Research Paper

The Effect of Tea, Coffee, Cola, and Distilled Water on the Color of Microfilled Composite Resin Light Cure (In Vitro Study)

Medical Science

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ABSTRACT

Objective: The aim of this in vitro study was to evaluate the effect of four different drinks (Tea, Coffee, Cola, Distilled water) on the color of a microfilled composite resin light cure(Tetric A1, Ivoclar Vivadent) after immersion in these different drinks.

Materials and methods: In this study, twenty resin-based composite specimens were prepared using a cylindrical mold measuring 2mm of thickness and ≅ 10mm of diameter. The composite specimens were light-cured for 40 s from both sides using a LED Radii at 1400 mW/cm2 and were randomized into 4 groups (n=5) according to the drinks : Tea, Coffee, Cola, And Distilled water (control solution). A digital spectro-photometer was used to evaluate the color changes at baseline and at 1 week after immersion in each solution.

Results: At the end of the week, the group of samples stored in the Cola drink solution showed a color change that was obvious compared to the baseline color and was highly significant(P<0.001), while Coffee was next in color change and was significant(P=0.02). Tea group also showed color change and was significant (P=0.042). .

Conclusions: We can conclude that drinking certain drinks may alter the color of the microfilled composite resin light cure. Cola has the higher effect, and then Coffee .While Tea has least effect.

INTRODUCTION:

Despite the significant decrease in caries prevalence worldwide, dental caries is still a significant problem and clinicians spend a considerable amount of time placing restorations to substitute the dental structure lost during caries progression .[1]

The use of composite resins has become an important reality in restorative dentistry. Due to improvements in both physico-mechanical and esthetic properties, composite resins are presently among the most popular esthetic restorative materials in dental clinical practice. Manufacturers have introduced different shades for restorative materials, capable of fulfilling all the requirements for environment light sensitivity, depth or cure, color match and stability. [2]

The currently available universal composites, microhybrid, nano-hybrid or nanoparticulate, present volumetric shrinkage lower than 4%, mechanical strength, polishability, polish retaining and wear resistance. Such improvements associated to the state-of-the-art placement technique have led to a clinical behavior comparable to that of amalgam restorations.[3]

Advances in resin-bonding technology have resulted in resin-based composite, materials with lifelike characteristics, making these products the primary choice of dentists striving to meet patients' esthetic needs.[4]

Due to the wide use of tooth-colored restorative materials, it is important to determine which one is susceptible to color change. To ensure excellent aesthetics, it is necessary for tooth-colored materials to maintain intrinsic color stability and a resistance to surface staining.[5]

The success of dental restorations depends, among other issues, on compressive, diametral tensile and flexural strengths, wear and fracture resistance and polish retention[6]. Furthermore, aesthetics restorative materials should mimic the appearance of natural tooth, and this fact is directly related to the material's color match and color stability.[7]

A restoration that undergoes significant discoloration may be a source of embarrassment for both the patient and the dentist. Indeed discoloration is considered a major esthetic failure in

tooth – colored orations. However, dental resin based composites have been reported to change color because of intrinsic and extrinsic factors.[8]

Extrinsic factors leading to composite resin restoration color change include staining by adhesion or penetration of colorants, as a result of contamination from exogenous sources such as coffee, tea, other stain producing beverages and colored solutions.[9]

Previous studies have shown that composite resins are susceptible to color instability when exposed to various staining media, especially red wine, coffee, cola, tea and whisky[4,5,10,11].The photoinitiator system can not only influence the polymerization characteristics, but also have impact on the composite color stability[9].

Tooth surface discoloration by the deposition of extrinsic stains is currently treated by professional cleaning with scaling and polishing[12]. However, intrinsic stains on composite restorations cannot be removed superficially, and might demand restoration replacement. The aim of this in vitro study was to evaluate the color stability of a microfilled composite resin light cure in different immersion media.

