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Surface Gloss of Resin Composite Restorative Materials Finished/Polished With Different Systems

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Abstract:
Objective: *To evaluate the effect of three different polishing systems on surface gloss of microfill, nanofill, and nanohybrid resin composites.*
Materials and Methods: A total of 120 resin composite discs were prepared in split Teflon mold with dimension of 10 mm diameter and two mm thick. Specimens were equally divided into three groups according to restorative materials (microfill composite A, nanohybrid composite B and nanofill C); 40 specimens for each material (n=40). Ten specimens from each restorative material were remained without finishing/polishing and used as a control group. The gloss of surface was measured with gloss meter.
Results: *There was statistically significant difference among the tested composite materials and polishing method (P <0.001). The nanofilled resin composite and the liquid polisher presented the highest gloss values After tooth brushing, mean gloss values was decreased for three tested resin composite.*
Conclusion: *Nanofilled composite and liquid polisher showed the highest gloss between the tested composites and polishing systems.*
Keywords: *Surface gloss, Nano-filled resin composite, Nano-hybrid resin composite & Finishing/Polishing.*

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I. Introduction

The esthetic success of a restoration is directly related to its optical appearance. Surface roughness, surface gloss and color are among the important factors that dominate the perceived visual appearance of resin composite restorations. 1 Correlations among these factors might differ by resin composite and shade; however, information on such correlations is limited.2 The color of an object depends on its surface spectral reflectance. 3 The reflectance of a surface is a sensitive function of its roughness and therefore the optical properties of the `resin composites may be influenced by the surface changes occurring during restorative procedures of finishing and polishing. 4

To reach the goal of restoring teeth with natural appearance, developments of restorative technology are evolved into two fold approaches. The first approach is development in filler size, while the second approach is development in finishing and polishing technology. 5

Proper finishing and polishing of dental restorations are important aspects in clinical restorative procedures, regardless of the type and location of the restoration, because they enhance both esthetics and longevity of restored teeth.6-7

Clinicians have their choice among a wide range of finishing and polishing instruments. The search for the ideal polishing system for dental composites is ongoing. 6 With the ultimate goal of achieving a smooth surface of the composite restoration in fewer steps, current one-step systems appear to be as effective as multi-step systems for polishing dental composites 6. The one-step polishing systems are appealing to the clinician. 8

Liquid polishers (surface sealant) are low viscosity fluid resins that provide a gloss over composite resin restoration, improving final esthetics and reducing microlekage at composite margin.9,10 Surface sealants have also been shown in vitro to help prevent stain penetration and discoloration of composite resins, and to result in greater shade stability. This procedure takes only a few seconds of chair side time.11,12

Surface roughness influences resistance to staining 12,13 and the natural gloss of the restoration.14,15 The most smooth and glossy surface is generally obtained under a Mylar strip without subsequent finishing or polishing, but unfortunately intra-oral finishing is always required. 16 The mylar strip finished surface has higher resin content and will reduce the wear resistance of the restoration over time. Therefore, finishing and polishing of tooth-coloured restoration after placement are inevitable procedures that will improve esthetics;

early wear resistance, color stability and marginal integrity. 17, 18 Several investigations have shown that removal of the polymer-rich, outermost resin layer is essential to achieving a stain-resistant, more esthetically stable surface. 19-21

The aim of the present study was to evaluate the effect of three different polishing systems on surface gloss of microfill, nanofill, and nanohybrid composites resin. The null hypothesis was there was statistically significant difference among the tested composite materials and polishing method.

II. Materials & Methods

The composite restorative systems employed in this study were; microfill resin composite (Heliomolar); nanohybrid composite (Tetric N Ceram) and nanofill resin composite (Filtek Z350XT).Three different polishing systems were used for each restorative system; three steps system(Astropol), one step (Astrobrush) and liquid polisher (G-coat Plus), as listed in Table 1. Shade A2 was used for all composites resin tested.

The restorative materials were used in accordance with manufacturer's instructions and only one operator performed all the procedures of specimen's preparation and all restorative procedures. A light emitting diode (LED) visible-light curing unit was used (bluephase C8, Ivoclar/Vivadent AG Schaan, Liechtenstein), and the power density of the light (800 mW/cm2) was checked every 10 specimens with a digital readout dental radiometer (bluephase meter, IvoclarVivadent AG, Schaan, Liechtenstein).

