Dentistry and Oral Health Care
2023 Volume 1, Issue 1
DOI:10.59657/dohc.brs.23.003

BioRes Scientia
Value your Research

Research Article

Open Access

Evaluation of Surface Roughness and Colour Changes of Restorative Materials used with different Polishing Procedures in Paediatric Dentistry

Oyku Peker*, Behiye Bolgul
Department of Paediatric Dentistry, School of Dentistry, Mustafa Kemal University, Hatay, Turkey.
*Corresponding Author: Oyku Peker, Department of Paediatric Dentistry, School of Dentistry, Mustafa Kemal University, Hatay, Turkey.

Abstract
Aim: It was aimed to evaluate the color stability and surface roughness properties of 4 different restorative materials used in pediatric dentistry clinics as a result of 4 different polishing procedures.
Background and Design: A total of 128 samples, 32 from each restorative material, were prepared by placing each material in 6 mm diameter, 2 mm high polyethylene molds to be polished with 4 different polishing procedures (n=8). Then, color stability and surface roughness measurements of the samples were made. Hysitron TI 950 Tribo Indenter device was used for surface roughness test measurements. A spectro-photometer device was used to determine the color stability. Then the samples were kept in the coke solution for 1 week and then the final color measurements were made.
Results: The lowest roughness values were surveyed in G-aenial restorative material polished with Super-Snap material, and the highest roughness values were surveyed in Equia material polished with Identoflex material. When all materials were evaluated, the least color change values were determined in G-aenial material polished with Super-Snap, and the most color change values were detected in Equia material polished with Identoflex. It was observed that the relationship between surface roughness and color change is statistically significant.
Conclusion: The lowest color change and surface roughness values were observed in the G-aenial material polished with Super-Snap. For clinically more successful results, it has been understood that the most appropriate polishing procedure should be chosen based on the restorative material used.
Key Words
paediatric dentistry; polishing procedures; colour change; surface roughness

Introduction

Restorative materials commonly used in pediatric dentistry include resin modified glass ionomer cements, conventional glass ionomer cements, compomers and resin composites [1]. Today, with the development of restorative materials, the filler contents have turned into nano particles instead of macro or micro particles, and the clinical use of composite resins containing nano fillers has become widespread [2]. The particle sizes and amounts of the restorative materials, the organic matrix and inorganic filler types, and the finishing and polishing materials applied determine the surface properties and polish ability of the restorations [3]. It has been reported that non-porous restoration surfaces reduce bacterial dental plaque attachment, the risk of gingival tissue irritation, the risk of discoloration of the restorative material, and the risk of long-term secondary caries [4]. The finishing and polishing techniques used vary with the type of restorative materials. The surface roughness of composite resins is pertinent to the composition of the material, its porosity, the composition of the polishing materials used, the size and the number of abrasive particles, and the polishing procedures. The amount of pressure applied during the polishing process, the difference in hardness between the abrasive material and the restorative material, the direction of the abrasive application surface, the time spent with each abrasive tool, and the geometry of the abrasive tools also affect the surface porosity of the material [5]. A great variety of abrasives are available for finishing and polishing restorative materials. These include carbide compounds, aluminum oxide, silicon dioxide, diamond particles, zirconium silicate, and zirconium oxide [6]. Studies have signified that the polishing system and the restorative substance have a direct impact on the results of finishing and polishing procedures [7]. Various studies have reported that many beverages consumed in daily life cause varying degrees of discoloration in restorations [8,9]. Well-polished restorative material surfaces increase aesthetic quality by minimizing surface porosity and discoloration on the surface [10]. The CIEDE2000 color determination system, which was developed by international color scientists in 2000, has been developed as an up-to-date method with high acceptability and it is calculated according to the formula $\Delta E_{00} = [(\Delta L/K_L S_L)^2 + (\Delta C/K_C S_C)^2 + (\Delta H/K_H S_H)^2 + RT\ (\Delta C/K_C S_C)\ (\Delta H/K_H S_H)]^{½}$. Theoretically, if the color of the object whose color is measured is fixed and does not change, the ΔE=0 value is obtained as zero and no color difference is detected. In scientific studies, the visual perceptibility of the color alteration or its clinically unacceptableness is expressed by the fact that the ΔE_{00} value is above the determined threshold value. This threshold value was determined by various researchers with different numbers, but no consensus could be reached [11]. For example, Yu et al. accepted the value 2.6, Karaman et al. accepted the value 3.3, and Paravina et al. accepted the value 3.7 [12,13,14]. The color alteration value limit that can be accepted in clinical practice, which is most frequently used in the literature review, is 3.3 [15]. It is important for physicians to know which polishing system provides sufficient surface quality in order to improve the aesthetics and longevity of restorative materials [2]. As a result, the determination of superior materials in regards to surface roughness and color stability and their use in clinics will provide longer-lasting and more aesthetic restorations.

