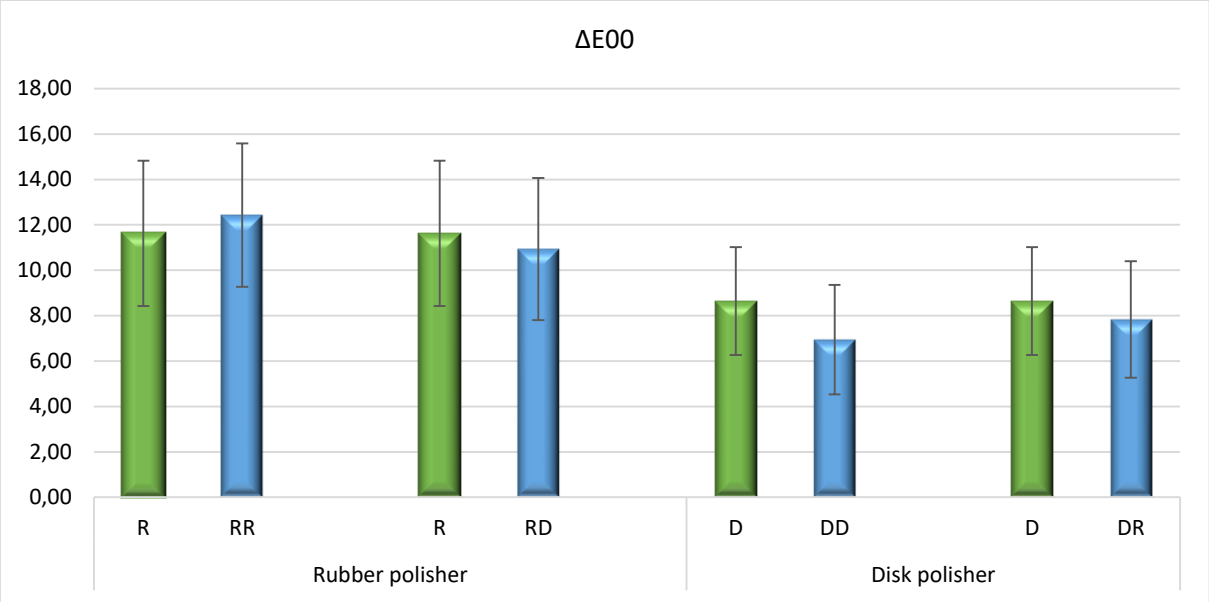

Figure 1. ΔE_{00} value of colour change of alkasite according to polishing and repolishing groups

Discussion

The surface texture of a tooth-colored restoration affects plaque build-up, discoloration, wear, and the esthetic appearance of the restoration.[14] Therefore, proper finishing and polishing are critical procedures that increase both the esthetics and lifetime of restored teeth.[15] In this study, the effect of repolishing on the color change of the current fluorine-released resin-containing bulk-fill alkasite material after being immersed in coffee repolishing with different polishing systems was investigated. As a result of the study, it was found that repolishing affected the color change and the H_0 hypothesis of the study was rejected.

The discoloration capacity of coffee on resins can be attributed to the degree of water absorption of the composite resins and the hydrophilicity of the matrix resin. Coffee contains yellow colorants with different polarities.[16, 17] In this study, coffee was used as a coloring agent because it is frequently consumed in daily life. Ertaş *et al.*[18] observed that immersion in coloring beverages for 24 hours corresponds to approximately 1 month of clinical aging. In this study, was examined the color changes over more than 6 months with measurements on the 7th day.

Recent studies have shown that the $CIEDE_{2000}$ formula better reflects the color differences perceived by the human eye than the CIELab formula ($\Delta E*ab$).[19] CIE_{2000} was used to determine the color change in this study. $CIEDE_{2000}$ ΔE_{00} is reported to have a 50:50% detectability threshold of 0.8 and an acceptability threshold of 1.8.[20] In this study, as a result of immersion of alkasite material in coffee, it showed a color change above clinical acceptability at the end of the 7th day in all polishing systems.

Different surface finishes and polishing processes can affect the color resistance by changing the surface roughness of the resins.[9,11,21] It has been reported that multi-step finishing and polishing systems outperform single-step systems in maintaining surface roughness.[22] Flury *et al.*[23] reported that a multi-step (Sof-Lex, 3M ESPE, USA) finishing and polishing system with aluminum oxide on tooth-coloured materials is less than a 2-step finishing and polishing system with diamond particles (Vita Enamic Polishing Set, VITA, Germany) They stated that it creates surface roughness.

Aydın *et al.*[12] compared the effect of multiple and single polishing systems of composite resins on color change, the most color change occurred in the multi-polishing system.[24] In this study, unlike other studies, the multi-disc system caused the least color change in the alkasite material. These results can be explained by the fact that the structure of alkasite differs from composite resins and a smoother surface can be obtained with aluminum oxide discs. Ergücü *et al.*[25] compared the color changes of five polished composites with two one-stage polishing systems when exposed to a coffee solution. They concluded that there was no significant difference between the OptraPol and PoGo polished groups. Samples finished with Mylar strip matrix showed the most intense coloration, while the most colorless surfaces were obtained with OptraPol. This finding is consistent with the present study.

Mundim *et al.*[26] found no significant differences in color values or between composite resins before and after repolishing samples immersed in distilled water and coke. Immersion of samples in coffee resulted in greater

discoloration of all composite resin types, and repolishing with discs reported contributing to clinically reduced staining. Studies are reporting that a superior whitening effect is obtained with the repolishing technique on composite resins compared to bleaching.[27,28] In this study, it was observed that there was a decrease in the color change of alkasite when polished with multi-pitch discs.

Limitations of this study include allowing staining on both sides of the material, unlike clinical staining conditions. The staining agents in food and beverages and restorative materials are frequently together in the oral cavity. However, the rinsing effect of saliva and oral hygiene procedures wash restorative materials. This study experimented to imitate the clinical conditions, but the effect of hygiene and scrubbing on the filling materials was not contained and the samples were in coffee nonstop during the immersion time. Moreover, the restricted sample size of in vitro conditions is also within the limitations of the present study.

Conclusions

The color stability of the alkasite was affected by the polishing procedure. Although the repolishing process reduced the color change, it could not bring it to clinically acceptable levels. The least color change in the alkasite material occurred in the multi-step aluminum polishing discs.

Conflicts of Interest

The authors declare no conflicts of interest.

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