Table 1: Restorative materials & polishing systems tested

Brand names	Specificatioin	Manufacture	Composition
Filtek™ Z350 XT	***Nano filled composite***	***3M ESPE St Paul, MN, USA***	***Matrix: Bis-GMA, UDMA, Bis-EMA,TEGDMA Filler: silica nanofiller (5−75 nm), zirconia/silica nanocluster (0.6−1.4 µm)***
Tetric N ceram	***Nano hybrid composite***	***IvoclarVivadent***	***Matrix: bisGMA,UDMA,TEGDMA,EthoxylatedBis-EMA. Filler:Barium glass, ytterbium trifluoride,mixed oxide, silicon dioxideprepolymers***
Helimolar	***Microfilled composite***	***IvoclarVivadent***	***Matrix: Bis-GMA, UDMA, Decandioldimethacrylate, Filler:silicon dioxide, Prepolymer, Ytterbium trifluoride***
A stropol F P HP	***Three step polishing system***	***IvoclarVivadent***	***Matrix:rubber Abrasive:siliconcarbid, aluminiumoxide, titanium oxide, ferrous oxide, diamond dust(HP)***
Astrobrush	***One step polishing system***	***IvoclarVivadent***	***Silicon carbide-impregnated polyamide bristle brush***
G-coat Plus	***Nano-filled self-adhesive light cured protective coating***	**GCcorporation Tokyo, japan**	***Urethane methacrylate, methylmethacrylate, camphorquinone, silicon dioxide, phosphoric ester monomers***

Abbreviations: bis-GMA, bisphenol-A glycidyl methacrylate; UDMA, urethane dimethacrylate; TEGDMA, triethyleneglycoldimethacrylate; DMA, dimethacrylate; Bis-EMA,Bisphenol A polyethylene glycol dietherdimethacrylate

Cylindrical split mold (50 mm diameter and 2 mm thick) was constructed from Teflon. In the center of the mold a circular recess (10 mm diameter) was constructed and used for preparing the composite specimens [22]. Three groups of specimens were prepared, one from each material (n=40). Each restorative material was placed in bulk pack technique in the mold using Optra Sculp modeling instrument (Ivoclar/Vivadent,AG Schaan, Liechtenstein) over a transparent, 0.051 mm thick Mylar strip (Universal strip of acetate foil) and a glass slide. Black paper was placed between the glass slide and Mylar strip to prevent reflection of light during polymerization. [23]

Every effort was made to prevent the inclusion of air voids while inserting the material in the mold. Another Mylar strip and a glass slide were placed over the inserted material. A 500 gm stainless steel weight was applied for 30 s over the specimen, allowing the composite to flow in order to obtain a smoother and standardized surface. After removal of the stainless steel weight, curing was performed according to manufacturer's instructions. The distance between light source and specimen was standardized by curing through the glass slide. The tip of the light curing unit was in contact with the covering glass slide. Finally the specimens were removed from the mold. The specimens were immediately finished and polished to simulate the clinical condition.[24]

All the specimens were notched on their reverse side to serve as an orientation aid for the finishing procedures; each disc was notched at two locations 180^0 apart to ensure consistent orientation of specimens during polishing procedures (double notch at one edge; single notch at the opposite edge), which were carried out perpendicular to the notch.[24]

Ten specimens from each restorative material were remained without finishing/polishing after removal of Mylar strip used as a control group. Specimens were finished and polished immediately after curing, following the routine clinical procedure. Specimens were finished with fine grit diamond instrument to simulate clinical condition for 30 s with a high-speed handpiece under water cooling; a new finishing bur was used for every five specimens.[25] Specimens were equally divided into three groups according to restorative materials (microfilled composite A, nanohybrid composite B and nanofilled C); 30 specimens for each material. Each group further subdivided into three sub groups according to polishing system (n=10).

In subgroups A1,B1,C1 the specimens were finished and polished with three steps silicon system, following a decreasing sequence of abrasiveness (the Astropol F; Finishing), the Astropol P (Polishing) and the Astropol HP (High Polishing) polishing discs using a low- speed hand piece at approximately 10,000 rpm in conjunction with water spray. Uniform light pressure and a planar motion 10 s for each abrasive step were used to polish the specimens. After each polishing step, the specimen was rinsed with water spray and blow dried with an air syringe. [26]

The second subgroup was polished using Astrobrush for 30 s (one-step system) which was mounted on a low speed handpiece attached to an electrical motor to fix the speed at 10000 rpm in conjunction with water spray. Each brush was removed after single use. The third subgroup, the specimens were coated with liquid polisher after finishing with diamond instruments.

