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EVALUATION OF CHANGE IN COLOR OF NANOFILL AND MICROHYBRID MATERIAL AFTER IMMERSING IN DIFFERENT BEVERAGES- AN IN-VITRO STUDY

Dental Science

Sejal Hanchate — Department of Conservative Dentistry and Endodontics, School of Dental Sciences, KIMSDU, Karad, Maharashtra, India

Adish Saraf* — Department of Conservative Dentistry and Endodontics, School of Dental Sciences, KIMSDU, Karad, Maharashtra, India *Corresponding Author

T. M Managala — Department of Conservative Dentistry and Endodontics, School of Dental Sciences, KIMSDU, Karad, Maharashtra, India

Sudha Mattigatti — Department of Conservative Dentistry and Endodontics, School of Dental Sciences, KIMSDU, Karad, Maharashtra, India

Saleem makandar — Department of Conservative Dentistry and Endodontics, School of Dental Sciences, KIMSDU, Karad, Maharashtra, India

Rushikesh Mahaparale — Department of Conservative Dentistry and Endodontics, School of Dental Sciences, KIMSDU, Karad, Maharashtra, India

ABSTRACT

OBJECTIVES- The aim of this in vitro study was to investigate the amount of change in color and color parameters of composite resin materials after immersing in various beverages.

MATERIALS AND METHOD-50 disk samples of each composite material were prepared of diameter 1cm and thickness of approximately 2mm. Polymerization was carried out by LED light-curing unit Elipar free light 2(3M ESPE, St. Paul, MN, USA) with light intensity of 1000 $\frac{mw}{cm2}$, using 20 seconds of exposure. Specimens were divided into 2 groups- Group 1 (Charisma) and Group 2(Filtek Z350) and again subdivided into 5 groups according to the bevarages- Tea, Cof-fee, Coke, Wine, Turmeric solution. A Spectrophotometer was used to evaluate the color change after immersing the specimens in respective solutions for 8 days. The color differences (ΔE) were analyzed by paired t-test and one-way ANOVA with complementary Tukey test ($p<0.05$).

RESULTS- The two restorative materials were evaluated, Filtek Z350 showed lowest staining than Charisma Smart. Among Tea, Coffee, Wine, Coke and Turmeric solution, Coke stained the most.

CONCLUSION- Within the limitation of this invitro study, it can be concluded that all solutions used in this study affected the color stability of tested composites materials.

KEYWORDS

Aesthetics, Beverages, Color, Nanohybrid, Stability

INTRODUCTION

Dentistry has been undergoing advancements which helps to develop more efficient techniques and materials for the treatment of patients who are in turn searching for aesthetic treatment.[1] The most common reason for the replacement of restorations is aesthetic faiure.[2]The use of composite resins has become an important reality in restorative dentistry showing properties very similar to those of natural teeth (lifelike) and changing the dental scenario by an ideal aesthetic material.[3]

There are many manufacturers who have been introducing different shades for composite materials which are capable of fulfilling all the requirements such as depth of use, color match and stability. The ideal requirement of dental restorative material should pertain compressive strength,diametral strength,diametral tensile and flexure strength,wear and fracture resistance and polish retention.[4,20]Further more it should mimic the tooth exactly. Thus, these products are primary choice of dentists striving to meet the 'patients need'. Composite resin must retain the colour and polish over a long period of time, but discoloration of tooth-colored resin-based materials may be caused by both intrinsic as well as extrinsic factors.[2]

The intrinsic factors involve the discoloration of resin matrix by itself, such as the alteration of the resin matrix and of the interface of the matrix and the fillers.[5] Extrinsic factors for discoloration include staining by absorption and adsorption of colorants as a result of contamination from exogenous sources.[2,3,5]The factors affecting discoloration from exogenous sources depends up on eating-drinking and smoking habits of the patient. Other factors such as surface roughness, surface integrity and polishing techniques are responsible for stain resistant of composite restorative material.[6]A restoration that undergoes significant discoloration may be an embarrassment for both the patient and the dentist.[3]

However, by the use of daily beverages such as tea, coffee, coke, wine and turmeric can cause discolouration which is considered as major aesthetic failure. Discolouration by extrinsic stains can be treated by professional cleaning whereas intrinsic stains needs to be re-restored as it cannot be cleaned by scaling.[7] As people are looking forward for more advancements and aesthetic looks it is important to determine the material which are stain resistant. Thus, the aim of this study was to evaluate the discolouration effects of various beverages like tea, coffee, wine, coke, turmeric solution on resin based composite materials that are commonly used in restorative dentistry.

