J Istanbul Univ Fac Dent 2016;50(2):17-23.
http://dx.doi.org/10.17096/jiufd.15743 *ORIGINAL RESEARCH*

THE EFFECT OF MOUTH RINSES ON THE COLOR STABILITY OF SONICFILL AND A NANOHYBRID COMPOSITE

Ağız Gargaralarının Sonicfill ve Bir Nanohibrid Kompozitin Renklenme Dayanıklılığı Üzerindeki Etkileri

Tuğba TOZ-AKALIN [1], Gencay GENÇ [1], Yonca KORKMAZ-CEYHAN [2], Funda ÖZTÜRK-BOZKURT [1]

Received: 28/10/2015
Accepted:18/01/2016

ABSTRACT

Purpose: *The aim of this study was to evaluate the effects of 4 mouth rinses on the color stability of two different resin composites.* ***Materials and Methods:*** *A2 shade sonic-activated bulk fill material SonicFill (Kerr) and conventional nanohybrid composite Filtek Z550 (3M ESPE) were used. Forty disc-shaped specimens (10 mm x 2 mm) were fabricated for both composites and finished using 400-grit SiC paper and polished. After polishing and immersing in distilled water for 24h all specimens were subjected to color measurements. The baseline color values (L*, a*, b*) of each specimen were measured with a colorimeter. Following baseline measurement each composite group was divided into 5 groups: Oral-B Pro Expert Clinic Line Alcohol-free (Oral-B) group, Listerine Tooth Defense Rinse (Listerine) group, Pharmol Zn Mouth rinse (Çözümilaç) group, Nilera Mouth rinse (Nilera) group and Distilled water (control) group. The specimens were incubated in mouth rinses (20 ml) at 37°C for 12 hours and subjected to color measurement. Two-way ANOVA was used for statistical analysis (p<0.05).* ***Results:*** *SonicFill showed significantly higher discoloration when exposed to Oral-B Pro Expert Clinic Line Alcohol-free, Listerine Tooth Defense Rinse and Pharmol Zn Mouth rinse. The color differences of two resin composites were not statistically significant for distilled water and Nilera Mouth rinse.* ***Conclusion:*** *Within the limits of this study it can be concluded that the SonicFill showed higher discoloration than nanohybrid resin composite Filtek Z550.*

Keywords: *Color stability; Mouth rinse; Resin composite; Bulk fill composite; SonicFill*

ÖZ

Amaç: *Bu çalışmanın amacı, dört farklı ağız gargarasının iki farklı kompozit rezinin renklenme dayanıklığı üzerine etkisinin değerlendirilmesidir.* ***Gereç ve Yöntem:*** *Çalışmada, A2 renginde sonikle aktive edilen bulk-fill materyal SonicFill (Kerr), ile geleneksel nanohibrit kompozit rezin Filtek Z 550 (3M ESPE) kullanılmıştır. Her iki materyal grubundan, kırk adet disk şekilli örnek (10 mm x 2mm) hazırlanmış ve 400-gritlik zımparalar ile bitirilerek parlatılmışlardır. Parlatma ve distile suda 24 saatlik bekletilme aşamalarının ardından, örneklerin renk ölçümleri gerçekleştirilmiştir. Her örneğin ilk ölçüm renk değerleri (L*,a*,b*) kolorimetre ile ölçülmüştür. İlk değerlendirmelerin ardından her kompozit materyali beş gruba ayrılmıştır: Oral B Pro Expert Clinic Line Alkolsüz (Oral-B), Listerine Tooth Defense ağız gargarası (Listerine), Pharmol Zn ağız gargarası, Nilera ağız gargarası (Nilera), ve Distile su (kontrol). Örnekler ağız gargaralarının içerisinde (20 mL) 37 C 0' de 12 saat bekletildikten sonra tekrar renk ölçümleri yapılmıştır. İstatistiksel analiz için İki yönlü ANOVA kullanılmıştır (p<0.05).* ***Bulgular:*** *SonicFill Oral B Pro Expert Clinic Line Alkolsüz, Listerine Tooth Defense ağız gargarası ve Pharmol Zn ağız gargarasında bekletildiğinde istatistiksel olarak anlamlı derecede renklenme göstermiştir. Hiçbir rezin kompozitin renk değişikliği distile su ve Nilera ağız gargarasında istatistiksel olarak anlamlı bir farklılık göstermemiştir.* ***Sonuç:*** *Bu çalışmanın sınırları dahilinde SonicFill'in nanohibrit rezin kompozit Filtek Z 550'den daha fazla renklenme gösterdiği belirtilebilir.*

