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Correlation Between Gloss and Surface Roughness of Low Viscosity Bulk Fill Resin Composites

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Research Article

History

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ABSTRACT

Objectives: This study aimed to determine the correlation between gloss and roughness in low-viscosity bulk fill resin composites.

Materials and Methods: The study had an experimental, analytical, prospective, and cross-sectional design. A total of 60 composite resin blocks were evaluated and distributed into three groups of 20 units each: Group 1—3M Filtek Bulk Fill Flow (FBF), Group 2—Opus Bulk Fill Flow APS (OBF), Group 3—Opalis Flow (OF) (Reference group). Gloss and roughness were measured using a gloss meter and a contact roughness meter. In the descriptive analysis, measures of central tendency and dispersion were calculated. The normality of the data was evaluated using the Shapiro-Wilk test. For the comparison of roughness between resin composites, the ANOVA test was applied, and for gloss, the Kruskal-Wallis test was applied, both with Tukey´s and Dwass-Steel-Critchlow-Figner post-hoc tests, respectively. The relationship between variables was measured using Pearson and Spearman correlations. The data were processed using the SPSS statistical package, considering a significance level of 0.05.

Results: The FBF resin had the highest average roughness (0.35 Ra), while OF had the lowest value (0.28 Ra); in addition, OF had the highest gloss values (26.94 GU). On the other hand, there was a statistically significant high negative correlation between roughness and gloss ($p < 0.01$).

Conclusions: There was an inverse relationship between roughness and gloss regardless of the type of resin composites evaluated.

Keywords: Resin composites, dental restoration, permanent, surface properties

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Introduction

In restorative dentistry, a range of resin composites containing filler particles are used to provide dimensional stability and improve functional and aesthetic performance. Among their properties is roughness, defined as the uniformity of the restorative material's surface. On the other hand, gloss is an optical property related to the fluorescence, hue, chroma, and opalescence of the material. Both are linked to the finishing and polishing techniques of restorative materials, which can improve the prognosis of the restoration.[1,2]

Conventional resin composites are frequently used in restorative dentistry; however, one of their disadvantages is limited light penetration, which results in inadequate curing and polymerization depth.[3] There are several factors that impair the photopolymerization of resin composites, such as: the type of resin, the space between the end of the light-conducting nozzle and the resin area, the volume and distribution of the filler, its color, and translucency.[4,5] The depth of light curing will depend on light penetration and resin thickness,[6] so some methods have been proposed to overcome this drawback, among which the incremental technique stands out, which consists of placing resin in successive layers. However, this technique has the disadvantage of longer working time and a high risk of trapping and contamination by air bubbles between each layer.[7] To overcome this situation, a new group of restorative materials has appeared on the dental market, such as Bulk Fill resins, which require less clinical working time because the material can be used in increments of 4 to 5 mm, unlike other types of resin.[8] In addition, this material has a high degree of transparency, high-tech monomers, filler modifications, and new photoinitiators, which help reduce polymerization stress, thus providing the benefits of greater curing depth and better fit with the cavity walls.[9,10]

Fluid or low-viscosity resins are most often used in Class I and II restorations. It should also be noted that, in various studies, this type of resin has achieved better results in Class V restorations.[11]

Bulk Fill resin composites are classified according to their viscosity as high and low viscosity, sonically activated modified viscosity, and dual-curing medium viscosity.[12]

The characteristics of the tooth surface are essential because they are considered determining factors for a successful long-term restoration.[13] High roughness of the composite resin could lead to bacterial plaque accumulation and produce an unsatisfactory aesthetic appearance, which may lead to future restoration failure.[14,15] In addition, Bulk Fill flowable resins have important optical properties such as gloss and color´,[16] which not only affect the structure of the restoration but also influence its visual appearance.[17] Although previous studies have mainly focused on conventional resin composites, some investigations have evaluated the surface roughness and gloss values of resin composites with different types of fillers before and after simulated abrasion with a toothbrush, finding that there is an inverse relationship between the two properties.[18] However, evidence regarding these surface and optical properties in low-viscosity Bulk Fill resin composites remains limited, highlighting the need for further investigation in this specific group of materials.

Given the above, the objective of this study was to determine the correlation between gloss and roughness in low-viscosity bulk fill resins. The null hypothesis indicated that there is no correlation between gloss and roughness in the materials studied.

