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ANALYSIS THE EFFECT OF DIFFERENT MOUTHWASHES ON DISCOLORATION OF FOUR TYPES OF RESIN COMPOSITE

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ABSTRACT

Objectives: stability of resin composite color during the time is one of the most influential factors in the success of restoration. Color change of composites can lead to patient dissatisfaction and in the long time will lead to failure in treatment. So the aim of this study is evaluate the effects of four common types of mouthwashes in the market on stability of color in four types of resin composite.

Materials and methods: prepared two hundred disc-shaped samples with dimensions of 2 * 7. Fifty sample for each of four composites (Z250, Heliomolar, Z350 XT, and Z250 XT). All samples were immersed for 24 hours at 37 ° C in the artificial saliva in the incubator. The initial colorimetric conducted with ((L*,a*,b*) vita easy shade compact in the CIELAB system.After the initial measurement, the samples were divided randomly into five sub-groups and were placed in 20 ML of case study solution(Oral_, B, Listerine, Colgate plax, irsha & saliva) at 37 ° C for 24 hours in the incubator. Then colorimetric was done for each

sample. The obtained data were examined with two-way analysis test of variance (ANOVA) and (Tukey's HSD) and P<0/05 was significant.

Results: All samples which are dipped in mouthwash showing a significant color change. Most discoloration was observed in the composite of Z250 and least discoloration was observed in the composite of Z350 XT. In between of mouthwashes, Oral B created most discoloration.

Conclusion: All materials of this study after immersion in Mouthwashes, showing change in its colors. Composite of Z250, have most discoloration. In most cases of samples, clinically color changes were acceptable. So use of these mouthwashes increases the possibility of changing the color of composites.

Keywords: color change, color stability, resin composite, mouthwash

1- INTRUDUCTION

In recent decades resin composites for having sufficient strength, initial great beauty, cost less than ceramic and tooth connections has become restorative material selected by most dentists which have particular appeal among patients(1).

The success of composite resin restorative materials greatly depends on its color stability. So that the color change is one of the most common causes for frequent switching of composite restorations (2).

The color change can occur with various internal or external reasons. Changes in filler, size and distribution of filler particles, resin matrix and type of photo initiator can be named as internal factors in changing colors. (3, 4, 5).External color change can be due to adsorption superficial and deep pigments with external origin caused by diet, poor mouth health care and habits such as smoking and associated with the type of dye particles, time of contact with the dye environment and kind of used composite(5,6). External color change if not penetrated to the lower layer, can be eliminated by polishing (7, 8).

Nowadays, stability of composite color extensively tested and examined (9).Different studies have shown composites in contact with a solution such as wine, tea, soft drinks and coffee have color change. In addition to these factors color change in mouthwash due to common use of them as another factor for create to color change. Mouthwashes for have decomposition and anti-gingivitis properties, eliminate bad breath and have cooling effects (10). However, continued use of mouthwashes can endanger oral tissues and dental materials (11). Bagis and colleagues have reported that using mouthwash for 3 weeks can change the color of natural teeth and this discoloration

not acceptable from perspective of clinically (12). Also, some studies have shown that mouthwashes contain alcohol, chlorhexidine and benzydamine HCL cause discoloration of tooth (12). However, studies about the impact of mouthwashes tooth restorative materials such as composites have been limited. Mouthwash solutions have different components such as detergents, emulsifiers, pigments, organic acid which that can cause discoloration in the composite (13). Composite resins are classified based on the size, composition and type of filler and physical and mechanical properties (14). Three groups of composites that are used more frequently are including: Micro fill composites, Nano composites and micro hybrid.

Recent advances in the manufacture of resin composites such as increasing the filler content, reducing the diameter of the filler particles and increasing the hydrophobic properties may be effective in the resistant of this material to change color. However still a major problem is the composites color stability (15).

Using of nanotechnology in the production of filler particles leading to produce Nano composites which that containing Nano particles with size of 25 nm and small grains with an average diameter of 75 nm. It seems that the resistance of these new materials to change of color in the effect of environmental factors is greater than the Micro hybrid composite (16).

