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Original Research Article

Effect of tooth brushing on color changes of esthetic restorative materials

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ABSTRACT

Background: The major problem of dental restorative material over time is color changes, and this discoloration is caused by either intrinsic or extrinsic factors. Intrinsic factors include the staining of the material itself caused by changes in the resin matrix and the interface between matrix and fillers.
Methods: The study was conducted using resin composite material (shade A2), and four solutions (distilled water, strawberry, pomegranate, and red grape juices). The specimens were distributed into four groups for immersion in one of the four solutions. Authors divided each group into brushing and non-brushing subgroups.
Results: When immersed in water, shade was changed from A2 to A3.5 and A4 (light to dark) in brushing group and no overall change was noticed in non-brushing group. However, there was statistically significant difference between the two groups.
Conclusions: All types of juices caused distinct color change. However, brushing caused more color change as compared to specimens with no brushing.

Keywords: Brushing effects, Color stability, Dental composites

INTRODUCTION

Increase in the esthetic demands among patients, along with the improvements of the composition and mechanical proprieties of resin-based materials have resulted in the increased use of composite restorations.[1,2] Under oral environment conditions, these improvements gave more strength and durability to the composite. PH changes and humidity might increase the composite biodegradation over time.[3] Dental materials under oral conditions are exposed to chemical agents present in saliva, food and beverages.

Prior studies have shown that surface degradation of restorative materials can be caused by different kinds of food and beverages.[4] Their components can soften the organic compositions and change the surface hardness.[5] Tooth brushing is another factor that influences the longevity of the composite restorations along with the chemical environment conditions. Tooth brushing has an effect on the dental materials wear processes by its abrasion contents, which results in surface hardness, loss of contour also staining and plaque retention.[6] Thus it is important to have smooth surfaces restorations to prevent plaque accumulation.[7-9]

Bacteria retain in a mean roughness of 0.2µm.[10,11] Patient's evaluation showed that they detect differences of surface roughness between Ra 0.25 and 0.5µm with their tongues.[12] Therefore, a smooth surface is also important for patients' comfort.

And furthermore, rough surfaces tend to stain faster.[13] Finishing and polishing are time-consuming procedures in dental practice. Surface sealants were first developed for provisional restorations. Surface sealant application on provisional restorations has significantly reduced bacterial adhesion.[14] Therefore it was a benefit to use surface sealant for direct composite restorations. It minimizes micro-leakage at the margins of the restorations and ensures the glossy surfaces.[15,16]

It has been observed in many studies that sealants provide a more regular, uniform surface and mask the resin composite surfaces defects.[17-19] It also has been observed that the application of surface sealant improves the surface texture.[20] Also it improves the resistance to abrasion and discoloration therefore it maintains the esthetic appearance.[21] The effectiveness of these materials depends on the material viscosity and wettability to penetrate into the restorations before it polymerizes, thus it is not able to compensate all surface irregularities.[22] The major problem of dental restorative material over time is color changes, and this discoloration is caused by either intrinsic or extrinsic factors.[23] Intrinsic factors include the staining of the material itself caused by changes in the resin matrix and the interface between matrix and fillers.[24] Extrinsic factors include changes in color by adsorption or absorption of colorants from exogenous sources as colored food and beverages.[25-27]

The oral environment continuously exposed to various media that have the capacity to stain and change the dental restorations surfaces causing esthetic regression. That's why it is important to understand how long-term daily expose to common kinds of beverages can change the color of restorative materials and whether or not these changes are perceptible to human eyes. To evaluate color changes of tooth-colored restorative materials, spectrophotometer and colorimetric can be used.[28,29] Staining effects of beverages has been studied in many researches before but most of the researches focused on studying the staining of coffee and tea since these are the most popular beverages in adulthood.[30] Previous studies performed on enamel found that some of the extrinsic stains can be removed by tooth brushing with dentifrices.[31]

The aim of this study is to evaluate the effect of various beverages and tooth brushing on the color changes of resin composite restorations. The null hypothesis was tested in this study is that there are no differences among three different solutions on color stability of three different tooth-colored materials; and that tooth brushing doesn't affect the stain ability of these restorative materials.

METHODS

The study was conducted using resin composite material (shade A2), and four solutions (distilled water, strawberry, pomegranate, and red grape juices). The specimens were distributed into four groups for immersion in one of the four solutions. We divided each group into brushing and non-brushing subgroups.

Specimens were prepared in the form of discs measuring 10mm in height, 8mm in width and 2mm in thickness. These composite materials were prepared in the clinics using the light cure and all specimens were measured for their uniformity in size and shape.

Inclusion criteria

Only composite specimens of shade A-2 were included in this study.

Exclusion criteria

All other shades than A-2 were excluded from the study.

Study period

- Literature review (2 weeks)
- Conduction of experiment (2 months)
- Manuscript writing (1 month)

Specimens were immersed in solutions for 3 hours per day at room temperature over a 60-day test period and replaced in distilled water following immersion. The solutions were replaced daily.

The specimens in the brushing subgroups were brushed with toothpaste (Oral-B Stages Fruit Blast, Gillette Group, London, UK) once a day using an electric toothbrush (Braun Oral-B Plak Control Ultra) for 5 seconds to each surface.