Materials and Methods

Design and Ethical Aspects

An in vitro experimental study was conducted in which the sample size was calculated using GPower software, considering a two-tailed calculation, a statistical power of 0.80, and an effect size of 0.9.[19] Sixty blocks of Bulk Fill resin composites from the brands Opus Bulk Fill Flow APS, 3M Filtek Bulk Fill Flow, and Opallis Flow (Reference group) (Table 1) were divided equally into three groups of 20 units according to brand. Gloss and roughness were measured on the same specimen. Samples that did not meet the pre-established measurements or that had bubbles and cracks on the surface were excluded. The study was approved by the Ethics Committee of the Faculty of Dentistry of the University of San Martín de Porres, Perú with registration number 010-2025-CEI-FO-USMP.

Table 1. Information on the resin-based composites used in the study

Material	Classification	Composition	
		Organic matrix	Filler
Opus Bulk Fill Flow APS (FGM)	Nanohybrid	UDMA, stabilizers, APS, co-initiator, silicon dioxide (silica), stabilizers, pigments.	The composite contains approximately 79% filler by weight.
3M Filtek Bulk Fill Flow (3M ESPE)	Nanofilled	AUDMA, UDMA, 1,12–Dodecanediol-DMA, BISEMA, TEGDMA, ytterbium fluoride.	The inorganic filler content is approximately 76.5% by weight (58.4% by volume).
Opalis Flow (FGM)	Nanohybrid	Bis-GMA, Bis-EMA, UDMA, and TEGDMA.	Particles range from 40 nm to 3.0 microns, with an average particle size of 0.5 microns; total inorganic filler content is 78.5% by weight and between 57% to 58% by volume.

UDMA = urethane dimethacrylate, AUDMA = aromatic urethane dimethacrylate, APS = advanced polymerization system, Bis-GMA = bisphenol-A-glycidyl methacrylate, Bis-EMA = ethoxylated bisphenol-A dimethacrylate, TEGDMA = triethylene glycol dimethacrylate.

Specimen Preparation

Circular resin blocks measuring 2 mm in height and 5 mm in diameter were fabricated using a steel mold placed on a glass slide. The 2-mm specimen thickness was selected in accordance with ISO 4049 for polymer-based restorative materials, which establishes this thickness as a standard for specimen preparation, ensuring flat and homogeneously polymerized surfaces suitable for reliable evaluation of surface properties. The resins were placed inside the mold using their respective dispensing tips in a single increment. Next, a celluloid tape was placed on the mold, followed by a second glass slide, on which light pressure was applied to homogenize and compact the resin. The end of an LED light-curing lamp (Woodpecker iLed – China) was placed in direct contact with the glass sheet, and the material was exposed to the light source for 20 seconds on each side of the mold.

The samples were polished using a Sof-Lex aluminum oxide disc system (3M ESPE) in three steps, applied in descending order of abrasiveness. Polishing was performed with a cloth wheel attached to a low-speed handpiece. The samples were rinsed and stored in distilled water for 48 hours at 37°C. All procedures were performed by a single researcher.

For the measurements, the investigators evaluated inter- and intra-examiner reliability using the intraclass correlation coefficient (ICC), with values exceeding 0.80.

Gloss Measurement

Gloss was measured using a gloss meter (3NH - HG60), with a measurement area of 2 mm x 2 mm. The equipment was previously calibrated using a standard gloss plate provided by the manufacturer. The measurement with the device was performed using a beam of light that struck the surface at an angle of 60 degrees. This gloss meter measured the magnitude of the reflected light and compared it to a reference value; the measurements were presented in gloss units (GU). Gloss measurements were taken in three different areas for each sample, with the average between them being considered the final value. The samples were handled with nitrile gloves to avoid

contamination, and the brightness readings were taken inside a dark booth to control ambient light.

Measurement of Surface Roughness

The roughness of each sample was measured using a roughness tester (Huatec SRT 6200, Beijing, China), which operated with a tensile force of 0.75 mN, a transverse length of 0.8 mm, a standard cut of 1.0 mm, a stylus speed of 0.5 mm/s, and an amplitude height of 2.5 mm. Three roughness measurements were taken in cross directions on the sample surface, with the arithmetic mean considered as the final value. The values were recorded in Ra units. Prior to use, the equipment was calibrated with a standard roughness plate provided by the manufacturer.