Due to increasing consumption of Mouthwashes, and limited number of studies in relation to their effect on composite immunoreactivity, this study was done with the aim of investigate the effect of 4 mouthwashes on the color stability of 4 kind of resin composite.

Zero hypotheses which examined in this study include: Mouthwashes cannot increasing the colorimetric of resin composites.

The impact of kind of mouthwashes oncolorimetric of the composite is the same. And amount of colorimetric in the Nano field, Micro hybrid, and Micro fill and Nano hybrid is the same.

2-MATERIALS AND METHODS

4 kinds of mouthwash (Irsha, Listerine, Colgate, Oral-B) and 4 restorative materials (Heliomolar, Z250, Z250XT, Z350XT) were used in this study. Artificial saliva was used as a control group. Material specifications which used in this study are shown in Tables 1 and 2.

Two hundred disc-shaped samples (50 from each composite) in the pre-prepared celluloid generator with the dimensions of 2*7 with same size with VITA Easyshade Compact (VITA Zahnfabrik, Bad

Säckingen, and Germany) were prepared. Composites with using of composite stylus were placed inside the generator. Its surface is compressed by transparent tape (Polyester Matrix Strip (Mylar Strip, SS White Co., Philadelphia, PA, USA) and glass (with thickness of 1 mm) in order to prevent air trapping and create a smooth surface. Each sample were exposure with light curing units (LED Valo (Ultra dent Products, South Jordan, USA) for 20 seconds for each of the upper and lower levels. In order to unify the device away from the samples surface, head of device vertically contact with the glass. Output light intensity of device before use was controlled by (Kerr (Demetron LED Radiometer, Kerr, Orange, USA).Lower surface of samples marked by scalpel then upper surface of the sample respectively polished with 600-800-1200 silicon carbide paper under the running water.

To complete the process of polymerization all samples were dipped for 24 hours at 37 ° C in an incubator in artificial saliva. The surface of samples was washed under running water after exit of artificial saliva and was completely dry then initial colorimetric was done for each sample with using a spectrophotometer (Vita Easyshade Compact) in CIELAB system on a white background. In this system, index L represents the amount of light in color, the index a represents a green or red and index b represents blue or yellow color. Before each colorimetric, calibration for each device will performing according to the manufacturer instructions. For colorimetric of samples using from colorimetric program for one part of the device and head of device placed perpendicular to the surface and in contact with the sample. And the amounts of L, a and b were recorded for each sample.

After initial measurement, 50 samples from each group of composite were divided to 5 sub-groups based on the type of mouthwash solution and the control group. The samples were dipped for 24 hours over two years, equivalent to two minutes daily use of mouthwash to 20 ml of solution at 37 ° C. During the study samples were kept inside sealed containers in the dark environment in the incubator.

After 24 hours, the samples were exit from the solution and were washed under running water. Then each sample was completely dry and its color was measured again with previous techniques.

Amount of change color ΔEab for each sample was calculated by the following formula:

$$\Delta Eab=[(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$$

The data obtained by statistical software SPSS 22 and test Two-way ANOVA and multiple comparisons Tukey Were

analyzed and significance level of P<0.05 was achieved.

3-RESULTS

Tables 3 and 4 shown mean and standard deviation of discoloration (Δ E) for each materials after placed in the test and control solutions. The results of this study observed that all samples observed discoloration after placed in mouthwashes (figure 1). Among this studied materials, most change in color observed in Micro hybrid ΔE (-5/578, z250). Difference between ΔE for Composite z250 and heliomolar ،Z250XT و Z350XT was significant. (Respectively0.009, 0.001, 0.000).Lowest color change observed in Composite Nano fill (ΔE =3/567) Z350XT.Difference between ΔE of this Composite with Composites heliomolar and Z250 was significant (p value respectively 0.025 and 0.000) but with Composite Z250XT was not significant.

Among the tested solutions, most discoloration was observed in mouthwash (ΔE=5/712) Oral-B and least change of color observed in artificial saliva (ΔE=3/070) among of Mouthwashes, least color change was related to Listrerine (ΔE=3/939). Among of difference between mouthwashes, Oral-B with Listerine،Irsha and artificial saliva was significant (p value respectively 0/000 ، 0/038 and 0/000) as well as the difference between artificial saliva with Irsha and Colgate was significant (p value respectively 0.000 and 0.000).