Materials and Methods

The ethics committee approval of our study was approved on 04/10/2021 with the decision no. 02 of the HMKU non-interventional clinical research ethics committee. Our study was carried out in accordance with the principles of the Declaration of Helsinki.

Materials used

Restorative materials

In our research, glass hybrid restorative material Equia Forte (GC, Tokyo, Japan), nano hybrid composite G-aenial Universal Injectable (GC, Tokyo Japan), micro hybrid dual cure composite Fill-up (Coltene Whaledent, Switzerland) and supra nano composite material Estelite Universal Flow Super Low (Tokuyama Dental, Tokyo, Japan) used in the pedodontics clinic were used. The restorative materials which were used in our research can be seen at Table 1.

Table 1: Restorative Materials Used and Their Contents

Materiel	Manufacturer	Type	Contents	Particle Size	Filler Ratio
Equia Forte	GC, Tokyo Japan	Glass hybrid restorative material	Fluoro aluminosilicate glass		
G-aenial Universal Injectable	GC, Tokyo Japan	Nano hybrid composite	Methacrylate monomers, barium glass, silica	0.15 µm	69% by weight, 50% by volume
Fill-up	Coltene Whale dent Switzerland	Micro hybrid dual cure composite	TMPTMA, UDMA, BIS-GMA, TEGDMA, Dental glass, methacrylate, zinc oxide amorphous silica,	2 µm	65% by weight, 49% by volume
Estelite Universal Flow	Tokuyama Dental, Tokyo Japan	Supranano composite	Bis-GMA, TEGDMA, Bis-MPEPP, UDMA	0.2 µm	70% by weight, 56% by volume

Polishing materials

In our study, 4 different polishing procedures, namely Opti Disc (Kerr, USA), Sof-Lex (3M ESPE, USA), Ident flex Composite Polisher (Kerr, USA) and Super-Snap (Shofu, Japan) were used to perform the finishing and polishing processes which can be seen at Table 2.

Table 2: Polishing Materials Used and Their Contents

Materiel	Manufacturer	Abrasive/Type	Number of Stages

Sof-Lex	3M ESPE, USA	Discs coated with aluminum oxide (coarse, medium, fine, superfine) 60µm,29µm,14µm,5µm	4 Stages
Opti Disc	Kerr, USA	Aluminum oxide coated discs (coarse, medium, fine, superfine) 80µm,40µm,20µm,10µm	4 Stages
Ident flex Composite Polisher	Kerr, USA	Rubbers containing diamond particles	3 Stages
Super-Snap	Shofu, Japan	Discs coated with aluminum oxide and silicon carbide (coarse, medium, fine, superfine) 60µm,30µm,20µm,7µm	4 Stages

Preparation of samples

A total of 128 samples, 32 from each restorative material were prepared for our study. The samples were prepared in accordance with the manufacturers' recommendations and were injected into polyethylene molds with a diameter of 6 mm and a height of 2 mm. Transparent tape (Dispo dent, Istanbul, TR) and glass coverslip were pressed on them to remove excess material. In the polymerization of the samples, the LED beam filler device VALO (Valo, Ultra dent, USA) producing light in the spectrum between 385 and 515 nm was used and polymerized with a light of 1,200 mW/cm2 for 20 seconds in compliance with the manufacturer's instructions.

Creation of restorative material groups

In our study, 32 samples were prepared from each restorative material. Restorative materials were randomly divided into 4 subgroups, each group containing 8 samples (n=8) for different finishing and polishing processes.

Finishing and polishing of samples

The samples obtained were randomly divided into various subgroups and then subjected to finishing and polishing processes. The finishing and polishing processes of the samples were performed under water cooling in compliance with the manufacturer's recommendations.

