

Effect of Mouthwash on Color Stability of Composite Resin

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Abstract

Background: Discoloration of composite resin restorations may occur from time to time, and this unacceptable color change may lead to the replacement of these restorations and unpleasant esthetics. **Aims and Objectives:** The study aims to observe the effect of non-alcoholic mouthwash on the color stability of nanofilled and microhybrid dental composite resins. **Materials and Methods:** Twenty specimens were immersed in 20 mL of distilled water. Randomly selected specimens from each group of composites were immersed in 20 mL of mouth rinse for 24 h. The post-immersion values were recorded for each sample using the same ultraviolet spectrophotometer. The measurement of the discoloration of the composite was analyzed. **Results:** The color change was displayed by both samples after immersion in the mouthwash but the change was not statistically significant (0.473). ΔE value for nanofilled composites is 2.67 whereas for the microhybrid composites, the value is 2.96. **Conclusion:** In the present study, it could be concluded that the mouth rinse solution used promoted color alteration of the tested composite resin.

Keywords: Color change, Composite resin, Mouthwash, Spectrophotometer.

INTRODUCTION

Composite resin is the first choice for restorative material attributed to its esthetic appeal. Superior esthetics is the prime requirement of patients with increasing demand in cosmetic dentistry. Composite resins have an initial form of viscous liquid that will harden due to polymerization reactions.^[1] The polymerization reaction occurs when external energy activates the initiator to produce free radicals so they can form a polymer. Composite resin is the mixture of the reinforcing phase and matrix phase. The reinforcing phase or filler is in fiber, sheet, or particle form. The reinforcing phase is embedded in another material called the matrix phase. The reinforcing phase and matrix phase could be metal, ceramic, or polymer.^[1,2]

The disperse phase of composite resins is made up of an inorganic filler material which, in essence, determines the physical and mechanical properties of the composite. As the particle size is smaller, resins made with this type of particle give the restoration a better finish.^[3]

Discoloration of tooth-colored, resin-based materials may be caused by several intrinsic and extrinsic factors. Intrinsic factors involve the discoloration of the resin material itself, such as alteration of the resin matrix and changes in the interface of matrix and fillers. Color matching plays an important role in achieving good results. However, discoloration of composite resin restorations may occur from time to time, and this

unacceptable color change may lead to the replacement of these restorations.^[4]

Extrinsic factors for discoloration of resin composites include staining by adsorption or absorption of colorants from exogenous sources such as coffee, tea, nicotine, beverages, and mouth rinses. Mouth rinses are mostly used as an important caries and gingivitis control method and a breath freshener. Because of their anti-inflammatory, antiseptic, and analgesic properties, they are occasionally administered after tooth preparation to reduce local inflammation and tenderness and to hasten mucosal healing.^[5]

Alcohol, which can be part of the composition of some mouth rinse solutions, has antiseptic properties and helps the breakage or dissolution of active principles (antimicrobial agents, especially essential oils), in addition to preserving the components of the formula, although its addition does not contribute directly to the control of biofilm and prevention of gingivitis.^[6] Chlorhexidine is the most commonly used

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mouthwash in India. However, chlorhexidine gluconate is a cationic antiseptic agent that has been shown to have a bactericidal effect by penetrating into the bacterial cell membrane. It has a known major disadvantage of causing discoloration despite its widespread use for the treatment of oral and dental diseases due to its antimicrobial activity.^[7]

Since the patient awareness of dental esthetics has been increasing, it is necessary to maintain perfect harmony between tooth and restoration in the long term. Thus, the present study aims to observe the effect of non-alcoholic mouthwash on the color stability of nanofilled and microhybrid dental composite resins.

MATERIALS AND METHODS

Materials used in this study are listed in Tables 1 and 2.

Specimen preparation

Twenty specimens (10 × 2 mm) of A2 shade were prepared. This was achieved with the help of stainless steel mold using a composite filling instrument (Densply Composite Filling Instrument). The composite was polymerized both from the top and the bottom for 20 s using an LED light curing unit (Bee Cool Turbo II) as per the guidance of the manufacturer.

The specimens were divided into two groups ($n = 10$).

- Group I – A nanofilled composite (3M ESPE, St. Paul, MN, USA)
- Group II – A microhybrid composite (3M ESPE, St. Paul, MN, USA)

All the prepared samples were immersed in 20 mL of distilled water in separate containers according to the group. Further incubation at 37°C for 24 h was done. After 24 h, baseline color values of each sample were recorded using a spectrophotometer (T 70 PG instrument, Alma Park, Leicestershire, United Kingdom). Colorimetric values of the specimens were determined using the L*a*b* system of the Commission Internationale de l'Eclairage (CIE L*a*b* Color Scale).