Also, all samples dipped in mouthwashes showed color change more than 3.3.

Table 1: consumption Composite Specifications

manufacturing factory	Filler size	Volumetric Percent	Compound	color	type	composite
Ivoclar-vivadent.Liechtenstein,	**µm**0/04-0/2	%64	**Resin:Bis-GMA ,UDMA,DDMA/colloidal filler:silicon dioxide, ytterbium**	**A1**	**Micro-fill**	**Heliomolar**
3M-ESPE. Minnesota, USA	**µm**0/01-3/5	%60	**Resin:Bis-GMA,Bis-EMA,UDMA, filler: Zirconia/silica**	**A1**	**Micro-hybrid**	**Z250**
3M-ESPE.Minnesota, USA	**20**	**%68**	**Resin:Bis-GMA,UDMA, Bis-EMA , PEGDMA, Filler:Zirconia/silica**	**A1**	**Nano hybrid**	**Z250 XT**
3M-ESPE. Minnesota, USA	**nm**20-75	%78/5	**Resin:Bis-GMA,Bis-EMA,UDMA, TEGDMA, filler: Zirconia/silica**	**A1**	**Nano fill**	**Z350 XT**

Table 2: Specifications of artificial saliva and mouthwashes

Mouth rinse Composite	Oral_B	Irsha	Colgate	Listerine	Saliva
Heliomolar	7.27±3.9(a)	3.67±1.68(bc)	5.56±1.42(ab)	3.41±1.1(bc)	2.5±1.4(c)
Z250	7.36±3.25(a)	5.19±3.71(a)	5.9±1.007(a)	5.54±2.50(a)	3.97±2.8(a)
Z250XT	5.25±2.4(a)	4.76±0.9(ab)	3.9±0.95(ac)	3.7±1.3(ac)	3.28±1.17(bc)
Z350XT	2.96±1.02(a)	5.37±2.68(b)	3.84±1.45(ab)	3.18±1.4(ab)	2.46±1.73(a)

Table3. Mean and standard deviation of each changes color due from solution in different Composite in each level with the same letters have not significant different

Manufacturer	pH	Compound	Brand
Procter & Gamble Schwalbach am Taunus ,Germany	5/24	Aqua, Glycerine, polysorbate, Aroma, Methylparoban, Cetylpyridinium chloride, sodium fluoride(0.05%), Sodium benzoate, Propyloparaben, Cl42051, Cl47005	Oral-B Pro-Expert
Johnson & Johnson, Santa Palomba, Italy	4/03	Aqua, Propylene Glycol, Sorbitol, Poloxamer 407, Sodium Lauryl Sulfate, Eucalyptol, Benzoic Acid, Sodium Benzoate, Methyl Salicylate, Thymol, Sodium Saccharin, Sodium Fluride (220 ppm), Mrnthol, Sucralose, Aroma, Cl42053	Listerine
Colgate-Palmolive, New York, USA	5/88	Aqua,Glycerin ,Propylene Glycol ,Sorbitol ,Polysorbate 20 ,Sodium Benzoate ,Menthol ,Aroma ,Cetylpyridinium Chloride ,Sodium Flouride ,Sodium Saccharin ,CI 42090 ,Contains: Sodium Fluoride 0.025% (112 ppmF^-)	Colgate Plax
,Healing medicine ,Karaj Iran	6/77	Alcohol, Glycerine, Synperonic, TSPP, SLS, Benzoic acid, Allantoin, benzoate, fluoride 0.05%, Aroma, Cl42090, Cl 19140, Demineralised Water	Irsha
BIOCODEX, Beauvais, France	6/75	Potassium chloride, sodium chloride, Magnesium Chloride, Calcium Chloride, Dipotassium Phosphate, Monopotassium phosphate	Hypizalix Artificial) (saliva

Table4. Mean and standard deviation of color changes of Composite in each level with same letter have not significant different.

