



Effect of Bleaching on the Staining Susceptibility of Enamel and Composite Resin (An in Vitro Study)

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ABSTRACT

Purpose: This study was aimed to assess the bleaching agent effect on the staining ability of enamel and composite resin. **Methods:** The overall number of samples was sixty; thirty enamel and thirty resin composite discs with thickness of 2 mm and 10 mm were preformed from resin composite material (filtek Z250). Each group of 30 specimens (enamel and composite) was divided into 2 groups according to the bleaching procedures, where the first group consisted of 10 specimens (n=10) and was given symbol (B₁) which received no bleaching agent control group (stored in artificial saliva). The second group was given symbol (B₂) which received a bleaching agent and consisted of 20 specimens (n=20) and then was divided into two subgroups of 10 specimens each according to time of immersion in the staining solution, where T₁ represents immediate immersion (2h) and T₂ represents delayed immersion (1week). **Results:** Student's t-test was applied for comparison between ΔE To compare staining ability of enamel and composite ΔE was calculated between post bleaching and post staining for different time intervals, for control or no bleaching group ΔE between baseline and after staining. No statistically difference was showed in the results between staining ability of enamel and resin composite. **Conclusion:** Bleaching significantly increases the staining ability of both enamel and composite resin. Delaying exposure to staining solution does not restore staining ability to pre-bleach levels.

KEYWORDS

Bleaching,
Staining susceptibility,
Enamel, Composite resin

INTRODUCTION

Esthetics dentistry has become a significant part of conservative dental treatment. Having whiter and aesthetically pleasing teeth is very important to patients and is often related to the perception of

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health and fineness. Thus, cosmetic protocols have become more desirable as standards of living have developed, and vital tooth bleaching is widely spread with patients and clinicians as a successful process to remove the stain of natural teeth. The exposing of tooth surfaces to whitening agents has been shown to sometimes lead to microstructural differences in the enamel surface. Coloring beverages, as tea, cola and coffee, used after bleaching may be result in coloring of bleached and usually more porous enamel surface ⁽¹⁾. Patients requesting bleaching treatment may have different aesthetic restorative materials in their teeth that may be negatively affected by tooth bleaching agents, changes in surface morphology, chemical and physical properties were from the effects of the bleaching agent. The relative porosity and roughness of the superficial layer of dental materials has a direct influence on their ability to staining ⁽²⁾. Teeth extrinsic staining is affected by the ingestion of food or drinks that have a great staining ability like coffee and wine ⁽⁴⁾. A patient seeking treatment for discoloration of stained teeth would want and expect whiter unstained teeth and they would want the treatment effect to be long lasting. However, in many cases, a patient that seeks treatment because of teeth severely stained because of his drinking habits is probably going to maintain the same eating or drinking pattern as dietary habits are not easy to change. This raises the question of the possibility of re-staining of these bleached teeth, thus negating the positive initial effect of the bleaching treatment, how much staining can happen after bleaching is affected by the staining ability of enamel, if the ability is dramatically increased it can potentially cause more staining than the original condition that caused the patient to seek treatment in the first place staining of teeth and resin composite depend on things as increase surface roughness, porosity and others ^(5,6). Thus, this study was performed to investigate the staining effect of coffee after the application of home bleaching for both enamel and resin composite.

MATERIALS AND METHODS

Thirty human central incisors extracted for periodontal reasons were used in this study. All of the teeth were sound without any decay, and a magnifying lens was used to examine restorations and cracks. Immediately after extraction, teeth were washed, scraped to remove fiber of periodontal ligament, scaled to remove calculus and then the teeth were polished with prophylaxes paste using a polishing brush at low speed. The root of each sample was removed at the level of cementoenamel junction using a low-speed double-faced diamond disc size: S-22 mm in a low speed straight hand piece. Thirty discs of resin composite of 2 mm thickness and 10mm diameter were prepared from the resin composite material (filtek Z250). To prepare the resin composite discs, a Teflon mold was fabricated as following: Two Teflon halves surrounding central hole of 10 mm in diameter and a 2mm in thickness were prepared. The two Teflon halves form a ring of 22 mm outer diameter and 10mm inner diameter that fit inside a copper ring. The copper ring of 2 mm thickness and of an outer diameter of 30 mm and inner diameter of 22 mm was machine crafted to stabilize the two Teflon halves. The mold was first placed on a one millimeter thickness glass slab. The resin composite material was packed into the mold increment by increment using a modeling instrument to make specimens of 2mm in thickness. A transparent polyester strip was then put on the mold. A one millimeter thickness glass slide was placed over the strip before curing to flatten the surface and to make the distance between the light curing tip and the resin composite specimen standard; the curing of resin composite was done according to manufacturer instructions. The cured specimens were removed by first removing the outer copper ring then the two Teflon halves were separated, Polishing of specimens was done using sofex polishing system. 10 specimens of each of enamel and composite were used as control while the other 20 were subjected to bleaching.

