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Effect of Fruit Juices and Aerated Beverage on the Colour Stability and Surface Roughness of Composite Resins. An In-Vitro Study

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Abstract

Background: One of the foremost challenges in restorative and aesthetic dentistry is to produce a restoration which looks natural and blends harmoniously with the oral environment. Defining aesthetics as “the art of the imperceptible”[1], color stability can be the difference between success and failure. Color stability, the property of material to retain its original color over a period of time, in a specified environment, is an important property of many materials used in dentistry.[2] However composites resins suffer in-service discoloration (staining) with time leading to patient dissatisfaction, additional time and money for replacement of restorations.[3]

Aim: The aim of the present study is to analyze the effect of two commonly consumed fruit juices (apple and orange) and an aerated beverage(Coca-Cola), on the surface roughness and colour stability of two different types of resin composites.

Materials & Method: In the present study, one hundred and twenty disc- shaped resin composite specimens were fabricated using Z350 XT and P60 resin composites (sixty each). These specimens were subjected to staining in various solutions, namely artificial saliva, coca cola, orange juice (fresh), orange juice (p), apple juice (fresh) and apple juice (p) for time intervals of 1 day, 7 days, 14 days, 28 days and 56 days, and were examined for surface roughness and colour changes using a surface profilometer and spectrophotometer respectively.

Results: The results of the present study show that there was a significant increase in surface roughness (Ra) and colour change (ΔE) in both the resin composite tested, at all the time intervals.

Conclusion: The silorane based resin composite (P60) exhibited better colour stability and relatively lower surface roughness when compared to methacrylate based resin composites (Z350 XT) in fruit juices and an aerated beverage.

Keywords: Fruits, Coca-Cola, P-60, Z350-XT.

Introduction

Colour matching is one of the most important characteristics of aesthetic restorative materials. Maintenance of colour throughout the functional lifetime of restorations is important for the durability of treatment. This characteristic is not constant among dental materials. Esthetic failure is one of the most common reasons for the replacement of restorations. Esthetic demands have created the need for dentists to have knowledge of colour and its three-dimensional nature, as well as factors that influence its stability.

Tooth colored composite resins with the methacrylate chemistry have been commonly and successfully used in restorative dentistry. They mainly comprise of monomeric resin matrix, silinated inorganic filler, polymerization initiator system, inhibitors for storage stability and pigmentation for shading [4,5] . Consumption of certain beverages may affect the esthetic and physical properties of the resin composite, thereby undermining the aesthetic quality of restorations[6]. The chemicals in beverages can lead to wear and surface degradation of composite restoration, resulting in unaesthetic external pigmentation, such as stains.

Several studies in literature have implicated dietary compounds as major etiological factor in staining of composite restorations that remain in prolonged contact with the dental surfaces[7-11]. The effects of such dietary compounds on methacrylate based resins have been investigated before, but have not been thoroughly studied for silorane based composite. The effects of different beverages on these two types of composites are relatively unknown. This knowledge is important for the practitioner, for the selection of restorative material for the management of patients, where an exogenous erosive habit is under treatment. The effect of storage period on these dietary compounds (staining agents) has not been reported earlier. Therefore the objectives of this study were to evaluate the effect of staining solutions and immersion time on color stability of silorane restorative material (Filtek P60) in comparison with its methacrylate counterpart (Z-350XT).

Materials and Method

This in-vitro study was carried out in Department of Conservative Dentistry & Endodontics, Saraswati Dental College, (Lucknow, India), in collaboration with the Department of Environmental Sciences, Dr. Babasaheb Bhimrao Ambedkar University (Lucknow, India) and the Department of Mechanical Engineering, Institute of Engineering and Technology(UPTU), Sitapur Road(Lucknow, India).

One Hundred and Twenty, disk-shaped samples with 8 mm diameter and 2 mm thickness, were prepared from both resin composite materials using a teflon mould. Each mould was placed between two glass slabs. The lower surface of the moulds were lined with mylar strips.

