ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2019; 5(2): 92-95

www.oraljournal.com
Received: 09-02-2019
Accepted: 13-03-2019

Ruchi Gupta
Professor, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Arvind Bhatheja
PG Student, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Ashvin G John
PG Student, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Midhun Ramchandran
PG Student, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Afnan Ajaz Raina
PG Student, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Akankshita Behera
PG Student, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Nitish Mittal
PG Student, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Correspondence
Ruchi Gupta
Professor, Dept. of Conservative Dentistry and Endodontics, DivyaJyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, India

Effect of beverages on color stability of resin composites: An *in vitro* study

Ruchi Gupta, Arvind Bhatheja, Ashvin G John, Midhun Ramchandran, Afnan Ajaz Raina, Akankshita Behera and Nitish Mittal

Abstract
Background: Consumption of certain beverages may affect the esthetic and physical properties of the resin composite, thereby undermining the quality of restorations.
Aim: To analyze the effect of four beverages (tea, Coca-Cola, haldi and lemonade) on color stability of two different types of resin composites *in vitro*.
Materials and Methods: A nano hybrid composite Filtek Z 350 and a microhybrid composite Spectrum 3D was used for veneer preparation. Each material was randomly divided into four equal subgroups of 10 samples each according to the beverages used (tea, Coca-Cola, haldi and lemonade). The samples were immersed in each beverage for 10 minutes each day. Colour change was observed by spectrophotometer.
Statistical analysis used: One way ANOVA and posthoc LSD tests were used to find the difference in color change in the two resin composites when immersed in different beverages.
Results: Spectrum 3D resin composites showed less colour change as compared to Filtek Z 350 in different beverages. When discoloration in different beverages was considered, maximum discoloration took place in Haldi followed by Lemonade, Coca-Cola and Tea respectively.
Conclusion: The effect of interaction of different resin composites and various beverages depend on a multitude of factors. The color match of esthetic restorations in the oral cavity is affected by dietary habits.

Keywords: beverages, color change, resin composite, time

Introduction
Esthetic failure is one of the most common reasons for the replacement of restorations. Color changes in resin composites occur from intrinsic and extrinsic factors. Intrinsic factors involve chemical changes in the material. Extrinsic factors, such as, adsorption or absorption of stains, pose a major problem for esthetic restorations. Surface roughness is one reason for exterior discoloration [1].
Consumption of certain beverages may affect the esthetic and physical properties of the resin composite, thereby, undermining the quality of restorations [2]. The chemicals in beverages can lead to wear and surface degradation of composite restorations, resulting in unesthetic external pigmentation, such as, stains. Due to its low pH, ethanol can produce erosion and alter some properties of composites, as well [3]. Alcohol is also thought to act as a plasticizer of the polymer matrix [4]. It is not known if the alcohol in typical alcoholic beverages has a negative effect on the wear resistance of resin composites.
Proper color match of a dental restoration with the adjacent teeth is important not only at the initial stage of giving the restoration but also over a longer period of time. The composites are known to be susceptible to discoloration because of internal mechanisms, external contamination and staining. The newer universal composite systems are optimized in terms of composition to minimize internal discoloration but still not much attention is given to resistance to external staining.
Different types of composites may behave differently. The effect of different beverages on these two types of materials is relatively unknown.
Introduction of laminate veneers in 1970s marked the beginning of modern cosmetic dentistry by combining the principles of esthetics and tooth conservation.

Though porcelain veneers have established themselves as ultimate conservative anterior esthetic restorations because of their natural appearance, good wear resistance and color stability. But the composite veneers still take an upper hand in popularity because of several advantages over porcelain such as easier processing and repairing, less time consuming, less expensive and moreover recent improvements in mechanical and handling properties of composites. The newer universal composite systems combine the properties of earlier hybrid composites and micro filled composites. Thus these systems with improved mechanical properties have the advantage of more strength, better translucency and smoother surface finish thus providing an ideal material for veneering purpose. Still one of the properties of the composites that have to pass the test of time is their color stability. Composites are susceptible to discoloration that may be intrinsic or extrinsic [1, 2, 3]. Intrinsic factors involve discoloration because of alteration of the resin matrix itself or the interface of matrix and fillers, oxidation or hydrolysis in resin matrix [4, 5, 6]. Extrinsic factors for discoloration include staining by adsorption or absorption of colorants as a result of contamination from various exogenous sources [7, 14]. Thus dietary habits such as large consumption of soft drinks and beverages can also contribute to the staining of the laminates.