Bleaching procedure:

The bleaching groups were exposed to the bleaching agent (opalescence pf 35% carbamide peroxide), Sufficient amount of opalescence pf was applied to cover the labial surface enamel specimens and on polished surface of the resin composite specimens, a total time for application of opalescence pf was 90 min. (according to manufacturing instruction). The specimens were then divided into enamel and composite, then each was divided into two groups according to time of exposure to staining solution, either immediate and after one week (delayed). All specimens were numbered and color was evaluated and recorded for each specimen to serve as baseline..

Immersion in staining solution:

All the specimens (composite and enamel) were stored in artificial saliva till time of staining. Staining solution was prepared by pouring 200 ml of boiling water on 5g of coffee (Nescafe Classic). The solution was filtered through filter paper after it has being stirred for 1 minute. Specimens were stained by immersion into the fresh coffee solution. Specimens were immersed in small containers having 20 ml of freshly prepared coffee solution for immersion period (3hour/day), for 12 successive days. The specimens were cleaned with distilled water; gently air dried, and kept in artificial saliva for the rest of the day⁽⁴⁾. The delayed groups were similarly immersed but after one week of bleaching.

Color was again evaluated after staining and the color change was calculated. Color chsnge(ΔE) between after bleaching and after staining were calculated from the equation: $\Delta E_{ab} = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$, Where (L) is lightness, (a) is green-red, (b) is blue-yellow.

Data were presented as mean value and standard deviation (SD) values of ΔE . (ΔE) are the difference between two color values. Student's t-test was used to compare between mean values of two groups. For comparisons between more than two groups one-way analysis of Variance (ANOVA) was used.

RESULTS

Comparison of enamel and composite to evaluate effect of substrate on staining ability of specimens is shown in (fig.1 and table 1). Results showed no significant difference in staining between unbleached enamel and composite. For bleached specimens, bleached enamel was significantly higher staining than composite for specimens stained one week after bleaching. To evaluate the effect of time of immersion, enamel immediate immersion showed a mean value and SD of ΔE of 5.23 ± 1.15 . This was followed by delayed immersion with a mean and standard deviation of ΔE of 4.26 ± 1.05 . The mean value and SD of ΔE was 1.61 ± 0.23 for Control group with the statistically significantly lowest mean value (ΔE). With regards to resin composite, immediate immersion showed the a mean value and standard deviation of 4.44 ± 1.10 which showed the highest mean value (ΔE). This was followed by delayed immersion and control group, their mean values and standard deviations were 2.85 ± 0.42 and 1.64 ± 0.31 respectively.

Immediately stained specimens showed no significant difference between enamel and composite. 4

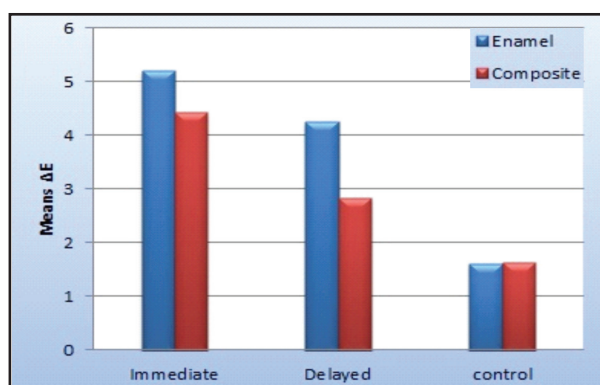


Figure (1) Bar chart represents mean values for comparison between (ΔE between post bleaching and post staining) of enamel and composite.

Table (I) Mean value, standard deviation (SD) values for comparison between (ΔE between after bleaching and after staining) with different immersion conditions and control group.