Disc shaped samples were prepared by addition of composite resin in two increments, the thickness of each increment was 1mm.

The composite resins were light polymerized with a LED curing light (D-Lux LED curing light) with an output power of 1250 mW/cm², according to the manufacturer's instructions.

After polymerisation, all specimens were removed from the mould and all surfaces were further light cured for another 20 seconds by the same curing light.

Figure 1: Filtek Z 350 XT Resin Composite (3M ESPE)

Figure 2: Filtek P 60 Resin Composite (3M ESPE)

Figure 3: Composite Restoration Kit

Figure 4: Sof-Lex ™ Finishing and Polishing Kit (3M ESPE)

Subsequently, all specimens were finished and polished with Sof-Lex™ aluminium oxide discs (3M/ESPE, St Paul, MN USA) mounted on an electric hand-piece with progressively finer grits at 10,000 rpm for 15 seconds with coarse and medium discs and followed by fine and superfine discs at 30,000 rpm for 15 seconds with intermittent usage of composite polishing paste according to manufacturer's instructions.This procedure was performed only on top surfaces of the samples while bottom surface was mylar strip finished (without finishing and polishing with soflex discs).

After polishing, all specimens were stored in distilled water at 37ºC for 24 hours, for completion of polymerization. All specimen preparation, finishing and polishing procedures were carried out by the same operator, to reduce variability.

These specimens were subjected to staining in various solutions, namely artificial saliva, coca cola, orange juice (fresh), orange juice (p), apple juice (fresh) and apple juice (p) for time intervals of 1 day, 7 days, 14 days, 28 days and 56 days, and were examined for surface roughness and colour changes using a surface profilometer and spectrophotometer respectively.

Figure 5(a): Six group of P60 Composite resin

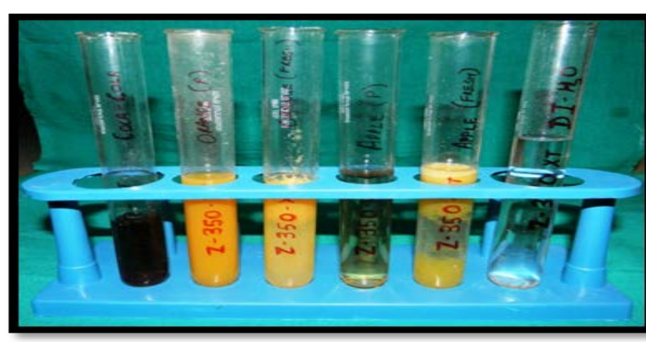

Figure 5(b): Six group of Z350XT Composite resin

Surface Roughness Assessment

The surface roughness of composite resins can be determined by a surface profilometer.

In the curent study, a Surface Profilometer (Mitutoyo – SJ-201, Mitutoyo Corp, Kawasaki, Kanagawa, Japan) was used to measure the surface roughness of each sample. (Figure 6)

Figure 6: Surface Profilometer (Mitutoyo – SJ-201, Mitutoyo Corp, Kawasaki, Kanagawa, Japan)

Colour Assessment:

The colour of composite resins can be determined by varying methods, including visual assessment and instrumental measurement by a colourimeter or spectrophotometer.

In the current study, a reflectance spectrophotometer (Medical High Technology SpectroShade™ Micro, Optic Research, Switzerland; Version 2.41) was used to measure colour change for each specimen (Figure 7).

This system uses two D65 (daylight) light sources illuminated at 45° and reflected to the detector screen at0°.

Figure 7: Reflectance Spectrophotometer

The colour difference in each sample between two immersions was calculated by Commission Internationale de l'eclairge (CIE) L*a*b* formula

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

{L* represents value (ranges from (100) white to (0) black), a* refers to chromacity in red and blue axis (+a red/ -a green) and b* refers to chromacity in yellow and blue axis (+b yellow/ -b blue)}.