Composite Mouth rinse	Heliomolar	Z250	Z250XT	Z350XT
Oral_B	7.27±3.9(a)	7.36±3.25(a)	5.25±2.4(ab)	2.96±1.02(b)
Irsha	3.67±1.68(a)	5.19±3.71(a)	4.76±0.9(a)	5.37±2.68(a)
Colgate	5.56±1.42(a)	5.9±1.007(a)	3.9±0.95(b)	3.84±1.45(bc)
Listerine	3.41±1.1(a)	5.54±2.50(a)	3.7±1.3(a)	3.18±1.4(ab)
Saliva	2.5±1.4(a)	3.97±2.85(a)	3.28±1.17(a)	2.46±1.73(a)

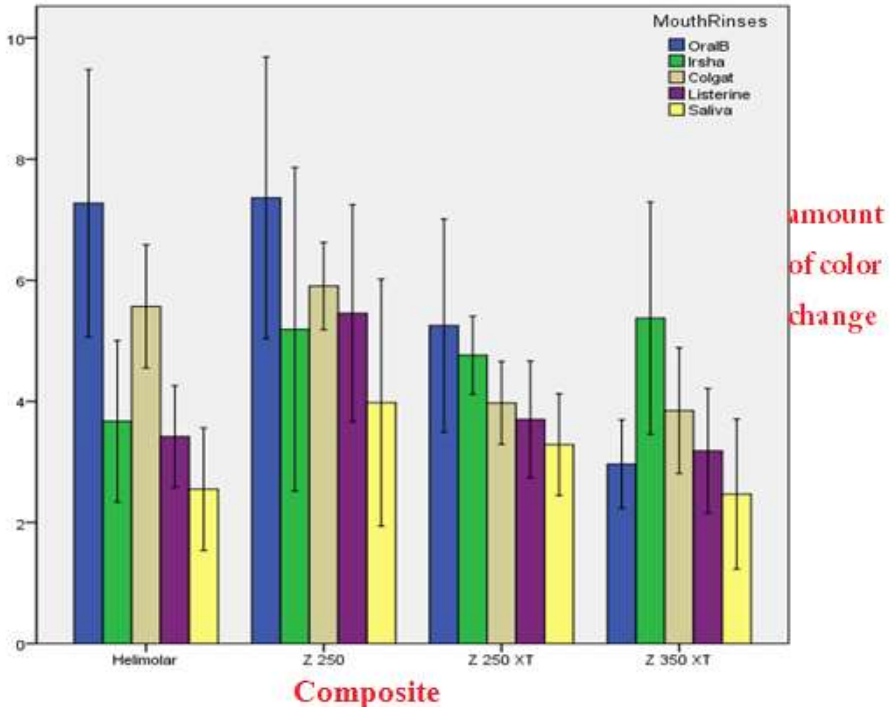

Figure1. Column chart for color change of composites in different solution

4- DISCUSSION

In this study, theeffects of 4 types of mouthwashes on the color change four types of composite resins were evaluated.According to results of this study,daily use of mouthwash can increase the risk of staining the resin composites which rejects the zero hypothesis of this study.

The findings of this study showed color change in composite Z250 significantly higher than the composite Heliomolar،Z250XT و Z350XT. And color change in composite Z250XT was lower from other composite. In a study Amikhatir et al the results were consistent with this study and show that Micro-hybrid composite resin was more talent in the field of color change than Nano fill(18). Other results are consistent with our results is Erdemir and colleagues which say that the color change is more in Z250 Z350.

Nano-composites are dispersed in class of new material with inorganic filler particles from resin matrix. In compared with micro hybrid composites, these materials have improved properties, such as modulus of elasticity, mechanical strength and better color stability. Nano-filled resin composite Z350 have silicate filler with particle size of 20nm and plenty of zirconia particles / silica with the size between 0.6 to 1.4 µm. whatever the particles was smaller, the polymer network have less absorption of water which causes less degradation of matrix and particles and smaller size of filler particles creating a more smooth surface after polishing which that is less talented to external color change and as a result, occurs less color change (21).

Also according to the study Kawauchi and colleagues Micro-hybrid composite with lower index of light transmission, due to existence particles with various sizes that impact on higher values of ΔE (22).Another reason for the high tonality in Z250 is high proportion of silane in composite structure. Because silane absorbs more water, silanization of filler particles plays an important role in changing colors (23, 24).