A Spectrophotometer is scientific standardized colorimetric equipment for matching and measuring colors that gives information about reflectance curve as a function of wavelengths in entire visible range and thus numerically specifies the perceived color of an object. This knowledge is important to the practitioner for the selection of restorative material for the management of patients, where an exogenous erosive habit is under treatment.

Materials and Methods

This study was conducted to evaluate the effect of four commonly consumed beverages viz. Tea, Coca-Cola, haldi and lemonade on color stability of two universal hybrid composites viz. Filtek Z 250 and Tetric-Ceram. Distilled water was taken as the control.

Two visible light-cured resin composites were used in this study.

Group 1: Nanohybrid composite Filtek Z 350

Group 2: Microhybrid composite Spectrum 3D

Forty samples for each material were prepared. The samples were cured as per the manufacturer's instructions.

Each sample was polished using the Super-Snap polishing system according to the manufacturer's instructions (Shofu Inc, Kyoto, Japan). The same operator polished all the samples in random sequence.

All the samples were stored at 37°C in distilled water for 24 hours for rehydration and completion of polymerization.

After 24 hours of storage, each material was randomly divided into four subgroups of 10 samples each, according to the beverages used.

Group 1A and 2A: tea

Group 1B and 2B: Coca-Cola

Group 1C and 2C: haldi

Group 1D and 2D: lemonade

250 ml of each solution was taken and specimens were immersed in solutions. Tea and distilled water were kept at a constant temperature of 50 ± 1°C in an incubator. Coca-cola was kept in a closed container in a dark place, at room temperature (20-25°C). Test solutions were changed after every 7th day. Color changes were measured in 10 days. Following removal from the staining solutions, the samples were dipped in distilled water and moved up and down ten times. The samples were then wiped dry with tissue paper and then placed in viewing port for color measurement. Statistical software SPSS 7.5 was used for analyzing the data. One-way ANOVA and posthoc LSD test was applied to see the statistical difference among the group.

Results

There were two variables in this study: Two resin composites and four immersion solutions. The interaction between these two variables produced statistically non-significant results in color change.

When discoloration of the two resin composites was considered, Spectrum 3D resin composites showed less colour change as compared to Filtek Z 350 in different beverages

When discoloration in different beverages was considered, maximum discoloration took place in Haldi, Lemonade, Coca-Cola and Tea respectively.

	N	Mean Color	Std. Deviation	Std. Error	F value	P value
Tea	6	2.75	0.41	0.17	30.519	0.001
Soft Drink	6	3.00	0.54	0.22		
Haldi	6	3.83	0.40	0.16		
Lemonade	6	3.08	0.66	0.27		
Control Gp	6	1.00	0.00	0.00		

		Mean Color	SD	S Error	P value	Significance
Tea	M Gp	2.66	0.577	0.33	0.675	Non-Significant
	N Gp	2.83	0.28	0.16		
Soft Drink	M Gp	2.83	0.763	0.440	0.436	Non-Significant
	N Gp	3.16	0.288	0.166		
Haldi	M Gp	3.66	0.57	0.33	0.325	Non-Significant
	N Gp	4.00	0.00	0.00		
Lemonade	M Gp	3.33	0.57	0.33	0.417	Non-Significant
	N Gp	2.83	0.76	0.44		

Discussion

The present study was conducted on two resin composites i.e. Spectrum 3D resin composites and Filtek Z 350 in different beverages. Long-term clinical performance and color stability of the nanofilled composites are yet to be known and proven. Commonly consumed nonalcoholic beverages (Coca-Cola and lemonade) were used as the discoloration media in the present study, to evaluate the discoloration of resin composites in an *in vitro* setting. During consumption, food or drink comes in brief contact with the tooth surfaces before it is washed away by saliva. However, in the previous studies, substrates usually contacted acidic foodstuff for a prolonged

period of time. Thus, the immersion regimen selected was to immerse each sample in the respective beverage for ten minutes each day. For the remaining part of the day the samples were kept in distilled water to mimic the neutralizing effect of saliva. According to the results of this study, both materials became significantly stained after they were subjected to the immersion regimen. This can be ascribed to the capability of acid media to soften resin-based restorative materials [10].