Anahtar kelimeler: *Renklenme dayanıklılığı; Ağız gargarası; Rezin kompozit; Bulk fill kompozit; SonicFill*

[1] Department of Restorative Dentistry School of Dentistry Istanbul Medipol University
[2] Clinical Department of Restorative Dentistry and Prosthodontics School of Dentistry University of Texas Houston, USA

Introduction

Currently, the improvements in adhesive dental technology and patients' esthetic expectations have resulted in a dramatic increase in the use of direct resin composite restorations for posterior teeth. Innovations are continually being made both in adhesive systems and also in adhesive restorative materials. These innovations have enabled clinicians to combine functionality and esthetics and have led to the introduction of "bulk fill" composites that can be applied as thick as 5 mm. These resin materials not only have enhanced curing properties and have provided low polymerization shrinkage, but are also more flowable and therefore result in better cavity adaptation (1). They require less chair time and a simpler application procedure. Generally, they are applied in two layers and only the second layer needs sculpting (2).

SonicFill is a sonic-activated bulk fill restorative material. It is different from other bulk fill flowable composites in terms of how it is applied. This material is applied in only one layer up to 5 mm in thickness. The proprietary resin highly-filled with special modifiers reacts to sonic energy and the material rapidly flows into the cavity with sonic activation. The manufacturer states that the modifier decreases the viscosity up to 87% with this energy, and increased flowability enables better marginal adaptation of the material to the cavity walls. During sonic activation, resin composite begins to have high viscosity to allow for sculpting. It was shown that SonicFill had a Rockwell hardness ratio of 80% or better. Moreover, unlike other bulk fill flowable composites, SonicFill allows for 5 mm depth of cure without increasing the translucency. Therefore, the final restoration ranges from good to very good in terms of aesthetics (3, 4).

Resin composite materials have some disadvantages like discoloration, wear, leakage, and polymerization shrinkage. The shades of these materials have been reported to change over time as a result of extrinsic or intrinsic discoloration. The discoloration can be intrinsic because of the physicochemical reactions in the body of restorative, or extrinsic due to different factors like staining materials, surface roughness and the type of resin itself. Previous studies have shown that beverages; such as coffee, tea, red wine and/or mouth rinses, could cause staining of resin composite to varying degrees (4-6).

Dental caries is considered as a multifactorial infectious disease which can be treated with non-restorative approaches which include caries control measures and remineralization methods of initial lesions and also with restorative treatments. For successful caries control, interception of disease components, like bacterial plaque control, must be achieved with mechanical or with chemoprophylactic agents like mouth rinses. Mouth rinses gain popularity as an effective method for bacterial plaque and oral malodor prevention and also caries control. However, they may have some adverse effects on oral and dental tissues, may result in allergic reactions and/or loss of taste. Moreover, some of their ingredients like alcohol are responsible for discoloration (7). Alcohol can cause wear and surface degradation in resin composite restorations, resulting in unaesthetic external pigmentation, like stains. Due to its low pH, alcohol may lead to erosion and alter some properties of resin composites (8). Alcohol is also thought to act as a plasticizer of the polymer matrix.(9).

Resin composites used in dentistry may behave differently in oral environment. Recently, nano composites and bulk fill resin composites have been introduced and started to be a choice for direct restorations. The effects of different beverages and mouth rinses with different ingredients on these new materials are relatively unknown. Thus, the aim of the present study was to analyze the in vitro effects of four different types of mouth rinses on the color stability of two different types of resin composites (bulk fill and nanohybrid). The null hypothesis of this project was that bulk fill material did not have a better color stability than the nano hybrid resin restorative.