MATERIAL AND METHODS:

For this study, a microfilled composite resin light cure (Tetric A1, Ivoclar Vivadent,Germany) was used as a composite restorative material. The color stability of this composite was tested by immersion in four media: Cola, Tea, Coffee, and distilled water (as a control group). Twenty discs, with ±2 mm of thickness and ±10 mm of diameter, were prepared using a polytetraflouroethylen mold mold. After inserting the material into the mold, a polyester strip was pressed onto the mold surface with a glass plate in order to obtain a flat surface without bubble formation. Materials were dispended, manipulated, and polymerized according to the manufacturers' instructions into which the composite material was light polymerized for 40 seconds from both sides using a LED source (Radii, SDI, Bayswater, VC, Australia; 1,400mW/cm² power density) fixed at a distance of 1 mm from each specimen. The light-activation time was performed according to manufacturer›s recommendations.

Specimens were randomized to 4 groups according to storage solution (n= 5): Group(1) Cola, Group(2) Coffee, Group (3) Tea and Group (4) distilled water (control group). All the solution was kept at a temperature of 37ºC.

Group 1-specimens were stored in coca cola drink (coca cola Inc.), which was at 37ºC.

Group2 -specimens were stored in 37˚C coffee (Nescafe Classic, Nestle, Switzerland); 5 g of the coffee was dissolved in 200 ml of boiling distilled water according to the manufacturer's suggested concentration. After 10 minutes of stirring, the solution was filtered through a filter paper.

Group 3-Specimens in Group were stored in 37˚C tea (Earl Gray; Lipton, Unilever Gulf, United Arab Emirates). The tea solution was prepared by immersing 1 prefabricated pack of tea into 200 ml of boiling distilled water for 10 minutes.

Group 4- specimens served as the control group, and specimens were stored in 37˚ C distilled water. Before exposure to the staining agents, baseline color measurement of all specimens was recorded with the spectrophotometer. After 7 days storage in the solutions, the specimens were rinsed with distilled water for 5 minutes and blotted dry with tissue paper before color measurement. Color of the specimens was measured using:

$$rE= [(L1 -L0)2 + (a1 - a0)2+ (b1 - b0)2]^{½}$$

RESULTS

After 1-week of immersion in Cola, Coffee, Tea, and water, specimens differ in their color change. The specimens stored in Cola show the highest change in color followed by the group of Coffee. Then tea specimens come in the third place in color change while the specimens in the distilled water did not show any perceptible color change. The color change of specimens stored in Cola was highly significant P<0.001. That of Coffee was significant P=0.02, also that of tea group was significant P=0.042, while that of distilled water was not significant P=0.525.Also the difference between the groups differ so the Cola group showed highly significant change than Coffee (P=0.002) and Tea (P=0.001) and water (P<0.001). Also the Coffee group showed a highly significant change than distilled water (control) group (P=0.005). While the difference between the Coffee and Tea groups was not significant (P=0.216).The difference between the Tea and distilled water (control) group was significant (P=0.026) and Table 2 shows these differences.

Table 1 - color means, and color difference (E) in the two evaluation periods for the specimens immersed in the different storage solution.

Spectrophotometer evaluation Mean	Evaluation period			p-value
The groups	Base-line	After 1 week of	Difference (E)	
Group1(Cola)	6.2	15.6	9.4	< 0.001
Group2 (Coffee)	6.5	10.0	3.6	0.02
Group3 (Tea)	6.3	8.7	2.4	0.042
Group4 (Distilled Water)	6.5	6.9	0.4	0.525

Table 2 showing the differences and the p value between the groups in color change of composite after one week of immersion in these four liquid media at 37 ºC and the Cola is the maximum then the Coffee and the Tea while the Dis- tilled water showed no difference in color after 1 week.

Groups	Mean	P value
Cola	9.4	0.002
Coffee	3.6	
Groups	Mean	P value
Cola	9.4	0.001
Tea	2.4	
Groups	Mean	P value
Cola	9.4	<0.001
D.water	0.4	
Groups	Mean	P value
Coffee	3.6	0.216
Tea	2.4	
Groups	Mean	P value
Coffee	3.6	0.005
D.water	0.4	
Groups	Mean	P value
Tea	2.4	0.026
D.water	0.4	