Overall, the Spectrum 3D resin composites showed less colour change as compared to Filtek Z 350 in different beverages. This result could be explained on the basis of different chemical compositions of both the materials. Thus, the degradation that took place could not be attributed to its higher/lower resin content. This was in accordance with the observations made in the previous studies, which stated that relatively small differences in the filler-resin ratio could not explain variations in water sorption [2, 11].

Staining of resins by beverages is caused by the adsorption or absorption of colorants by the resins [12]. And the resin's affinity for extrinsic stains is modulated by its water sorption rate [1, 13]. The increased synergism between filler particles and resin matrix may be responsible for the reduction in water sorption and solubility. Nanohybrid fillers seem to be less color-resistant than the micron-sized fillers due to the former's relatively high water sorption character.

As the interface between the resin and filler particles is one of the weakest points of the composite material, with a high sensitivity to water sorption, it may be supposed that hydrolytic degradation of this interface can modify the way in which light is scattered by the particles [11].

The smoother the surface, the more resistant the material was to staining [1].

When different beverages were compared, Haldi had the most degrading effect. No significant change was seen in distilled water. All the beverages used in the study were acidic with Coca-Cola being the most acidic (pH=1.57)>lemonade (pH=2.32). Lower pH was seen to negatively affect the wear resistance of composite materials [17]. Lower pH increased the erosion in polymers. Thus, the higher degradation that took place in Coca-Cola could be attributed to its lower pH.

When discoloration in Coca-Cola and alcoholic beverages is compared, the result of the present study is conflicting. However, the previous studies compared the staining ability of Coca-Cola with red wine, in which red wine caused more color change. Cola gains its color through the addition of caramel color and red wine, mainly from grapes. Probably the caramel in Coca-Cola has more staining ability than the colorants present in Whiskey.

It is difficult to extrapolate the results of this study to *in vivo* conditions. However, the results of this study can give an insight into how different resin composites may behave when exposed to different beverages, thus affecting the clinician's choice of material and the patient's control of dietary habits.

A number of factors are known to influence the intrinsic color stability as well as extrinsic stain resistance of the composites. In the present study it was taken care to minimize the different factors that could precipitate the staining of samples during polymerization, finishing and storage. It is evident from the literature that composite surfaces polymerized against mylar surface alone without subsequent polishing, stains more because of inferior physical properties of surface layer. The color measurements in the present study were carried out using a spectrophotometer, as color perception is a psychophysical phenomenon with variations, both between individuals and within an individual at different times and instrumental measurement has the advantage of obviating the subjective errors of color assessment.