Materials and Methods

A sonic-activated bulk fill material and nanohybrid resin composite treated with four mouth rinses having different resins ingredient were evaluated in this study. A2 shade was selected for each brand. Table 1 shows details of the restorative materials and mouth rinses used in this study.

Specimen Preparation

A total of 40 disc-shaped specimens (10 mm x 2 mm) of each resin composite were prepared according to the manufacturer's recommendations. After placing resin composite into the mold, a polyester strip (Mylar strip; SS White Co., Philadelphia, PA, USA) was pressed onto the mold surface with a glass plate to

obtain a flat surface. The composite was polymerized both from the top and the bottom for 20 s, in accordance with the manufacturer's instructions using a LED light curing unit (Elipar Free Light, 3 M ESPE, AG, Germany, 1007 mW/cm^2). The guide of the light curing unit was kept perpendicular to surface and the distance between the unit and the specimen was standardized using a 1 mm thick glass slide. All the specimens were stored in distilled water for 24 h at 37^{0}C to ensure complete polymerization. The specimens were finished with 400-grit SiC paper and were polished with OptiDisc (Kerr, Orange, CA, USA) polishing discs, Opti shine (Kerr, Orange, CA, USA) polishing brushes and HiLusterPLUS Polishing System (Kerr, Orange, CA, USA) rubbers The specimens were kept in distilled water for 24h before baseline color measurements were taken.

Table 1.*Characteristics of the materials used in the study.*

Material	Type	Composition	Manufacturer
SonicFill	Bulk fill resin composite	Glass, oxide, chemicals 3-trimethoxysilylpropyl methacrylate Silicon dioxide Ethoxylatedbisphenol-Adimethacrylate Bisphenol-A-bis-(2-hydroxy-3-mehacryloxypropyl) ether Triethyleneglycoldimethacrylate	Kerr Corporation, USA
Filtek Z550	Nanohybrid resin composite	Silane treated ceramıc Bisphenol a polyethylene glycol dietherdimethacrylate Bisphenol a diglycidyl ether dimethacrylate (BisGMA) Silane treated silica Diurethanedimethacrylate (UDMA)	3 M ESPE, USA
Oral-B Pro Expert Clinic Line Alcohol-free	Alcohol-free mouth rinse	Aqua, Glycerin, Polysorbate 20, Aroma, Methylparabene, CetylpyridiniumChloride, Sodium Floride, SodiumSaccharin, SodiumBenzoate, Propylparaben, CI42051, CI 47005	Oral-B, Procter &Gamble, USA
Listerine Tooth Defense Rinse	Mouth rinse	Aqua, Alcohol, Sorbitol, Poloxamer 407, Benzoic Acid, Sodium Saccharin, Eucalyptol, Aroma, Methyl Salicylate, Thymol, Menthol, Sodium Benzoat, CL 42053	Listerine, Johnson and Johnson, USA
Pharmol Zn Mouth rinse	Mouth rinse	Zinc- Chloride, Acide Borique, Deionized Water, Gliserin	Cozumilac, Turkey
Nilera Mouth rinse	Mouth rinse	Arginine, zincsulfate, potassiumbenzoate, AscorbicAcid, SodiumChloride, xylitol	Nilera, Turkey

Immersion of Specimens in Solutions

To observe the color stability in various solutions after polishing, 40 specimens were divided into five subgroups (n=8) which will be treated with four different types of mouth rinses and distilled water (control). The specimens of each resin composite were individually immersed in light-proof vials containing either 20 mL of Oral-B Pro Expert Clinic Line Alcohol-free (Oral-B), Listerine Tooth Defense Rinse (Listerine), PharmolZn Mouth Rinse (Çözüm ilaç) or Nilera Mouth Rinse (Nilera). The vials were sealed to prevent the evaporation of the solutions. After 12 hours of immersion (10) (which was considered equivalent to 1 year of 2 minutes daily use) at room temperature, the specimens were rinsed with distilled water and were dried with absorbent paper before measurements.