Once the baseline color measurements were done, ten randomly selected specimens from each group were immersed in 20 mL of mouth rinse (Listerine, Mumbai, India) for 24 h. After 24 h, the specimens were washed with distilled water followed by blot drying and then it is subjected to spectrophotometric analysis. The post-immersion values were recorded for each sample using the same ultraviolet spectrophotometer. The measurement of the discoloration of the composite was analyzed. The formula

used for calculating color differences in this system is as follows:

$$\Delta E^*_{ab} = ([\Delta L^*]^2 + [\Delta a^*]^2 + [\Delta b^*]^2)^{1/2}$$

The main principle of spectrophotometry is that every substance absorbs or transmits certain wavelengths of radiant energy, but not other wavelengths. It measures the light absorption peak of the material subjected to the analysis. The wavelength of the measurement spectrum used in this study was between 400 and 720 nm.^[8]

Statistical analysis

Data were collected and entered in MS Excel spreadsheet 2010. Statistical analysis was done usually the Statistical Package for the Social Sciences software version IBM 22 and data were expressed in frequency and mean value. The comparison between the two groups was done using Student's t-test. Statistical significance was taken <0.05.

RESULTS

Table 3 denotes the before and post-immersion measurements of the two groups, that is, nano-filled composite and microhybrid composite. The mean colorimetric value, that is, L*a*b* is shown in the table.

Table 4 denotes a comparison of color change between nanofilled composite and microhybrid composite. The comparison was done with a t-test and it showed that there is no statistically significant difference between the groups ($P = 0.473$).

Interpretation

The color change was displayed by both the samples after immersion in the mouthwash but the change was not statistically significant (0.473). ΔE value for nanofilled composites is 2.67 whereas for the microhybrid composites, the value is 2.96.

DISCUSSION

Mouthwashes have been proven to be an excellent method to prevent the formation of biofilm and protect from bad breath. However, the organic acids present in the mouthwashes such as citric acid and benzoic acid cause a decrease in pH and hence reduce the microhardness of polymeric composite resin.^[6,9] Various other studies have shown the discoloration by chlorhexidine mouthwash.^[4,7] Composite resins containing less fillers are more prone to discoloration. Discoloration of materials is also related to its surface roughness. An increase

Table 1: Composition of composites used

Material	Shade	Manufacturer	Resin Matrix	Filler
Group I – Filtek Z350 XT	A2	3M ESPE, St. Paul, MN, USA	TEGDMA, UDMA, BisGMA	Non-aggregated 20-nm silica Non-aggregated 4–11-nm zirconia Silica cluster filler
Group II – Z 100	A2	3M ESPE, St. Paul, MN, USA	BIS-GMA, UDMA, BIS EMA	Zirconia/silica fillers (0.01–3.5 mm) 66% by volume

Table 2: Composition of mouthwash used

Mouth rinse	Composition	Manufacturer
Hexidine	Chlorhexidine gluconate 0.2%	ICPA Health Products., Ankaleshwar, India

Table 3: Baseline and post-immersion measurements

Material (shade - A2)	Mean (L*)	Mean (a*)	Mean (b*)	Delta E
Group 1				
Nanofilled composite (baseline measurements)	68.83	-0.58	12.73	2.67
Nanofilled composite (post-immersion measurements)	67.42	-0.72	10.35	
Group 2				
Microhybrid composite (baseline measurements)	67.35	-1.84	12.65	2.96
Microhybrid composite (post-immersion measurements)	65.63	-1.82	13.83	

Table 4: Comparative evaluation showing the color change between the groups

Groups	n	Mean±SD	SE	t-value	P-value
Group 1	10	2.953±0.074	0.042	4.752	0.473
Group 2	10	2.792±0.093	0.072		

in the particle size of the restorative materials causes increased water absorption through the polymer chains, affects the bonds between the matrix and filler particles, and results in an irregular surface during polishing.^[7]

In restorative materials, color changes stemming from intrinsic and extrinsic factors can be evaluated visually and with the use of instrumental techniques. One of these instrumental techniques is spectrophotometry and it is superior to visual evaluation as it leaves no room for subjective interpretation. It is able to measure the color change (ΔE) by comparing the values of before and after, according to a formula that has been reported to be a reliable technique.^[10]

The findings of our study are in accordance with the previous studies which state that the type of mouthwash, immersion duration, and composite type have a significant effect on the discoloration of the resin and hence compromising the esthetics. Festuccia *et al.*^[11] and Lepri *et al.*^[12] observed that the microhardness of composite resin changes after the usage of chlorhexidine alcohol-free mouthwash and affects the color stability of resin.

Al-Samadani^[13] also in his study stated that mouthwashes/gels affect color shifting for all composite resin materials, and changes are exaggerated over time. However, he also stated

that discoloration effects are not perceptible to the human eye. Ghiorghe *et al.*^[14] in his study presented visible colorimetric changes after immersion in tested solutions. The most obvious changes were observed after immersion in Coca-Cola, coffee, and red wine. Domingos *et al.*^[15] on the other hand, found no significant difference in color stability regardless of the light sources, and coffee was the immersion medium that promoted the highest color changes on the tested composite resin.

CONCLUSION

In the present study, it could be concluded that the mouth rinse solution used promoted color alteration of the tested composite resin.

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