In the Sof-Lex system, the samples were kept in water cooling for 15-20 seconds, taking into account the grain order. Thick and medium-grained discs were applied at a speed of 30,000 rpm, and fine and super-fine-grained discs were applied at 10,000 rpm in the same direction, provided that each disc was used at once. Restoration surfaces were washed for 5 seconds after each disc was applied.

In the Opti Disc polishing system, the specimens were polished with thick, medium, thin, and extra-thin discs, respectively, at a constant speed between 10,000 and 20,000 rpm, and the surface of the restorations was polished for 15-20 seconds and washed for 5 seconds in each disc group.

In the Ident flex Composite Polisher system, the samples were applied for 60 seconds to achieve high surface gloss, and then the samples were washed for 5 seconds.

In the Super Snap group, the samples were polished at 10,000 to 20,000 rpm for 15-20 seconds under water cooling as thick, medium, fine and super fine, respectively. After each disc was applied, the sample surfaces were washed for 5 seconds and dried with air water spray.

Initial Roughness and Color Value Measurements of Samples

After the samples were kept in distilled water for 24 hours, before the color values were measured, the samples were dried with blotting paper and the initial color values of the samples in each group were measured with the help of a digital spectrophotometer (VITA Easyshade® Advance 4.0 (VITA Zahnfabrik, Bad Sackingen, Germany).

After the finishing and polishing processes, the initial surface roughness values of the samples were evaluated with the Hysteron TI 950 Tribo Indenter device by scanning an area of 40×40 µm, one area from the center point of the samples and 4 areas from the peripheral points, a total of 5 areas. A Ra (nm) value was obtained by taking the arithmetic mean of the measurements of each restorative material.

Coloring the samples

In order to assess the time-dependent change of color analysis of the samples, after the initial surface roughness and color determination of the samples, the samples were kept in the coke solution for 7 days. The solutions were refreshed every 24 hours to maintain the carbonic gas level.

After the initial color values were measured, the final color measurements of the samples kept in the cola solution were measured with the help of the same spectrophotometer device. The color difference between the final color measurements and the initial color measurements was calculated with the CIEDE 2000 formula and recorded as the ΔE_{00}* value.

Statistical Analysis

In our study, the SPSS 21 (Armonk, NY: IBM Corp.) program was used to analyze the data. In the statement of descriptive measures, mean, standard deviation, minimum-maximum statistics are given. Comparisons by materials and polishes were made using ANOVA and Kruskal Wallis tests. LSD test was used for pairwise comparison after parametric test, and Mann Whitney U tests with Bonferroni correction (p=0.05/6=0.008) were used after nonparametric test. Pearson and Spearman correlation coefficients were used in the analysis of the relationship between continuous variables. The cut-off value for all tests was set at 0.05 [16].

Results

Color change and surface roughness values of restorative materials are indicated in Table 3.1, surface roughness and color change values of polish materials are indicated in Table 3.2. See Table 3.1 and Table 3.2 in Table 3.

Table 3: Color Change and Surface Roughness of Materials

Categories	Ra			CIEDE2000		
	Avg ± SD	Min - Max	p	Avg ± SD	Min - Max	p
G-aenial	95.5 ± 71.7	95.5 – 71.7	<0.001	1.7 ± 1.6	0.37 – 5.95	<0.001
Equia	394.3 ± 76.7	394.3 – 76.7		3.3 ± 2.6	0.54 - 11.98	
Fill-Up	206.6 ± 74.9	206.6 – 74.9		1.3 ± 0.3	0.59 – 1.95	
Estelite	155.8 ± 58	155.8 - 58		3.8 ± 1.2	1.17 – 5.8	

Table 3.1: Color change and surface roughness values of restorative materials

Categories	Ra			CIEDE2000		
	Avg ± SD	Min - Max	p	Avg ± SD	Min - Max	p
Super-Snap	184.04 ± 119.2	21.15 ± 387.3	0.02	2.61 ± 2	0.59 ± 6.6	0.069
OptiDisc	228.29 ± 128.2	71.14 ± 483.7		2.98 ± 2	0.37 ± 6.9	
Sof-Lex	172.57 ± 126.5	32.77 ± 432.4		1.86 ± 1.3	0.46 ± 5.8	
İdentoflex	267.24 ± 138.3	114.35 ± 544.9		2.62 ± 2.3	0.68 ± 12	

Table 3.2: Color change and surface roughness values of polishing materials

When the surface roughness values determined as a result of the SPM measurement of the restorative materials are examined according to the brands, the average roughness values (Ra) are from the lowest to the highest; G-aenial (95.5) < Estelite (155.8) < Fill-up (206.6) < Equia (394.3). The surface roughness values of the restorative materials were examined after different finishing and polishing processes, and the findings are shown in Table 4.