Assessment of Color Changes

Color values (L*, a*, b*) of specimens were measured with a colorimeter according to the CIELAB color scale (Vita Easy Shade Compact, Vita North America, CA, USA). All measurements were performed at the center of the resin composite discs and were repeated three times by one operator before (baseline) and after immersion in mouth rinses. The color difference ΔE was calculated from the mean ΔL*, Δa*, Δb* values for each specimen using the following formula: $\Delta E_{ab}^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$ where, ΔL*, Δa*, Δb* are the differences in L*, a*

and b* values before and after immersion at each time interval.

Statistical Analysis

The mean and standard deviation taken from the specimens for each subgroup were statistically analyzed. The differences between two resin composites after staining in different solutions were analyzed with two-way analysis of variance and post-hoc Bonferfoni tests. Mean values of the different groups were compared using two-way analysis of variance. In the present study, $p<0.05$ was selected as the level of significance. Values of $\Delta E^* < 1$ were regarded as not appreciable by the human eye. Value of $\Delta E^* < 3.3$ were considered perceptible by skilled operators, but considered clinically acceptable, while value $\Delta E^* > 3.3$ were considered perceptible also by non-skilled persons and therefore clinically not acceptable (8).

Results

The mean and standard deviations of the color change values (ΔE) for both resin composites after immersion in different solutions are summarized in Table 2 and graphically represented in Figure 1. According to our findings, the highest ΔE values were consistently observed in the SonicFill specimens regardless of the immersion solutions used ($p<0.05$).

Table 2.*Mean and standard deviations (SD) of the ΔE color change values obtained from composite material specimens stratified by the type of mouth rinses.*

Solutions	Filtek Z550 mean±(SD)	SonicFill mean±(SD)
Distilled water	2.44 (1.30)	2.42 (1.08)
Oral-B Pro Expert Clinic Line Alcohol-free	2.17 (0.68)	4.25 (1.16)*
Listerine Tooth Defense Rinse	2.25 (0.88)	4.12 (0.84)*
Pharmol Zn Mouth rinse	1.35 (0.16)	2.38 (0.62)
Nilera Mouth rinse	2.2 (1.13)	2.2 (0.62)

** Indicates clinically unacceptable values ΔE≥3.3*

No statistically significant differences were observed among any solution for Filtek Z550 specimens. However, the statistical analysis showed that, for SonicFill groups, the specimens exposed to Oral-B Pro Expert Clinic Line Alcohol-free and Listerine Tooth Defense Rinse showed significantly higher discoloration ($p<0.05$). The color differences were not statistically significant for the specimens of SonicFill groups immersed in distilled water, Pharmol Zn Mouth Rinse and Nilera Mouth Rinse. The SonicFill specimens showed higher discoloration from Z550 specimens when they were immersed in Oral-B Pro Expert Clinic Line Alcohol-free ($p<0.01$), Listerine Tooth Defense Rinse ($p<0.01$) and Pharmol Zn Mouth rinse ($p=0.026$).

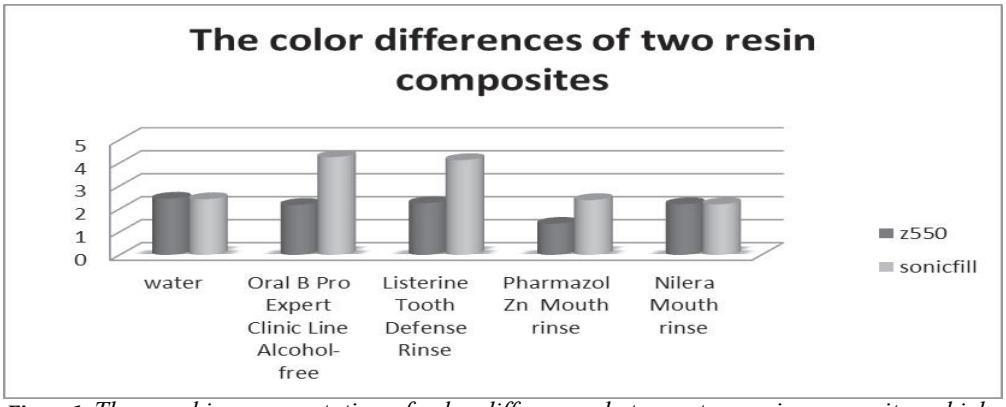

Figure 1. *The graphic representation of color differences between two resin composites which were immersed in mouth rinses.*