MATERIALS & METHOD

- **Restorative materials:**

Restorative materials evaluated for their colour stability were namely -

1. Nanohybrid composite resin filtek Z350 XT (color A2; 3M ESPE, St. Paul USA)
2. Microhybrid composite resin Charisma Smart(color A2; HeraeusKulzer GmbH, Germany)

Other details concerning the restorative materials used in this study are shown in the table no.1 below

- ***Table 1. Name and Characteristic of materials used in the study***

Product	Composite Resin Type	Composition	Lot no	Manufacturer
1.Filtek Z350	Nano hybrid	UDMA, Bis GMA, Bis-EMA, TEGDMA, Fillers:Silica, zirconia, clusters,silica aggregated particles	N7717743	3M ESPE, St. Paul, USA

2.Charisma Smart	Microhybrid	BiS GMA Resin 59% Filler by volume. Barium Aluminium fluoride Glass, highly dispersive silicone dioxide 0.005-10µm	010501A	Heraeus Kulzer GmbH, Germany

- ***StainingAgents:***

Five different solutions served as staining agents in this study: Tea, Coffee,Coke, Wine and Turmeric solution.

The staining solutions were prepared in following concentrations as given below-

1. Tea (Brooke Bond,Mumbai, India)
   For preparation of Tea solution, 2.8g of tea and 4g of sugar was added to 150ml of boiling distilled water
2. Coffee(Nescafe, New Delhi, India)
   For preparation of coffee solution, 2.8g of coffee and 4g of sugar was added to 150ml of boiling distilled water
3. Coke
   Was used as such.
4. Wine(Sula, Nashik, India)
   Was used as such
5. Turmeric solution(MDH Haldi powder, New Delhi, India)
   For preparation of turmeric solution, 0.5g of turmeric pinch was added to 150 ml of distilled water

SPECIMEN PREPARATION

50 disk samples of each composite material of diameter 1cm and thickness of approximately 2mm were prepared using a brass mold. The mold with the composite resin was held between the two glass slides, each covered with transparent nylon strip (Mylar, Du. Pont, Wilmington, USA) and then the microscope slides were gently pressed together and the excess material was removed.Materials were dispensed, manipulated and polymerised according to manufactures instructions.Polymerisation was carried out by LED light-curing unit Elipar freelight 2(3M ESPE, St. Paul, MN, USA) with light intensity of 1000 $\frac{mW}{cm^2}$ using 20 seconds of exposure. During the light polymerization process the end of the light guide was in contact with the cover slide.Polymerization was done on both the sur-face on top as well as the bottom surface and the distance between the light source and specimen was standardized by the use of 1mm brass mold and then the specimens were polished with polishing kit (Super snap, Shofu) to reduce the surface roughness. The surfaces were polished with fine and superfine polishing disks with a low speed head-piece. On completion of the polished disks, the disks were randomly divided into 10 subgroups (Tea, Coffee, Coke, Wine, Turmeric solution).Then the prepared specimens were stored in distilled water at 37O Celsius for 24 hrs after curing in order to elute un-reacted components from the composite and allow for post irradiation and post-setting polymerization to occur.

10 randomly selected disk specimens from each material were immersed in each stain-ing media for 8 days and solutions were freshly prepared every day for 8 days.The col-ours of the specimens were measured after staining with the help of Spectrophotometer(Spectroline). Statistical analysis was performed using statistical software SPSS ver-sion 17 (SPSS INC, Chicago, IL, USA). The colour differences (ΔE) were analyzed by paired t-test and one-way ANOVA with complementary Tukey test ($p<0.05$).

RESULTS

1. When discoloration of different materials was considered, maximum discoloration was seen with Charisma Smart [ΔE=0.37±0.515] and minimum with Filtek Z350 [ΔE=0.305±0.125].
2. Among the solution in which the specimens were kept; maximum discoloration was seen with Coke [ΔE=0.185±0.08] and minimum with Tea [ΔE=0.105±0.33].The significant values were seen with Coffee and Wine.
3. Charisma smart showed highest staining with Coffee whereas Filtek showed highest staining with Coke.