Substrate \ Immersion	Control (No bleaching)		Immediate		Delayed		P-value
	Mean value	SD	Mean value	SD	Mean value	SD	
Enamel	1.61 ^b	0.23	5.23 ^a	1.15	4.26 ^a	1.05	0.009*
Composite	1.64 ^c	0.31	4.44 ^a	1.10	2.85 ^b	0.42	0.002*

*: Significant at $P \leq 0.05$, Different letters are statistically significantly different

DISCUSSION

Many methods are currently used to assess color one of these the spectrophotometer⁽⁷⁾, the spectrophotometer which was used in this study as a color determination machine, not only eliminates subjective interpretation but enables little color changes to be noticed. Spectrophotometer denotes color change according to the CIE lab system⁽⁸⁾ which is widely used and was introduced for determination of colors based on human visual thresholds. In this method color change value (ΔE) is expressed as difference in color change between successive color measurements. It is widely agreed that the value of $\Delta E \geq 3.2$ is considered visually observed⁽⁹⁾. 50% of observers under controlled conditions can detect color change of one ΔE unit visually. The threshold for the clinically acceptable ΔE values varies widely from ΔE - 2.70, ΔE - 3.2 and ΔE - 3.5⁽¹⁰⁾. The coffee is coloring solution used in this study which is one of the most widely used drinks. In a previous study aimed to detect the immersion time, a time that have been recorded for a hot beverage to be in contact to the tooth was sixty seconds for one mug. This study stimulated a total of 2.5 year with a mean of 2 mugs of hot beverage consuming / day⁽¹¹⁾. The storage in artificial saliva was used to simulate the oral environment which stimulates the remineralization of bleached specimens⁽¹²⁾. For standardization human saliva was replaced by artificial saliva, an important thing in tooth staining.

In particular, the plaque that resulted by saliva will accelerate its stain ability^(13, 14). Results showed in regards to substrate when comparing bleaching effect on the color of the enamel and resin composite showed statistically significantly higher mean value (ΔE) of enamel than composite. This was in agreement with the previous study, ΔE values greater than 3.3 were also observed for hydrogen peroxide, it may be explained by oxygen being a potential oxidant, which is the basis of bleaching treatments⁽¹⁵⁾. This result of the current study were in agreement with previous study showed color change have to be toward the lighter and less yellow shades (higher L* and lower b* values), they also found that the activation of light helped tooth whitening efficacy which was detected until 24 weeks after whitening⁽¹⁶⁾. The conclusion of this study is in coincident with the results of another study where color alteration of the nanoparticles of composite after whitening was not detectable. Therefore, it is not indicated to replace composite after bleaching⁽¹⁷⁾. When comparing enamel and composite staining ability, unbleached specimens showed similar ability under the conditions of this study. This suggests a good clinical behavior if enamel and composite stain in a similar pattern. After bleaching both also stained much more but they still were similar in behavior as differences were not statistically significant. However, for the delayed immersion, the composite resin staining

ability was markedly less than that of enamel. This might suggest a less than favorable clinical picture, as both will not stain at a similar rate, the color match will be lost and the eye can differentiate between the enamel and the composite. The explanation of this is that although the effect of the bleaching material on enamel and composite are different, yet it had a similar overall effect immediately after bleach⁽¹⁸⁾. These results were in agreement with a previous study which found increased enamel staining ability to wine after bleaching. The increased staining ability after bleaching may be explained by the surface morphological alteration and all changes promoted by bleaching agent, and also to water sorption rate due to permeability alteration, and roughness left on bleached labial surfaces⁽¹⁹⁾, whitened enamel stains immediately after bleaching because increased enamel porosity due to bleaching process. The effect of 35 % of carbamide peroxid accelerates enamel ability to coloring because of the morphology difference resulted from oxidizing reaction. The morphological changes have been related to the oxidation reaction, which could affect enamel integrity and its structural properties . also demineralization of bleached enamel because of the loss of Ca and PO₄⁽²⁰⁾.

CONCLUSIONS

With the limited conditions of this study, we may conclude that enamel and composite have staining ability that is similar in control and immediate staining conditions. Bleaching significantly increases the staining ability of both enamel and composite resin. Delaying exposure to staining solution does not restore staining ability to pre-bleach levels.

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