Table 4: Surface roughness values of restorative materials applied with different polishing procedures

Ra	Super-Snap	Opti Disc	So flex	Ident flex	
	Avg ± SD	Avg ± SD	Avg ± SD	Avg ± SD	p
G-aenial	31.17 ± 10	186.21 ± 68.28	44.21 ± 11	120.4 ± 7.02	<0.001
Equia	342.85 ± 4	426.87 ± 36.12	354 ± 48.73	453.43 ± 103.5	0.002
Fill-Up	195.36 ± 47	145.47 ± 37.9	185.71 ± 71.13	299.86 ± 36.16	<0.001
Estelite	166.78 ± 54	154.6 ± 65	106.39 ± 41.1	195.31 ± 36.37	0.013

When the surface roughness values of the polishing materials were examined according to the brands, the values were found as Sof-Lex (172.57) < Super-Snap (184.04) < OptiDisc (228.29) < Identoflex (267.24) from the smallest to the largest. When all materials were examined, the least surface roughness values were detected in the G-aenial restorative material polished with Super-Snap material, and the most roughness of surface values were detected in the Equia material polished with Identoflex material. When the color change values of the restorative materials are examined according to the brands, the average color change values (ΔE00) are from the lowest to the highest; Fill-up (1.3) < G-aenial (1.7) < Equia (3.3) < Estelite (3.8). The change of color values of the restorative materials was examined after different finishing and polishing processes, and the data obtained are shown in Table 5.

Table 5: Color change values of restorative materials applied different polishing procedures

CIEDE	Super-Snap	OptiDisc	SofLex	İdentoflex	
	Avg ± SD	Avg ± SD	Avg ± SD	Avg ± SD	p
G-aenial	0.91 ± 0.21	3.17 ± 2.3	1.33 ± 1	1.56 ± 1.13	0.08
Equia	3.78 ± 2	3.29 ± 2.09	1.63 ± 0.8	4.7 ± 3.9	0.119
Fill-Up	1.09 ± 0.41	1.34 ± 0.17	1.05 ± 0.18	1.52 ± 0.24	0.004
Estelite	4.64 ± 0.86	4.14 ± 0.36	3.44 ± 1.42	2.82 ± 1.12	0.014

When the color change values that occur after the application of polishing materials are examined according to the brands, the average color change values (ΔE_{00}) are from the lowest to the highest; Sof-Lex (1.86) < Super-Snap (2.61) < Identoflex (2.62) < OptiDisc (2.98). When all materials were examined, the least color change values were determined in G-aenial material polished with Super-Snap material, and the highest change of color values were determined in Equia material polished with Ident flex material. According to the results of Spearman correlation analysis, it was determined that there is a statistically significant relationship between color change and surface roughness. Materials with higher surface roughness showed more coloration.

Discussion

The longevity and aesthetic success of restorative materials is directly related to the material's surface smoothness and color stability [17]. It is very important to obtain bright and smooth restoration surfaces for aesthetic, long-lasting and easily tolerated restorations by the patient [18]. The effect of finishing and polishing procedures on the surface roughness and color stability of restorations is well known [19]. It has been shown that the use of polishing rubbers alone is not sufficient to obtain an ideal and acceptable restoration surface [20]. It is known that multi-stage finishing and polishing procedures produce more successful restoration surfaces in the long run [22]. AFM, SPM, SEM and profilometers are frequently used to evaluate the surface properties of restorative materials [22]. Atomic force microscopy, unlike profilometry, is a high-resolution, alternative, up-to-date method at the nanometer scale. Since AFM has some important advantages, such as visualizing the 3D image of the surface, it holds great promise for the examination of biomaterials [23]. In dentistry, visual or instrumental color measurement methods are used to measure color changes in restorative materials. Since the visual color selection method is subjective and can be affected by many different factors, colorimeters, spectrophotometers, spectroradiometers, digital cameras and imaging systems have begun to be used in color measurements. Spectrophotometers are the most frequently used devices in dentistry for the evaluation of color changes in dentistry, which cannot be perceived by the human eye and can evaluate colors at different wavelengths [24]. In the research conducted by Pusateri et al., it was suggested that the VITA EasyShade® spectrophotometer was the most reliable device with a rate of 96% in the evaluation of the colors of restorative materials with color measurement devices such as VITA EasyShade®, ShadeVision®, SpectroShade® and ShadeScan® [25]. The results of the measurements obtained with the spectrophotometer are converted into three different color parameters based on the CIE L*a*b* and CIEDE 2000 color systems and calculated as ΔE* values in line with these values [26]. It has been reported that the CIEDE2000 formula reflects the color differences that the human eye can detect better than the CIE Lab formula [27].