Table 2. Mean, Standard deviations and test of significance of mean values of color change be-tween different groups.

Staining agents	Group 1 Mean±SD Charisma Smart	Group 2 Mean±SD Filtek Z350	Unpaired t-test	P-value	Total *Mean±SD*
Tea	0.11±0.62	0.10±0.04	0.05	0.9605	*0.105±0.33*
Coffee	0.18±0.11	0.09±0.04	2.432	0.0333	*0.135±0.075*
Coke	0.15±0.1	0.22±0.06	1.898	0.0785	*0.185±0.08*
Wine	0.14±0.08	0.08±0.03	2.221	0.0483	*0.11±0.055*
Turmeric solution	0.16±0.12	0.12±0.08	0.8771	0.3943	*0.14±0.1*
Total	0.37±0.515	0.305±0.125	0.8673	0.3896	*0.337±0.32*

DISCUSSION

Composite resins are widely used presently in dental clinical practice. The use of these materials has been increased spontaneously as new composite materials are upcoming. Colour is the most important factor affecting aesthetic restoration. Matrix, filler composition, filler content, minor pigment addition, initiation components and filler coupling agents affect the colour of these aesthetic material.

The present study addresses the colour instability of the two composite resins- Filtek Z350 (Nanohybrid) and Charisma Smart (micro hybrid). Nanocomposities posses a higher modulus of elasticity and greater flexural, compressive and diametrical tensile strengths, along with improved hardness, fracture toughness and wear resistance. The increased filler loading, decrease overall content of the soft organic matrix and strong interfacial interactions between the resin matrix and filler particles result in lesser polymerization shrinkage. In the study, Charisma smart showed more staining than Filtek Z350 (0.37±0.515> 0.30+0.125) as they have a higher content of organic matrix. These results were in agreement with the previous study.[1] Large filler particles highly exposed on surface will produce large surface roughness values.[2]The structure of resin composite has a direct impact on surface smoothness and its susceptibility to extrinsic staining. UDMA which is the primary resin present in Filtek Z350 is more stain resistant than Bis-GMA because of its low water absorption and solubility characteristics.[6,19]

Staining of resins by fluid pigment and beverages is commonly caused by adsorption or absorption (uptake of substances into or through tissues) of colorants by resins. Charisma smart showed highest staining with coffee(0.18±0.11).This is because of caffeine pigments present. The results were statistically significant when compared to Filtek Z350($p=0.03$) an were in accordance to the previous study.[3] However, tea showed lower staining value as compared to coffee (0.105±0.33<0.135±0.075). The yellow colorants of coffee are less polar than tea colorants.[3] The gallic acid present in both tea and coffee is another reason for staining.[9]

Coke the commonly consumed aerated soft drink showed highest staining in Filtek Z350. It is a brown carbonated beverage and gains its color through addition of caramel.[19] This result is in accordance to the study conducted by Thakib A Al-Shalan.[19]

With respect to Wine, the results are statistically significant ($p=0.04$). The sorption of alcohol molecules contained in Wine penetrates the resinous matrix and increases the softening of composite surface and contribute to staining.[23,24]

Tumeric is a popular spice, which is major ingredient of almost every Indian food. Conjugated diarylhepnoids like curcumin are responsible for orange color and highest staining of turmeric solution.[8]

Instrumental techniques for color measurement include Colorimetry and Spectrophotometry. Spectrophotometer have been shown to be more accurate in measuring the color change than colorimeters as Spectrophotometers contain monochromatogens and photodiodes that measure the reflectance curve of a products color every 10nm or less.[8]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 analysis. In this study, wavelength used was between 300nm to 700nm as a typical human eye can respond to these wavelengths.[15]

CONCLUSION

1. The greater colour stability of Filtek Z350 is attributed to the higher percentage of urethane-dimethacrylate (UDMA) which is more resistant to water, in its resin matrix and hence Filtek Z350 stained less than Charisma Smart.
2. Coke has the highest staining ability amongst the staining agents used.
3. Coffee & wine stained Charisma smart.

There is a significant difference observed in staining of Charisma smart with coffee and wine when compared with Filtek Z-350

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