Discussion

The present study addressed the staining problem of direct adhesive restorative materials by commonly used types of mouth rinses. Staining can be evaluated by visual and/or instrumental techniques. One of these instrumental techniques is spectrophotometry and it is superior to visual evaluation as it leaves no room for subjective interpretation. It is able to measure the color change (ΔE) by comparing the values of before and after, according to a formula that has been reported to be a reliable technique (11). In our observations, we preferred to use Vita Easy Shade because Kim *et al.* (12) have reported that the reliability and accuracy values of this testing procedure was greater than 90% .

The use of adhesive restorative materials especially in posterior teeth, has increased dramatically in recent years (13). However, insufficient material properties limited the success in high stress bearing regions. Several manufacturers have developed posterior "bulk fill" resin composites. These new products were introduced to clinicians claiming that they had enhanced curing and physical properties and they could be applied into the cavity in thickness of 5mm (14). SonicFill is a single-step composite system that does not require an additional capping layer and possesses the advantages of both flowable and universal composites. This system is a combination of a hand piece that enables sonic activation and a resin composite (15).

Adhesive restorative materials should especially duplicate the natural tooth color. Thus, the performance of a dental restoration depends on its color matching ability and its stability. However, a major disadvantage of these materials is the discoloration that occurs after prolonged exposure to oral environment. Unacceptable color is an indication for the replacement of resin composite restorations (16). Accordingly, the color stabilities of posterior nanohybridresin composite and bulk fill resin composite SonicFill, which are commonly used and commercially available restorative materials, were evaluated in this study. The specimens were immersed in distilled water for 24 hours, for elution of unreacted components from the materials (17) and to allow for post setting polymerization to occur after light curing and polishing (18). Similar to Gurgan *et al.* (10), we have used 12 hours mouth rinse immersion which is equivalent in time to 1 year of 2 min/day, even though in a different study, the authors have prolonged the immersion time up to 24 hours (19).

If a resin composite absorbs water, it can also absorb other fluids that may cause material discoloration. The amount of water absorption is related to the resin ingredient of the composite and the quality of the interaction between the resin and the filler. Excessive water absorption can have an adverse effect on the clinical success of resin composite by plasticizing the resin ingredient, by hydrolyzing the saline and by causing micro cracks. Consequently, the interface between matrix and filler allow discoloration (20).

Like micro-filled composites, hybrid and nano-filled composites have the advantage of having nano-particles that can 'fill in' the gaps between large particles, which result in less and smaller voids in resin composite. These materials have also higher resistance to water absorption. In addition to this, due to the small particle size provided by the nano technology, the surface area of the fillers has increased dramatically and the interaction between the matrix and the filler surface has also increased. Thus, water absorption had less influence on the hybrid and nano-filled composites because these materials have decreased water absorption, less filler-matrix debonding and also less hydrolytic degradation.(21). This situation could partly explain the higher color stability of nano technology resin composites tested in this study. Filtek Z550 and SonicFill, were tested in our study and only the color differences of SonicFill groups which were stained in Oral-B Pro Expert Clinic Line Alcohol-free and Listerine Tooth Defense Rinse showed higher discoloration than 3.3 which is not clinically acceptable. Listerine Tooth Defense Rinse is a mouth rinse that includes alcohol which may affect the surface integrity of resin composites and causes staining. It was demonstrated that the mouth rinses can affect the hardness of restorative materials (22). Alcohol, which is found in some mouth rinses, may have some unwanted effects like softening of resin composites (23). Oral-B Pro Expert Clinic Line Alcohol-free does not include alcohol, but has fluoride in its composition. Sarkis (24) mentioned that the resin composites that releases fluoride are stained more than the other composites tested and postulated that this finding might have been related to the fluoride. However, in our study, the fluoride containing test specimen was present in the mouth rinse instead of the composite. It has also been shown that fluoride plays a minor part in the discoloration of resin composite materials with high ΔE values in one study (25).