Yamanel et al., in their study, suggested that due to the very small size of the inorganic filler particles in the structure of the restorative materials containing nanofillers, smoother surfaces can be obtained after finishing and polishing compared to microhybrid composites [27]. In our study, the nanohybrid restorative material G-aenial was found to show statistically significantly less surface roughness than the microhybrid restorative Fill-up.

In the research of Mallya et al., that they examined the surface roughness of three different glass ionomer-containing materials with three different finishing and polishing procedures, they found that the surface roughness values of single resin-free glass ionomer cement were higher than other glass-ionomer materials containing resin, and that the presence of resin in the structure of the materials reduced the surface roughness and smoother surfaces [28]. Similarly, in our study, the surface roughness of the resin-free Equia material was found to be significantly higher than that of other resin-containing restorative materials. In another research evaluating the surface roughness of restorative materials containing different glass ionomers, it was reported that resin modified glass ionomer cement, giomer and compomer showed lower roughness values. Researchers state that the glass particles in these materials dissolve less because they are embedded in a polymer resin, and therefore why restorative materials with higher resin content show lower roughness values compared to other restorative materials [29].

Bayraktar et al., in their research, in which they investigated the effect of finishing and polishing systems on the surface roughness of three different hybrid and nanofil composites, reported that, unlike our thesis, nanofil composite samples produced lower surface roughness than hybrid composite samples after finishing and polishing processes. We think that this difference is due to the different content and particle sizes of the restorative materials used. Ilday et al. reported that brighter and smoother surfaces were obtained after polishing with aluminum oxide-containing discs (Sof-Lex, 3M ESPE) compared to tires containing fine diamond particles (Astropol, Ivoclar Vivadent) and diamond finishing burs. In our study, Ident flex polishing rubber containing diamond particles formed the highest roughness value. We think that this is because diamond particles form more rough surfaces on restoration surfaces after finishing and polishing processes, since they are harder than silicon carbide and aluminum oxide particles. It has been reported that discs containing aluminum oxide create smoother surfaces as they abrade the resin matrix and filler particles evenly [30]. While multi-stage polishing systems contain smaller particles in each step to remove the scratches created by the previous step, this is not the case in single-stage systems. In single-stage systems, the grain size becomes more important in order not to create scratches on the surface.

According to the results of our research, it was determined that the same polishing procedure did not create the same level of surface quality in all restorative materials. In line with these findings, it is thought that not only the polishing procedure, but also the interaction of the polishing procedure and the restorative material is effective in determining the surface quality. Tooth-colored restorative materials may undergo color change as a result of various internal or external factors. While the internal coloration is the coloration that occurs due to the material's own structure, the external coloration is a coloration that occurs as a result of contact with various coloring agents [31]. In scientific studies, the visual perceptibility of the color change or its clinically unacceptableness is expressed by the fact that the ΔE_{00} value is above the determined threshold value. This threshold value has been determined with different numbers by various researchers, but a consensus has not been reached [11]. For example, Yu et al. accepted the value 2.6, Karaman et al. accepted the value 3.3, and Paravina et al. accepted the value 3.7.[12,13,14] The color change value limit that can be accepted in clinical practice, which is most commonly used in the literature review, is 3.3 [15]. In our study, the color change value limit was accepted as 3.3 in accordance with the literature. In the study of Ardu et al., in which they compared the coloration of 11 hybrid and 1 macrophile composites according to the CIE Lab system, they obtained the lowest color change values in the micro hybrid composite group, similar to our thesis [32].