Prior to color measurement, specimens were drained of liquid, lightly rinsed with distilled water, and dried with paper tissue.

Color was measured using a vita shade guide with B1 being the lightest and C4 the darkest shade. The shade detection was completed by two examiners, which required the inter-examiner reliability using Kappa test. The value was achieving as 0.90, which is a highly acceptable agreement between the two examiners. It was made sure that the two examiners did not have any color discrepancy or other ocular disorders before they conducted the examination.

Data was analyzed using the statistical software SPSS for Windows, Version 16 (SPSS Inc., Chicago, IL, USA).

RESULTS

Shade was changed from A2 to A4 (light to dark), however not statistical difference was found between the two groups. Table 1 also shows that the median, range, minimum and maximum values did not differ when compared on the basis of brushing and non-brushing

groups. It can also be noted that the chi-square test gave a p-value of 1.000, which shows highly insignificant comparison between the two groups. This suggests that the strawberry juice did not have an effect on the color of composite specimens.

Table 1: Descriptive statistics for specimens immersed in strawberry juice.

	Immersed in strawberry juice		P-value
	Brushing group	Non-brushing group	
Median	A4	A4	1.000
Range	A4	A4	
Minimum	A4	A4	
Maximum	A4	A4	

Table 2 shows that the shade was changed from A2 to C3 and C4 (light to dark). These findings can be observed in brushing and non-brushing groups using their median, range minimum and maximum values. However no statistically significant difference was found between the two groups as the chi-square test gave a p-value of 0.633. This suggests that the grape juice did not have an effect on the composite specimens.

Table 2: Descriptive statistics for specimens immersed in grape juice.

	Immersed in grape juice		P-value
	Brushing group	Non-brushing group	
Median	C4	C4	0.633
Range	C3	C4	
Minimum	C3	C4	
Maximum	C4	C4	

Table 3: Descriptive statistics for specimens immersed in pomegranate juice.

	Immersed in pomegranate juice		P-value
	Brushing group	Non-brushing group	
Median	A4	C4	0.247
Range	A4	C4	
Minimum	C1	C4	
Maximum	A4	C4	

Shade was changed from A2 to A4 and C1 in brushing group (light to dark), whereas from A2 to C4 (light to dark) in non-brushing group (Table 3).

No statistically significant difference was found between the two groups as chi-square test gave a p-value of 0.247. It can be noted from the findings that median, range, minimum and maximum values indicated no major change in the shades of composite after they were immersed in pomegranate juice.

Finally, Table 4 shows the change in shade was observed from A2 to A3.5 and A4 (light to dark) in brushing group and no overall change was noticed in non-brushing group. However, there was statistically significant difference between the two groups as the chi-square produced a p-value of 0.002. It can be appreciated from the table that the median value for brushing group was A4 and A2 for non-brushing group. Similar findings were observed for range, minimum and maximum values.

Table 4: Descriptive statistics for specimens immersed in water.

	Immersed in water		P-value
	Brushing group	Non-brushing group	
Median	A4	A2	0.002
Range	A4	A2	
Minimum	A3.5	A2	
Maximum	A4	B3	

DISCUSSION

This study was conducted to measure any possible change in shade when the tooth with composite restoration is exposed to various types of solutions under brushing or non-brushing conditions. When the specimens were immersed in strawberry juice, both groups (brushing and non-brushing) showed a similar change in shade from very light to very dark, whereas the difference between two groups was not statistically significant. Similarly, the specimens showed change in shade when immersed in grape and pomegranate juices. It was noted that the extent of color change was overall similar among the groups. Reason behind this finding could be the presence of sugar present in these artificial beverages.[32]

Similar to present study findings, distinct color change was recorded in composites when exposed to grape juices.[33] Statistically significant difference was seen between brushing and non-brushing groups when the specimens were immersed in water. No change in color was observed in non-brushing group, whereas clear change in shade was observed in the brushing group. This has been proven in the past as dentifrices and tooth brushing cause change in shade as far as composite is concerned.

It is possible that some patients may use the teeth whitening pastes as a regular product in their daily routines. This may play an important role in the chances of shade change over the course of time. Since this study involved groups with brushing and non-brushing techniques, it is imperative to understand the effect of these on the extent of shade change.[34]

One of the previous studies showed that there was a significant change in the composite shade when the specimens were immersed in coffee and fruit juices. However, this shade change was reversible and was controlled by brushing. Furthermore, continuous exposure of these drinks resulted in a permanent shade change which was not possible to be removed by brushing.[35] Another study gave significant findings on the color change of different types of composites when immersed under drinking fluids of various kinds.[36]

There are factors that play an important role in the beverages affecting the shade of composites in the oral cavity. This study was done in laboratory; therefore, the natural environment was missing. Factors including saliva, temperature and pH of oral cavity are essential in determining the extent of shade change of composites.

CONCLUSION

All types of juices caused distinct color change. However, brushing caused more color change as compared to specimens with no brushing. Natural oral conditions may alter the overall outcome of these investigations.

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