Gross and Moser [8], and Yannikakis found that the staining intensity of coffee was higher than tea and water. Chan, Fuller and Hormati found that coffee caused more discoloration than tea and cola beverages. In contrast a study by Moon, Eystein and Ruyter on staining of resin based veneering materials with three heat cured and two light cured resins as test materials showed more discoloration by tea in comparison to coffee over an observation period of 48 hours. But at the same time, it reported that staining with tea was superficial and more easily removed in comparison to coffee stains after cleansing treatment with soap and toothbrush. However these results cannot be truly compared with the present study because of different test materials and smaller observation period. Tea was found to cause more discoloration in Tetric-Ceram than Filtek Z 250. This has been explained on the basis of nature of the filler particles present in Tetric-Ceram i.e. glass fillers have been reported to discolor more with tea. This is in agreement with the study previously reported in literature by Gross and Moser [8]. Which reported that composite with glass beads as filler (Prestige) stained more with tea. When the trend for color change was observed over the observation period of 1day to 1 month, it was noticed that Tetric-Ceram showed a greater amount of discoloration in the first two weeks in general, whereas Filtek Z 250 showed a marked increase in discoloration after 15 days, which could be due to inherent intrinsic properties of the composites. The possibility of a slow breakdown at matrix- filler interface because of water sorption and increased temperature cannot be ruled out. In our study, samples were stored at an increased temperature of 50°C to simulate a long-term clinical exposure. Thus tea was found to cause yellowing and reddening of the composites and is in agreement with previous studies and has been explained on basis of yellow component present in both the solutions [10]. The response to Coca-Cola varied among the test materials. The extremely low pH of Coca-Cola (approx. 2) can be a contributing factor to changes in the color characteristics of the materials. The control i.e. distilled water, was also found to cause small variations in color which may be due to increased temperature, causing increased water uptake by the materials and leaching out of few soluble components of the materials. From the present in-vitro study, it can be concluded, however, that the color match of esthetic restorations can be maintained over a longer period of time in the oral cavity by observing some restrictions on the dietary habits.

Conclusion

The results of this *in vitro* staining study showed that the effect of interaction of different resin composites and various beverages are depended on a multitude of factors.

Spectrum 3D resin composites showed less colour change as compared to Filtek Z 350 in different beverages. When discoloration in different beverages was considered, maximum discoloration took place in Haldi followed by Lemonade, Coca-Cola and Tea respectively.

References

1. Dietschi D, Campanile G, Holz J, Meyer JM. Comparison of the color stability of ten new-generation composites: An *in vitro* study. Dent Mater. 1994; 10:353-62.
2. Topcu FT, Sahinkesen G, Yamanel K, Erdemir U, Oktay

EA, Ersahan S. Influence of different drinks on the colour stability of dental resin composites. Eur J Dent. 2009; 3:50-6.
3. Badra VV, Faraoni JJ, Ramos RP, Palma-Dibb RG. Influence of different beverages on the microhardness and surface roughness of resin composites. Oper Dent. 2005; 30:213-9.
4. Ergucu Z, Turkun S, Aladag A. Color stability of nanocomposites polished with one-step systems. Oper Dent. 2008; 33:413-20.
5. Guler AU, Yilmaz F, Kulunk T, Guler E, Kurt S. Effects of different drinks on stainability of resin composite provisional restorative materials. J Prosthet Dent. 2005; 94:118-24.
6. Vichi A, Ferrari M, Davidson CL. Color and opacity variations in three different resin-based composite products after water aging. Dent Mater. 2004; 20:530-4.
7. Gupta G, Gupta T. Evaluation of the effect of various beverages and food material on the color stability of provisional materials - an *in vitro* study. J Conserv Dent. 2011; 14:287-92.
8. De Gee AJ, Ten Harkel-Hagenaar E, Davidson CL. Color dye for identification of incompletely cured composite resins. J Prosthet Dent. 1984; 52:626-31.
9. Palin WM, Fleming GJP, Burke FJ, Marquis PM, Randall RC. The influence of short and medium-term water immersion on the hydrolytic stability of novel low-shrink dental composites. Dent Mater. 2005; 21:852-63.
10. Ertas E, Guler AU, Yucel A, Koprulu H, Guler E. Color stability of resin composites after immersion in different drinks. Dent Mater J. 2006; 25:371-6.
11. Ahmed KI, Sajjan G. Color stability of Ionomer and resin composite restoratives in various environmental solutions: An *in vitro* reflection spectrophotometric study. J Conserv Dent. 2005; 8:45-51.
12. Patel SB, Gordan VV, Barrett AA, Shen C. The effect of surface finishing and storage solutions on the color stability of resin-based composites. J Am Dent Assoc. 2004; 135:587-94.
13. Bagheri R, Burrow MF, Tyas M. Influence of food-simulating solutions and surface finish on susceptibility to staining of aesthetic restorative materials. J Dent. 2005; 33:389-98.
14. Abu-Bakr N, Han L, Okamoto A, Iwaku M. Color stability of compomer after immersion in various media. J Esthet Restor Dent. 2000; 12:258-63.