In contrast to our findings of several previous studies, less color change was reported in Z250 than Z350.Z350 have same matrix Z250 except that TEGDMA percent which is more in Z350. kalachandra and colleagues show that increasing TEGDMA in Z350 from 0٪ to 1٪can increase water absorption from 3 to 6 percent in composites with Bis-GMA (26). Over the time and with water absorption, resin composite enter to process of Plasticizing in resin part and the hydrolysis of silane and thus creating microscopic cracks. The cracks and gaps at the junction of filler and matrix let to penetrate the color materials and color change in the composites. However, amount of composite water absorption in addition to the amount and type of resin depends on the quality of filler connection and amount and size of filler (27, 28).

According to results of this present study, Heliomolar composite showed the greatest change colors after the composite Z250. Reported during on this process, more rigid particles protruding from surface of filler and softer matrix is removed. So that the micro-filled composite showing Smooth surface than the hybrid composites (29) which absorbing less foreign pigment (30,31) which this reason could be a justification for less changing the color than composite Z250.

According to the findings, compare ΔE in the composite Z350 XT and Z250 XT was not significant which is consistent with study of Heshmat and colleagues.

Change the color of dental materials can be evaluated visually or with using different systems. Evaluating changing color with eye is not a reliable method. There are various systems for evaluating color such as colorimetry, spectroscopy and digital image analysis which spectrophotometric is most reliable techniques in dental studies. VITA Easyshade is a spectrophotometer device which used in this study. According to KIM-Pusateri and colleague's report, accuracy and reliability of VITA Easy shade the color measurement is greater than 90%. Easy shade system based on CIE L *, a *, b * gives report color of samples. Color system CIE L *, a *, b * is

most common international method for dental purposes which specifies color by three factors a, L and b which L represents the brightness of the color and a represents the red-green color and b represents the yellow-blue colors (35, 36).

In between mouthwashes which studied, most EΔ seen in the oral-b mouthwash which clearly was more than from ΔE of artificial saliva. This finding was consistent with results of clinical trials Celik and colleagues which checked mouthwash in oral-B, klorhex. In the study of Jafari and colleagues which in that mouthwash was similar with this study, was shown that Oral-B mouthwash provides the highest color change. A possible reason could existence of dye materials which have polyphenols and less polarity and compatibility with the matrix polymer composite material which cause penetrate to material.

In this study, least amount of ΔE was seen in the Listerine mouthwash. Among the examined mouthwash, Listerine had the lowest pH. According to some studies, mouthwashes which have low pH, may over time affect some of the physical and mechanical properties of resins composite such as softening levels, significant increases biodegradable resin composites, loss of the bond between the filler and matrix polymer, emissions of remaining monomer and wear and tear composite surface. According to the results, it seems that the pH factor alone is not effective in changing colors. This result was in line with the study celik and colleagues which says that existence of the low pH, the effect of Listerine mouthwash on color change of composite was less than with other mouthwash.

Some studies reported results against these results. Gurdal and colleagues demonstrated that impact of mouthwashes on the stability of the color is not difference with distilled water. Lee and colleagues also reported that Mouthwashes have impacton color fastness but indistinguishable from perspective of clinically which may cause these results are different situations in Materials and Methods.

According to previous studies, if the amount ΔE was less than 1 is not detectable with eye. ΔE between 1 and 3.3 is recognizable by expert's person but from perspective of clinically is acceptable. ΔE higher than 3.3 is recognizable by non-experts but from perspective of clinically is not acceptable. The results of this study showed that all Mouthwashes cause discoloration above the clinically acceptable. (Above 3.3).In clinical conditions, it may be several reasons affect the stability of the composite colors such

as the amount of saliva, the salivary pellicle, foods and beverages. Since the oral environment periodically are in contact with different factors, and fully condition is not renovate like laboratory, is better other studies done in the oral environment.

5-CONCLUSION

The results of this study showed that all samples were color change which from perspective of clinically was acceptable. Composite Z250 showed most change of color and composite Z350 showed least change color. Mouthwash Listerine and Oral B, respectively, created highest and lowest color change. In sum, we can conclude that daily use of mouthwash can change the color of composite resin.

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