Nasim et al., in their study evaluating the color stability of micro hybrid, nanohybrid and macrophile composite resins, reported that micro hybrid' color stability composite resins were higher than that of nanohybrid and macrophile composites [33].

They thought that the greater color change of the nanohybrid composite than the microhybrid composite might be due to the the resin matrix nature and potential porosity in the aggregated filler particles as well as the barium glass fillers porosity.

Iazetti et al. reported in their research that the color stability of restorative materials containing fluorine may be lower because fluorine is a water-soluble component [34]. Similarly, in our thesis, Equia material containing fluorine showed more color change than other materials.

In another study by Gönülol and Yılmaz, it was concluded that restorative materials with smaller particles do not always show less coloration, and it was stated that the coloring of restorative materials is also related to the monomer structure, filler particle ratios and surface irregularities [9]. In our study, restorative materials with smaller particles did not show less coloration and it was thought that other properties of the restorative materials other than the particle structure also had important effects on the coloration.

The resistance of restorative materials to discoloration is affected by parameters such as the resin matrix structure, water absorption of the restoration, the filler particles' structure and size, and the continuity of the resin matrix-filler particle connection, as well as the finishing and polishing processes applied to the restoration surface. For this reason, the clinical success of different restorative materials applied the same polishing procedure may differ [34].

In another study by Aydın et al. in which different finishing and polishing systems evaluated the composite resins' color change and surface roughness, they found the least color change values in the Clearfil Twist Dia group, which is a polishing rubber with diamond spiral content, unlike our study. We think that this difference may be due to the difference in the color system and colorant solution used.

In the research of Korkut et al., in which they utilized the effects of 7 different polishing systems on the coloring of microhybrid and nanohybrid composite resins colored with coffee, they obtained the highest change of color values in the Super-Snap group, unlike our study [11]. This was followed by OptiDisc and Sof-Lex materials, respectively. The different results in the literature can be attributed to variables such as polishing time, speed of the handpiece used, water cooling, applied pressure, dexterity and operator experience. We think that this difference may be due to the fact that the Optidisc and Sof-Lex polishing materials used in this study were applied without water cooling.

In the research of Schmitt et al., in which they examined the color change and surface roughness of samples containing nanofillers and microhybrid composite resins after they were subjected to Sof-Lex and Pogo finishing and polishing systems. Reported that the Sof-Lex polish system produced higher color stability and lower surface porosity, similar to our thesis [35]. The abrasive particles only need to be harder than the filler particles to be able to abrade the resin matrix and prevent the filler particles from protruding. On the other hand, in order to prevent scratches on the composite surface, the abrasive particles must be small in structure. We think that in the Sof-Lex polishing system, due to the smaller particle size of the discs coated with aluminum oxide, they create lower surface roughness values and high color stability. In the literature studies evaluating the color change and surface roughness of restorative materials, various studies with a positive correlation between color change and surface roughness have been identified. In our study, it was determined that there was a statistically significant relationship between surface roughness and color change, and materials with higher surface roughness showed more coloration.

Conclusion

As a result of the findings obtained, it was determined that the finishing and polishing procedures had significant effects on the surface roughness. It has been seen that the effectiveness of finishing and polishing techniques in terms of color change and surface roughness depends on the restorative material to which they are applied. We think that more clinical studies are needed to acquire more accurate findings due to different factors such as saliva, blood, isolation and difficulty in working in the oral environment.

Declarations

Availability of Data and Materials: The data presented in this study are available.

Author Contributions: Both authors contributed equally to all parts of the manuscript. All authors reviewed and approved the final manuscript.

Ethics Approval and Consent to Participate: This study was approved by the Hatay Mustafa Kemal University Non-interventional Clinical Research Ethics Committee (04/10/2021-02) and complied with the principles of the Declaration of Helsinki.

Acknowledgments: The authors acknowledge the support from the Mustafa Kemal University, Hatay TURKEY.

Conflict of Interest: The authors declare no conflict of interest.

References

1. Dhar V, Hsu KL, Coll JA, Ginsberg E, Ball BM, et al. (2015). Evidence-Based Update of Pediatric Dental Restorative Procedures: Dental Materials. J Clin Pediatr Dent. 39(4):303–310.
2. Dursun MN, Atalay C. (2022). Farklı Polisaj

Sistemlerinin Posterior Bölgede Kullanılan Kompozit Rezinlerin Yüzey Pürüzlülüğü Üzerine Etkisi. Atatürk Üniversitesi Diş Hekimliği Fakültesi Dergisi. 3(1):376-310.