One of the tested mouth rinses was Pharmol Zn. It includes zinc which is an essential trace element and is naturally present in plaque, saliva and enamel. Zinc is added into oral health products to control plaque, to reduce malodor and to inhibit calculus. It has better oral permanency and can persist for many hours in the presence of plaque and saliva (26). According to our findings, the specimens immersed in Pharmol Zn did not show unacceptable staining.

The affinity of the resin matrix to staining can be modulated by its degree of conversion and this degree is exactly affected by the amount of unreacted monomer (27). Higher monomer conversion leads to low amount of unreacted monomer, low water uptake and better color stability (28). It was shown that SonicFill allows a 5 mm depth of cure (29). However, in the present study, a total of 2 mm thickness disc-shaped specimens were polymerized from both the top and bottom sides for 20 s. It could be thought that a 2 mm thickness would result in better polymerization and a lower amount of unreacted monomer. However, we noticed that the highest ΔE values were consistently observed in the SonicFill.

It has been reported that the type of resin matrix used in a composite material also plays an important role in staining susceptibility (30). Urethane dimethacrylate (UDMA) is known as more stain-resistant than Bisphenol A-Glycidyl Methacrylate (Bis-GMA) because of its low water absorption and solubility characteristics. The Bis-GMA matrix is a highly viscous and bulky bifunctional monomer. High viscosity of this monomer is diluted by the addition of more reactive trietylene glycol dimethacrylate (TEGDMA). TEGDMA contains an ethoxy group that has high affinity with water molecule through hydrogen bonding to oxygen thus resulting in increased hydrophilicity of resin composite (31). The materials used in this study were Filtek Z550 which includes Bis-GMA and UDMA and also the SonicFill which includes TEGDMA. It can be stated that the monomer ingredient of SonicFill (TEGDMA) could also be related with its higher discoloration.

Conclusion

Within the limitations of this study, SonicFill showed higher discoloration than Filtek Z550. The color changes exhibited by each mouth rinses were only statistically different for SonicFill. The specimens exposed to Oral-B Pro Expert Clinic Line Alcohol-free which includes fluoride and Listerine Tooth Defense Rinse that contains alcohol, showed higher discoloration. Clinicians must consider the staining ability of daily used mouth rinses on restorative materials.

Source of funding
None declared

Conflict of interest
None declared

References

1. El-Safty S, Silikas N, Watts DC. Creep deformation of restorative resin-composites intended for bulk-fill placement. Dent Mater 2012;28(8):928-935.
2. DENTSPLY Caulk. SureFil SDR Flow Technical Product Profile. Clinician Information CD October 2010.
3. Jackon RD. Placing posterior composites: Increasing efficiency. Dent Today 2011;30(4):126, 128, 130-131.
4. Yapp R, Powers JM. Depth of cure of several composite restorative materials. Dent Advis Res Report 2011;33:1.
5. Al Kheraif AA, Qasim SS, Ramakrishnaiah R, Ihtesham ur R. Effect of different beverages on the color stability and degree of conversion of nano and microhybrid composites. Dent Mater J 2013;32(2):326-331.
6. Paravina RD, Ontiveros JC, Powers JM. Curing-dependent changes in color and translucency parameter of composite bleach shades. J Esthet Restor Dent 2002;14(3):158-166.
7. Sarrett DC, Coletti DP, Peluso AR. The effects of alcoholic beverages on composite wear. Dent Mater 2000;16(1):62-67.
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;15(3):283-288.
9. Diab M ZM, Mubarak EH, Olaa MIF. Effect of five commercial mouth rinses on the micro-hardness and color stability of two resin composite restorative materials. Aust J Basic & Appl Sci 2007;1(4):667-674.
10. Gurgan S, Yalcin Cakir F. The effect of three different mouth rinses on the surface hardness, gloss and colour change of bleached nano composite resins. Eur J Prosthodont Restor Dent