After the finishing/polishing procedures, the specimens were washed with air-water spray for 5 s and examined under a stereomicroscope (Nikon model SMZ-IB, Tokyo, Japan) for grinding debris or surface defects. If voids were present, the specimen was discarded and replaced with another then stored in distilled water at room temperature for 24 hours to complete the polymerization.[27]

The Gloss of surface was measured with gloss meter (SMART Spectro TM Spectrophotometer; TC-3000 Tri-Meter). The measuring principle of this device is based on a light beam that strikes the surface at an angle of 60◦. The gloss meter measures the intensity of the reflected light and compares it with a reference value. [28] Measurements were expressed in gloss units (GU). Initial gloss measurement was recorded for control and polished specimens. All specimens were exposed to mechanical tooth brushing and final gloss was taken. The measured specimen placed on a black cloth to exclude external light during the measurement and exactly at the center of the aperture of the gloss meter. All data were collected and were statistically analyzed.

III. Results

The gloss mean values and standard deviation of each material against Mylar strips and after polishing with either three step system, one step system or liquid polisher were obtained through the analysis of glossometer reading are shown in table 2. Statistical evaluation of the data was performed with two ways ANOVA to evaluate the effect of different polishing methods, different types of dental resin composite tested, and their interaction on surface gloss. It was found that there was a significant effect of finishing method and material type on surface gloss. In addition, there was no significant interaction between polishing method and material. Least significant difference (LSD) test was conducted to detect any significance of different dental resin composite tested within every finishing method tested.

Regarding to polishing methods tested, a significant difference was observed among polishing procedures. A Mylar strip was used as the control, and the surface gloss values for all polishing systems were compared to that of the Mylar strip as it has the highest gloss for nanofill, nanohybrid, microfill respectively, to be followed by liquid polisher for nanofill, nanohybrid, microfill respectively, to be followed by three step systems for nanofill, nanohybrid, microfill respectively. The lowest gloss values were recorded for all the restorative materials polished with one step system for nanofill, nanohybrid, microfill respectively. There was no polishing system could produce glossy surface similar to Mylar strip. There was significant difference among three polishing systems.

When the dental resin composite resins were evaluated regardless of polishing procedures, the final overall gloss mean values for nanofill (66.0, 50.50, 42.0, 39.0 for Mylar, liquid polisher, three step, one step respectively), were highest than that for nanohybrid (64.0, 48.0, 40.0, 37.0) while the least values recorded with microfill (58.0, 40.0, 35.0, 30.0) with significant difference between microfilled, nanofilled and microfilled, nanohybrid and no significant difference between nanohybrid, nanofilled.

Table 2: Mean gloss (GU) and standard deviation for the tested composite and finishing /polishing procedures evaluated before tooth brushing.

Materials	Mylar	Three-step system	One-step system	Liquid polisher	LSD	P value
microfilled	**58.0± 3.496 ^{a}**	**35.0± 3.496^{b}**	**30.0± 6.055 ^{c}**	**40.0 ± 2.789^{d}**	**3.764**	**<.0001**
nanohybrid	**64.0 ± 3.496^{aA}**	**40.0 ± 3.496^{bB}**	**37.0 ± 3.496^{cC}**	**48.0 ± 3.83 ^{dD}**	**3.249**	**<.0001**
Nanofilled	**66.0 ± 4.643^{aA}**	**42.0± 3.496^{bB}**	**39.0± 3.496^{cC}**	**50.50 ± 3.03^{dD}**	**3.37**	**<.0001**
LSD	**3.59**	**3.208**	**4.1415**	**2.9786**		
P value	**.0003**	**0.0004**	**0.0003**	**<.0001**		

Means with the same small superscripted letters in the same row and the same capital superscripted letters in the same column demonstrated no statistically significant differences (p > 0.05).

After tooth brushing, the mean gloss values for all tested groups were decreased. Two way ANOVA statistical analyses were used to evaluate the effect of material and polishing system on gloss; as shown in table 3. Gloss was decreased for all evaluated materials with significant difference among them. No significant difference among polishing system.

LSD test was used to compare between different restorative materials and different polishing systems tested. The nanofilled was the highest mean gloss values (40.9, 39.3, 40.0, 39.6 for Mylar, liquid polisher, three step system, one step system respectively) followed by nanohybrid (31.85, 30.7, 30.0, 31.0 for Mylar, liquid polisher, three step system, one step system respectively) and microfilled recorded the least values (29.5, 29.0, 29.1, 29.2 for Mylar, liquid polisher, three step system, one step system respectively). There was significant difference between nanofilled, microfilled. There was significant difference between nanofilled, nanohybrid. There was no significant difference between microfilled ,nanohybrid.

Table 3: Mean gloss (GU) and standard deviation for the tested composite and finishing /polishing procedures evaluated after tooth brushing.