Figure showing the distribution of changes in color of composite after immersion in the four liquid media (at base line and after 1 week)
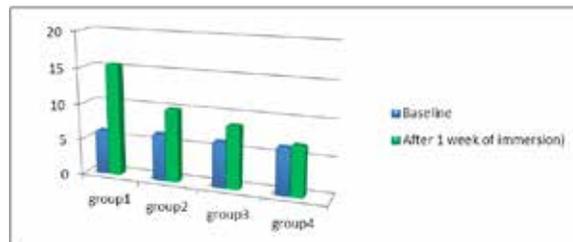
Difference statistically significant between groups (p < 0.05)

DISCUSSION

As tooth-colored restorative dental materials are continuously exposed to saliva, beverages and food stains in the oral environment, it is important to determine their susceptibility to color change. To ensure restorations' imperceptibility both intrinsic color stability and staining resistance over a long period in the oral environment are necessary[11]. Although clinical studies require long-term evaluation periods to achieve results, several laboratory tests have been used in order to simulate and accelerate the discoloration, simulating oral aging conditions[13]. For this in vitro study, the color of composite resin specimens was measured after two different immersion times: at baseline before immersion and, after 1-week immersion in four different staining solutions.

Oral habits such as tobacco use and certain dietary patterns (for example, caffeine intake) may exacerbate the external discoloration of resin based composite material [4]. A recent study[14] showed that an adequate evaluation of color stability in tooth restoration can be carried out by either visual assessment with shade guides or use of a digital spectrophotometer. Considering the color as a complex phenomenon, several factors such as lighting conditions, translucency, opacity, light scattering and human eye, may influence the overall perception

of tooth color[15]. Color determination in dentistry can be divided into two categories: visual and instrumental. Instrumental colorimetry can potentially eliminate subjective errors in color assessment. Colorimetry and spectrophotometer are most exact than the naked eye in measuring slight differences in colored objects on flat surface.[16]

The staining susceptibility of resin composites might be attributed to their degree of water sorption and hydrophilicity of the matrix resin. If the resin composite can absorb water, then it is also able to absorb other fluids, which results in its discoloration[17]. Water sorption occurs mainly as direct absorption in the resin matrix. The glass filler particles will not absorb water into the bulk of the material, but can adsorb water onto the surface [5].

Composite resin specimens were stored for seven days and at the end of storage period, color measurements were taken. The results of this study revealed that, distilled water showed no observed staining while coffee produced the most severe stain on composite resin. This finding agrees with Bagheri et al. in 2005, Omata et al. in 2006 and Villalta et al. in 2006 who found that, distilled water caused no perceptible color change on composite resin. This observation confirms the fact that water sorption by itself didn't alter the color of composite resin to a considerable extent [18].

In this study, when comparing between tea and coffee storage solutions, coffee stained composite resin more than tea and this is due to the fact that both coffee and tea storage solutions contain yellow colorants, which have different polarities. Higher polarity components (those in tea) are eluted first, and lower polarity components (that in coffee) are eluted later. Therefore, discoloration by tea was due to adsorption of polar colorants onto the surface of materials, which was removed by tooth brushing[5,11], whereas discoloration by coffee was due both to adsorption and absorption of colorants[19], [5]. This absorption and penetration of colorants into the organic phase of the materials were probably due to compatibility of the polymer phase with the yellow colorants of coffee [5,11]. This finding agree with Bagheri et al. in 2005 who determined the surface staining of resin based composites and glass ionomer cements after immersion in various stains and food stimulating solutions and this result agree with Guler et al in 2005 who evaluated the stainability of composite resin upon exposure to different staining agent

Although developments in filler technology have led to significant improvements regarding filler size, low wear and high resistance against degradation of resin materials, the present study showed that immersion in Cola caused a high color change in the specimens after the staining .These results indicate that this composite staining will be easily perceptible and thus clinically unacceptable. It is likely that the lower pH of the grape juice affected the composite resin surface, increasing pigment absorption[20,4]. However, few studies have evaluated the association between pH variations and staining[10,21].

CONCLUSION
Microfilled composite resin light cure can undergo color change if exposed to different liquids and stains. Cola, Coffee caused perceptible color changes on the composite resin, while Tea resulted in less color change. Avoiding or minimizing drinking these drinks may preserve the color of the composite restoration for a longer time.

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