3. Türkyilmaz G, Tunçer TN, Bal FA. (2008). Farklı Bitirme ve Parlatma Sistemlerinin "Bulk Fill" Kompozit Rezinlerin Yüzey Pürüzlülüğüne Etkisi. Turkiye Klinikleri J Dental Sci. 27(2):283-287.
4. Ozel E, Korkmaz Y, Attar N, Karabulut E. (2008). Effect of One-Step Polishing Systems on Surface Roughness of Different Flowable Restorative Materials. Dent Mater J. 27(6):755-764.
5. Kadhom TH. (2021). A Study to Compare the Efficiency of Different Finishing-Polishing Systems on Surface Roughness of Nanohybrid Composite Resin. Annals of RSCB. 25(6):9709-9717.
6. Olmez A, Kisbet S. (2013). Kompozit Rezin Restorasyonlarda Bitirme ve Polisaj Işlemlerindeki Yeni Gelişmeler. 30(2):116-117.
7. Babina K, Polyakova M, Sokhova I, Doroshina V, Arakelyan M et al. (2020). The Effect of Finishing and Polishing Sequences on The Surface Roughness of Three Different Nanocomposites and Composite/Enamel and Composite/Cementum Interfaces. Nanomaterials (Basel). 10(7):10-15.
8. Guler AU, Yilmaz F, Kulunk T, Guler E, Kurt S. (2005). Effects of Different Drinks on Stainability of Resin Composite Provisional Restorative Materials. J Prosthet Dent. 94(2):118-124.
9. Gönülol N, Yılmaz F. (2012). The Effects of Finishing and Polishing Techniques on Surface Roughness and Color Stability of Nanocomposites. J Dent. 40(2):64-70.
10. Ehrmann E, Medioni E, Brulat Bouchard N. (2019). Finishing and Polishing Effects of Multiblade Burs on the Surface Texture of 5 Resin Composites: Microhardness and Roughness Testing. Restor Dent Endod. 44(1):1-2.
11. Korkut B. (2021). Evaluation of the Effect of Polishing Materials on Discoloration of Microhybrid and Nanohybrid Resin Composites. Turkiye Klinikleri J Dental Sci. 27(3):451-461.
12. Reis AF, Giannini M, Lovadino JR, Ambrosano GM. (2003). Effects of Various Finishing Systems on the Surface Roughness and Staining Susceptibility of Packable Composite Resins. Dent Mater. 19(1):12-18.
13. Yu B, Lee YK. (2008). Differences in Color, Translucency and Fluorescence between Flowable and Universal Resin Composites. J Dent. 36(10):840-846.
14. Paravina RD, Ontiveros JC, Powers JM. (2002). Curing-Dependent Changes in Color and Translucency Parameter of Composite Bleach Shades. J Esthet Restor Dent. 14(3):158-166.
15. Ozdemir OS, Karaman E, Tuncer D, Firat E, Karahan S. (2014). Influence of Different Staining Beverages on Color Stability, Surface Roughness and Microhardness of Silorane and Methacrylate-Based Composite Resins. J Contemp Dent.15(3):319-325.
16. Corp. (2013). I.IBM SPSS statics for Windows, version 21.0. Armonk, NY: IBM Corp.
17. Çeli̇k N, Sağsöz Ö, Gündoğdu M. (2017). Farklı İçeceklerin Posterior Kompozitlerin Renk Değişikliği Ve Yüzey Pürüzlülüğü Üzerine Etkisinin Değerlendirilmesi. Atatürk Üniversitesi Diş Hekimliği Fakültesi Dergisi. 27(1):27-33.
18. Sang EJ, Song JS, Chung SH, Jin BH, Hyun HK. (2021). Influence of a New Polishing System on Changes in Gloss and Surface Roughness of Resin Composites after Polishing and Brushing. Dent Mater J. 40(3):727-735.
19. Heintze S, Forjanic M, Rousson V. (2006). Surface Roughness and Gloss of Dental Materials as a Function of Force and Polishing Time in Vitro. Dental Materials. 22(2):146-165.
20. Bilgili D, Dündar A, Barutçugil Ç, Öcal İB. (2020). Farkli Cila Sistemlerinin Kompozit Rezinlerin Yüzey Pürüzlülükleri üzerine Etkisi. 7tepe Klinik Dergisi 16(2):147-153.
21. Antonson SA, Yazici R, Kilinc E, Antonson DE, Hardigan PC. (2011). Comparison of Different Finishing/polishing Systems on Surface Roughness and Gloss of Resin Composites. J Dent. 1(3):9-17.
22. Kakaboura A, Fragouli M, Rahiotis C, Silikas N. (2007). Evaluation of Surface Characteristics of Dental Composites Using Profilometry, Scanning Electron, Atomic Force Microscopy and Gloss-Meter. J Mater Sci Mater. Med. 18(1):155-163.
23. Tholt de Vasconcellos B, Miranda-Júnior WG, Prioli R, Thompson J, Oda M. (2006). Surface Roughness in Ceramics with Different Finishing Techniques Using Atomic Force Microscope and