Materials	Mylar	Three-step system	One step system	Liquid polisher	LSD	Pvalue
microfilled	**29.5±3.028^{a}**	**29.1 ± 2.60^{a}**	**29.2 ± 2.044^{a}**	**29.0 ±3.496^{a}**	**2.58**	**0.9815**
nanohybrid	**31.85±2.56^{a}**	**30.0± 3.496^{a}**	**31. ± 3.496^{a}**	**30.7 ± 1.65^{a}**	**2.634**	**0.5604**
nanofilled	**40.9 ± 3.48 ^{b}**	**40.0 ± 3.496^{b}**	**39.6 ± 2.76 ^{b}**	**39.3±3.027 ^{b}**	**2.907**	**0.757**
LSD	**2.795**	**2.9597**	**2.5954**	**2.602**		
P value	**<.0001**	**0.0004**	**<.0001**	**<.0001**		

Data with the same superscriptedletters in the same row demonstrated no statistically significant differences (p > 0.05).

IV. Discussion

Particle size and the amount of particle in composite resin technology represent crucial information in determining how best to use composite materials.1 The present study compared the surface gloss of two different nanocomposite resin restorative materials; nanofill (Z350XT), nanohybrid (Tetric N Ceram), and a microfill resin composite (helimolar) after finishing/polishing with different systems. These restorative materials were selected on the basis of filler load and filler size. Also, the different polishing systems investigated in this study were selected to compare and evaluate the effectiveness of one step polishers compared to multistep polisher.

Gloss is a desirable characteristic for restorative materials to mimic the appearance of the enamel.29A smooth and glossy surface is generally obtained under a Mylar strip without subsequent finishing or polishing, but unfortunately intra-oral finishing is always required.16 Gloss has been shown to be influenced by the size distribution, mechanical properties, and index of refraction of the fillers present in matrix, as well as the viscosity and index of refraction of the matrix component.30

In the present study, the highest gloss was obtained under Mylar strip polymerized specimen followed by liquid polisher, followed by three step polishing system and the least gloss obtained with one step polishing system. While the highest gloss recorded with nanofilled then nanohybrid with no statistically significant difference between two materials. Therefore, it might be concluded that the composition of the material rather than the roughness might have an effect on the gloss. So, gloss is affected by other factors not roughness alone.

Gloss was decreased significantly after tooth brushing and change in gloss was influenced by the type of composite resin. Tooth brush abrasion resulted in rougher and matte surfaces for all materials tested. The nanofilled composite still represented the highest gloss in comparison to other two tested materials. And this may be explained by its lowest surface roughness after tooth brushing, gloss was more affected by the classification of the filler size. The small size of filler particles improve the optical properties of resin composites because their diameter is a fraction of wavelength of visible light (0.4-0.8 nm), resulting in the human's eye inability to detect the particle.31 So use of nanotechnology can offer high translucency, high polish and polish retention. In addition, not only filler size but also the shape of fillers influenced the gloss. Since nanofill uses spherical fillers, it may be that spherical particles are able to reflect more light than irregular particles.27

V. Conclusion

Based on the findings of this study, the following conclusions can be found:

1. Nanofilled composite showed the highest gloss between the tested composites.
2. Liquid polisher exhibited the highest gloss among the tested polishing systems but still worse than Mylar strip.

References

[1]. Kakaboura A, Fragouli M, Rahiotis C andSilikas 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: 155-63.

[2]. Hosoya Y, Shiraishi T, Odatsu T, Ogata T, Miyazaki M and Powers JM (2010). Effects of specular component and polishing on color of resin composites. J Oral Sci; 52:599-607.

[3]. Bennett HE andPorteus JO. Relation between surface roughness and specular reflectance at normal incidence. J Opt Soc Am)1961(; 51:123–29.

[4]. Chung KH. Effects of finishing and polishing procedures on the surface texture of resin composites (1994). Dent Mater; 10:325-330.

[5]. Ferracane JL, Condon JR,Mitchem JC 1992. Evaluation of subsurface defects created during the finishing of composites. J Dent Res; 71:1628–32.

[6]. 6. Jefferies SR (1998). The art and science of abrasive finishing and polishing in restorative dentistry. Dent Clin North Am; 42:613-27.

[7]. Baseren M(2004). Surface roughness of nanofill and nanohybrid composite resin and ormocer-based tooth-colored restorative materials after several finishing and polishing procedures. J BiomaterAppl; 19:121-34.

[8]. Bashetty K, Joshi S (2010). The effect of one-step and multi-step polishing systems on surface texture of two different resin composites. J Conserv Dent; 13: 34–38.