Statistical Analysis

SPSS Version 17.0 was used for statistical analysis. Descriptive analysis that includes mean and standard deviation was determined for each of the test groups. To test the significance and possible interactions of each factor, repeated measures analysis of variance (ANOVA), with one within-unit factor (three measurement times) and three between-unit factors (two materials and six staining solutions) were used.

Bonferroni post hoc tests were applied to each factor where significant differences between-unit factors were found. The level of significance (p-value) for all statistical testing was set at a ≤ 0.05.

Results

Table 3a, 3b, 3c, 4a, 4b, 4c

The results of the present study show that there was a significant increase in surface roughness (Ra) and colour change (ΔE) in both the resin composite tested, at all the time intervals.

The silorane based resin composite (P60) exhibited better colour stability and relatively lower surface roughness when compared to methacrylate based resin composites (Z350 XT) in fruit juices and an aerated beverage.

Discussion

Surface Roughness

When surface roughness was compared between the two resin composite groups, while comparing two staining solutions at a time, it was observed that significantly higher profilometer readings of surface roughness were observed in the Z350 XT resin composite group all time intervals as compared to the P60 resin composite group when exposed to:

(i) Artificial saliva or Coca Cola.($p<0.001$).

(ii) Orange (Fresh) or Orange (P).($p<0.001$).

(iii) Apple (Fresh) or Apple (P). ($p<0.001$).

When the overall increase in surface roughness was compared among both the resin composite groups, it was observed that, profilometer readings of surface roughness were maximum with Coca cola (Z350 XT) > Coca cola (P60) > Orange – fresh (Z350 XT) > Orange – packed (Z350 XT) > Apple – fresh (Z350 XT) > Apple – packed (Z350 XT) > Orange – fresh (P60) > Orange – packed (P60) > Apple – fresh (P60) > Apple – packed (P60)

These observations were consistent with a similar study by **Bansal K. et al**[8] in 2012, in which the silorane based resin composite (Filtek P90) showed an overall less colour change when compared to its methacrylate based counterpart, when immersed in Coca-cola, whiskey, nimbooz and distilled water.

In a recent study by **Prashanthi S.M. et al**[12]in 2015 it was inferred that food stuffs with low pH have greater erosive effect. Low pH affected the surface integrity of polymers. This was because under acidic conditions, the polymer surface was appreciably softened by loss of structural ions. Yoghurt and lime exhibited a similar behavior. The acidic ingredients in yoghurt and lime for eg. lactic acid and citric acid might have caused surface dissolution of polymeric surface leading to much paler appearance. Hence specimens after their specified immersion period when observed visually showed a lighter color match when compared to the control group (distilled water).

Lower pH increased the erosion in polymers[13]. Thus, the higher degradation that took place in Coca-Cola could be attributed to its lower pH.

More surface roughness change in Coca-Cola is supported by an earlier study in 2005 by **Badra V.V. et al**[14], in which Coca-Cola caused a significant increase in surface roughness than sugar cane spirit (alcoholic graduation 39.00% v/v)29.

Colour Change

When a day-wise comparison of colour change in the Z350 XT resin composite group was made, it was observed that, the spectrophotometer readings were maximum with Coca cola > Orange(fresh) > orange(P) > Apple(Fresh) > Apple(P) > Artificial saliva

The results of this study were consistent with those of a study by **Kang A. et al in 2012**[7], where the methacrylate based (Z250, Z350) resin composites showed greater colour change in the staining solutions when compared to the silorane based (P90) resin composite.

When colour change was compared between the two resin composite groups, while comparing two staining solutions at a time, it was observed that a significantly higher spectrophotometer reading was observed in the Z350 XT resin composite group all time intervals as compared to the P60 resin composite group when exposed to:

(i) Artificial saliva or Coca Cola.($p<0.001$).

(ii) Orange (Fresh) or Orange (P).($p<0.001$).

(iii) Apple (Fresh) or Apple (P). ($p<0.001$).