Profilometer. Oper Dent. 31(4):442-449.
24. Kurt M, Turhan Bal B, Bal C. (2016). Güncel Renk Ölçüm Yöntemleri: Sistematik Derleme. Turkiye Klinikleri. Dishekimligi Bilimleri Dergisi. 22(2):132-134.
25. Kim-Pusateri S, Brewer JD, Dunford RG, Wee AG. (2007). In Vitro Model to Evaluate Reliability and Accuracy of a Dental Shade-Matching Instrument. J Prosthet Dent. 98(5):353-358.
26. Gómez-Polo C, Montero J, Gómez-Polo M, Martin Casado A. (2020). Comparison of the CIELab and CIEDE 2000 Color Difference Formulas on Gingival Color Space. J Prosthodont. 29(5):401-408.
27. Yamanel K. (2021). Effect of Different Prophylactic Polishing Procedures on the Surface Roughness of Microhybrid and Nanohybrid Resin Composites. Cumhuriyet Dental Journal. 21(2):85-89.
28. Mallya P, Thomas M, Acharya S, Ballal V, Ginjupalli K et al. (2013). Profilometric Study to Compare the Effectiveness of Various Finishing and Polishing Techniques on Different Restorative Glass Ionomer Cements. J Interdiscip Dent. 3(2):86-90.
29. Hepdeniz ÖK, Kelten ÖS, Gürdal O. (2019). Cam Iyonomer Içerikli Dört Farklı Restoratif Materyalin Yüzey Pürüzlülüklerinin Değerlendirilmesi. SDÜ Sağlık Bilimleri Dergisi. 10(1):13-17.
30. Gupta R, Rai R. (2013). In Vitro Evaluation of the Effect of Two Finishing and Polishing Systems on Four Esthetic Restorative Materials. J Conser Dent. 16(6):564-567.
31. Reis AF, Giannini M, Lovadino JR, Ambrosano GM. (2021). Effects of Various Finishing Systems on the Surface Roughness and Staining Susceptibility of Packable Composite Resins. Dent Mater. 19(1):12-18.
32. Villalta P, Lu H, Okte Z, Garcia-Godoy F, Powers JM. (2006). Effects of Staining and Bleaching on Color Change of Dental Composite Resins. J Prosthet Dent. 95(2):137-142.
33. Nasim I, Neelakantan P, Sujeer R, Subbarao CV. (2010). Color Stability of Microfilled, Microhybrid and Nanocomposite resins An in Vitro Study. J Dent. 38(2):137-142.
34. Lu H, Roeder LB, Lei L, Powers JM. (2005). Effect of Surface Roughness on Stain Resistance of Dental Resin Composites. J Esthet Restor Dent. 17(2):102-108.
35. Schmitt VL, Puppin-Rontani RM, Naufel FS, Nahsan FPS, Alexandre Coelho Sinhoreti M, et al. (2011). Effect of the Polishing Procedures on Color Stability and Surface Roughness of Composite Resins. ISRN Dent. 35(1):1-6.

Cite this article: Peker O, Bolgul B. (2023). Evaluation of Surface Roughness and Colour Changes of Restorative Materials used with different Polishing Procedures in Paediatric Dentistry, *Dentistry and Oral Health Care*, BRS Publishers. 1(1); DOI:10.59657/dohc.brs.23.003

Article History **Received:** February 28, 2023 | **Accepted:** March 24, 2023 | **Published:** March 30, 2023