[9]. Owens BM, Johnson WW (2006). Effect of new generation surface sealants on the marginal permeability of Class V resin composite restorations. Oper Dent; 31:481-88.

[10]. Ramos RP, Chimello DT, Chinelatti MA, Dibb RG, Mondelli J (2000). Effect of three surface sealants on marginal sealing of Class V composite resin restorations. Oper Dent; 25:448-53.

[11]. Ramos RP, Chinelatti MA, Chimello DT and Dibb RG(2002);. Assessing microleakage in resin composite restorations rebonded with a surface sealant and three low- viscosity resin systems. Quint Int 33:450-56.

[12]. Doray PG, Eldinwany MS and Powers JM (2003). Effect of resin surface sealers on improvement of stain resistance for a composite provisional material. J EsthetRestor Dent; 15:244-49.

[13]. Yap AU, Sau CW, Lye KW (1998). Effects of finishing/polishing time on surface characteristics of tooth colored restoratives. J Oral Rehabil; 25:456-61.

[14]. Yap AU, Lye KW,Sau CW (1997). Surface characteristics of tooth colored restoratives polished utilizing different polishing systems. Oper Dent; 22:260-5.

[15]. Heintze SD, Forjanic M,Rousson V (2006). Surface roughness and gloss of dental materials as a function of force and polishing time in vitro. Dent Mater; 22: 146-65.

[16]. Paravina RD, Roeder L, Lu H, Vogel K, Powers JM (2004). Effect of finishing and polishing procedures on surface roughness, gloss and color of resin-based composites. Amer J Dent; 17: 262-66.

[17]. Craig RG, Ward ML (1997). Restorative Dental Materials. 10th ed. Mosby; St. Louis, USA.

[18]. Senawongse P, Pongprueksa P (2007). Surface roughness of nanofill and nanohybrid resin composites after polishing and brushing. J EsthetRestorDent; 19: 265-75.

[19]. Anusavice KJ, Antonson SA (2003). Finishing and Polishing Materials in Philip's Science of Dental Materials 11th ed. Philadephia WB Saunders Co., p. 352-53.

[20]. Lu H, Roeder LB, Lei L, Powers JM (2005). Effect of surface roughness on stain resistance of dental resin composites. J EsthetRestorDent; 17:102–08.

[21]. Gordan VV, Patel SB, Barrett AA,Shen C (2003). Effect of surface finishing and storage media on bi-axial flexure strength and microhardness of resin-based composite. Oper Dent; 28: 560-67.

[22]. Ergücü Z, Türkün LS,Aladag A (2008). Color stability of Nano composites polished with one-step sysms. Oper Dent; 33: 413-20.

[23]. Yap AU, Yap SH, Teo CK and Ng JJ. Comparison of surface finish of new aesthetic restorative materials. Oper Dent 2004; 29:100-104.

[24]. Dukic W, Dukic OL, Milardovic S andDelija B. Clinical evaluation of indirect composite restorations at base- line and 36 - monthafter placement.Oper Dent 2010; 35:156-164.

[25]. Monteiro PM, Manso MC, Gauinha S and Melo P. Two-year clinical evaluation of packable and nanostructured resin- based composites placed with two techniques. Am Dent Assoc 2010; 141:319-29.

[26]. Kameyama A, Nakazawa T, Haruyama A, Haruyama C, Hosaka M andHirai Y. Influence of finishing/polishing procedures on the surface texture of two resin composites. Open Dent 2008; 2:56-60.

[27]. Wang L, Garcia FC, Araujo PA, Franco EB and Mondelli RF. Wearresistance of packable resin composites after simulated toothbrushingtest. J EsthetRestor Dent 2004; 16:303-14.

[28]. Silikas N, Kavvadia K, Eliades G and Watts D. Surface characterization of modern resin composites: A multi- technique approach. Am J Dent 2005; 18:95-100.

[29]. Da Costa J, Ferracane J, Paravina RD, Mazur RF, Roeder L (2007). The effect of different polishing system on surface roughness and gloss of various resins composite.J EsthetRestor Dent; 19:214-26.
[30]. O'Brien WJ, Johnston WM, Fanian F and Lambert S. The surface roughness and gloss of composites. J Dent Res 1984; 63:685–688.
[31]. Alexander-Katz R, Barrera RG. Surface correlation effects on gloss. J PolymSci [B] 1998; 36:1321.
[32]. Dresch W, VolpatoS, Gomes JC, Ribeiro NR, Reis A and Loguercio AD. Clinical evaluation of a nanofilled composite in posterior teeth: 12-month results.Oper Dent 2006; 31:409-17.

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