When the overall increase in colour change was compared among both the resin composite groups, it was observed that, spectrophotometer readings for colour change were maximum with Coca cola (Z350 XT) > Coca cola (P60) > Orange – fresh (Z350 XT) > Orange – packed (Z350 XT) > Apple – fresh (Z350 XT) > Apple – packed (Z350 XT) > Orange – fresh (P60) > Orange – packed (P60) > Apple – fresh (P60) > Apple – packed (P60). This observation was consistent with a study by **Barutcigil C et al** in 2012[10], in which the methacrylate based (Z250 XT) resin composite exhibited greater colour change when immersed in four staining solutions (red wine, coffee, cola, and tea).

Conclusion

The results of this in-vitro staining and surface roughness study showed that the effect of interaction of different resin composites, various beverages, and time, depended on a multitude of factors. The silorane based resin composite (P60) exhibited better colour stability and relatively lower surface roughness when compared to methacrylate based resin composites (Z350 XT) in fruit juices and an aerated beverage. Coca cola, among the six beverages, caused the highest discoloration and surface roughness change in both the tested resin composites. Both the resin composites exhibited increased staining and surface roughness change, over time, on selective exposure to fruit juices (freshly prepared and packaged) and an aerated beverage. 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. Future studies warrant the need for in-vivo evaluation of the same resin composites to simulate these results in clinical conditions.

References

1. Mendes WB, Paula E, Bonfante G. Seleção de Cores sem Mistério. In: Gonçalves EANG, Feller C. Atualização na clínica odontológica: a prática na clínica geral. São Paulo: Artes Médicas; 1998. p. 100-20.
2. Bowen R: Properties of a silica-reinforced polymer for dental restorations. J Am Dent Assoc 1963, 66:57-64.
3. Alandia-Roman CC, Cruvinel DR, Sousa AB, Pires-de-Souza FC. Effect of cigarette smoke on color stability and surface roughness of dental composites. J. Dent. 2013 Aug;41 Suppl 3:e73–79.
4. Ayad NM. Susceptibility of restorative materials to staining by common beverages: an in vitro study. Eur J Esthet Dent. 2007 Summer;2(2):236-47
5. Kang A, Son SA, Hur B, Kwon YH. The color stability of silorane- and methacrylate-based resin composites. Dent. Mater J. 2012;31(5):879–884.
6. Mckenzie AM, Linden RWA, Nickolson JW. The effect of Coca-Cola and fruit juices on the surface hardness of glass- ionomers and compomers. J Oral Rehabil 2004; 31:1046-52.
7. Kang A, Son SA, Hur B, Kwon YH. The color stability of silorane- and methacrylate-based resin composites. Dent. Mater J. 2012;31(5):879–884.
8. Bansal K, Acharya SR, Saraswathi V. Effect of alcoholic and non-alcoholic beverages on color stability and surface roughness of resin composites: An in vitro study. J. Conserv Dent. 2012 Jul;15(3):283–288.
9. Erdemir U, Yildiz E, Eren MM. Effects of sports drinks on color stability of nanofilled and microhybrid composites after long-term immersion. J Dent. 2012 Dec;40 Suppl 2:e55-63.
10. Barutcigil C, Yildiz M. Intrinsic and extrinsic discoloration of dimethacrylate and silorane based composites. J. Dent. 2012;40:e57–63.
11. Gonulol N, Gilmaz F. The effects of finishing and polishing techniques on surface roughness and color stability of nanocomposites. J Dent. 2012 Dec;40 Suppl 2:e64-70.
12. Prashanti SM, Dilip GN, Ravindra K, Srikant N, Kumar MRB. Effect of Staining Solutions on Colour Stability of Silorane & Methacrylate Restorative Materials. Int J Biomed Sci. 2015 Mar; 11(1): 29–34.
13. Ortengren U, Andersson F, Elgh U, Terse Lius B, Karisson S. Influence of pH and storage time on the

sorption and solubility behaviour of three composite resin materials. J Dent 2001;29:35-41.

14. 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