2008;16(3):104-108.
11. Johnston WM. Color measurement in dentistry. J Dent 2009;37 (Suppl 1):e2-6.
12. Kim-Pusateri S, Brewer JD, Davis EL, Wee AG. Reliability and accuracy of four dental shade-matching devices. J Prosthet Dent 2009;101(3):193-199.
13. Garoushi S, Sailynoja E, Vallittu PK, Lassila L. Physical properties and depth of cure of a new short fiber reinforced composite. Dent Mater 2013;29(8):835-841.
14. Ilie N, Hickel R. Investigations on a methacrylate-based flowable composite based on the sdr technology. Dent Mater 2011;27(4):348-355.
15. Poggio C, Chiesa M, Scribante A, Mekler J, Colombo M. Microleakage in class ii composite restorations with margins below the cej: In vitro evaluation of different restorative techniques. Med Oral Patol Oral Cir Bucal 2013;18(5):e793-798.
16. 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;40 (Suppl 2):e55-63.
17. Ferracane JL, Condon JR. Rate of elution of leachable components from composite. Dent Mater 1990;6(4):282-287.
18. Yap AU, Lye KW, Sau CW. Surface characteristics of tooth-colored restoratives polished utilizing different polishing systems. Oper Dent 1997;22(6):260-265.
19. el-Badrawy WA, McComb D, Wood RE. Effect of home-use fluoride gels on glass ionomer and composite restorations. Dent Mater 1993;9(1):63-67.
20. Bagheri R, Tyas MJ, Burrow MF. Subsurface degradation of resin-based composites. Dent Mater 2007;23(8):944-951.
21. Yua B, Lim HN, Lee YK. Influence of nano- and micro-filler proportions on the optical property stability of experimental dental resin composites. Materials and Design 2010;31(10):4719-4724.
22. Gurgan S, Onen A, Koprulu H. In vitro effects of alcohol-containing and alcohol-free mouth rinses on microhardness of some restorative materials. J Oral Rehabil 1997;24(3):244-246.
23. Moreira AD, Mattos CT, de Araujo MV, Ruellas AC, Sant'anna EF. Chromatic analysis of teeth exposed to different mouth rinses. J Dent 2013;41 (Suppl 5):e24-27.
24. Sarkis E. Color change of some aesthetic dental materials: Effect of immersion solutions and finishing of their surfaces. Saudi Dent J 2012;24(2):85-89.
25. Autio-Gold JT, Barrett AA. Effect of fluoride varnishes on color stability of esthetic restorative materials. Oper Dent 2004;29(6):636-641.
26. Lynch RJ. Zinc in the mouth, its interactions with dental enamel and possible effects on caries; a review of the literature. Int Dent J 2011;61 (Suppl 3):46-54.
27. de Gee AJ, ten Harkel-Hagenaar E, Davidson CL. Color dye for identification of incompletely cured composite resins. J Prosthet Dent 1984;52(5):626-631.
28. Garoushi S, Lassila L, Hatem M, Shembesh M, Baady L, Salim Z, Vallittu P. Influence of staining solutions and whitening procedures on discoloration of hybrid composite resins. Acta Odontol Scand 2013;71(1):144-150.
29. Kerr, Sonic Fill Sonic activated, Bulk fill composite. Technical Product Profile. 2011.
30. Villalta P, Lu H, Okte Z, Garcia-Godoy F, Powers JM. Effects of staining and bleaching on color change of dental composite resins. J Prosthet Dent 2006;95(2):137-142.
31. Ren YF, Feng L, Serban D, Malmstrom HS. Effects of common beverage colorants on color stability of dental composite resins: The utility of a thermocycling stain challenge model in vitro. J Dent 2012;40 (Suppl 1):e48-56.

Corresponding Author:
Funda ÖZTÜRK BOZKURT
Department of Restorative Dentistry
School of Dentistry Istanbul Medipol University
34083, Fatih - Unkapanı / Turkey
Phone: +90 212 521 04 26
e-mail: fbozkurt@medipol.edu.tr