Statistical Analysis

The data were described using mean and median values, standard deviation, and maximum and minimum values; scatter plots were also used. The normality of data distribution was assessed using the Shapiro–Wilk test. Based on the distribution of the data, parametric analysis of variance (ANOVA) was applied for surface roughness data showing normal distribution, whereas the nonparametric Kruskal–Wallis test was used for gloss data that did not meet normality assumptions. Pearson or Spearman correlation tests were selected accordingly. The data were processed using the SPSS statistical package, version 29. The analysis was performed with a significance level of 0.05.

Results

Table 2 shows that Opalis Flow composite resin had a statistically significant higher average gloss value than the other resins studied ($p < 0.001$); furthermore, there were no statistical differences between Opus Bulk Fill Flow APS and 3M Filtek Bulk Fill Flow ($p = 0.091$).

Table 3 shows that 3M Filtek Bulk Fill Flow had the highest average roughness compared to the other resins studied ($p < 0.001$).

None of the evaluated resins reached the reference gloss value of dental enamel (>40 GU), as all recorded values were below this threshold. Additionally, surface roughness values of all evaluated resins exceeded the reference threshold of 0.2 µm.

Figure 1 shows a strong negative correlation between surface roughness and gloss for all evaluated resin composites. Opalis Flow showed r = −0.7935* ($p < 0.01$), Opus Bulk Fill Flow APS showed r = −0.7968** ($p < 0.01$), and Filtek™ Bulk Fill Flow showed r = −0.7519* ($p < 0.01$). *Pearson correlation; **Spearman correlation.

Table 2. Gloss measurements (GU)

Composite resin	Mean*	Median	SD	Minimum	Maximum
Opalis Flow	26.9433^{a}	26.4833	6.0448	19.1667	41.0333
Opus Bulk Fill Flow APS	19.5983^{bc}	18.3167	5.2200	13.3333	35.5333
3M Filtek Bulk Fill Flow	16.6350^{c}	15.8167	3.5947	10.8667	24.4000

**Kruskal-Wallis test. Different letter superscripts indicate statistically significant differences ($p < 0.05$) – Post-Hoc test: Dwass-Steel-Crichlow-Fligner. SD: Standard deviation.*

Table 3. Roughness values (Ra)

Composite resin	Mean*	Median	SD	Minimum	Maximum
Opalis Flow	0.2829^{a}	0.2750	0.0438	0.2260	0.3770
Opus Bulk Fill Flow APS	0.3116^{b}	0.3100	0.0255	0.2740	0.3740
3M Filtek Bulk Fill Flow	0.3555^{c}	0.3620	0.0272	0.2890	0.3979

**One-way ANOVA test. Superscripts with different letters indicate statistically significant differences ($p < 0.05$) – Tukey's post hoc test. SD: Standard deviation.*

Discussion

Several studies highlight the importance of finishing and polishing in achieving smooth and glossy surfaces in resin restorations. The literature clearly states that both surface roughness and gloss significantly influence the aesthetics, durability, and oral health of the patient.

The gloss values of resin composites are often compared to that of natural enamel as an aesthetic reference. Zhang et al.[19] reported that human enamel has a gloss value close to 53 GU, which is considered a critical comparison point. However, Da Costa et al.[20] concluded that gloss values consistently perceived as clinically acceptable ranged between 40 and 50 GU. In the present study, none of the analyzed resins exceeded the gloss of natural enamel;[19] however, the gloss values obtained in Opalis Flow suggest better performance compared to the other studied resins, while Filtek Bulk Fill Flow could be considered clinically and aesthetically deficient.

According to Soliman et al.[18] high gloss not only enhances the aesthetic appearance of the restoration but also allows better optical integration between the resin and natural teeth. Gloss, by favoring specular reflection of light, influences color perception, which is fundamental for achieving harmonious and aesthetically acceptable restorations. On the other hand, Altınışık et al.[21] explain that gloss is directly influenced by surface roughness, as well as by intrinsic material factors such as the refractive index between the resin matrix and the filler, particle size, and matrix homogeneity, all of which directly affect the surface roughness of restorations. This is because filler particles, depending on their size, can generate small or large defects when detached from the surface during the finishing and polishing process. Furthermore, when the

particles are small and closely distributed, they offer greater protection to the resin matrix against the wear caused by polishing abrasives, making them less susceptible to material loss and contributing to better gloss preservation.

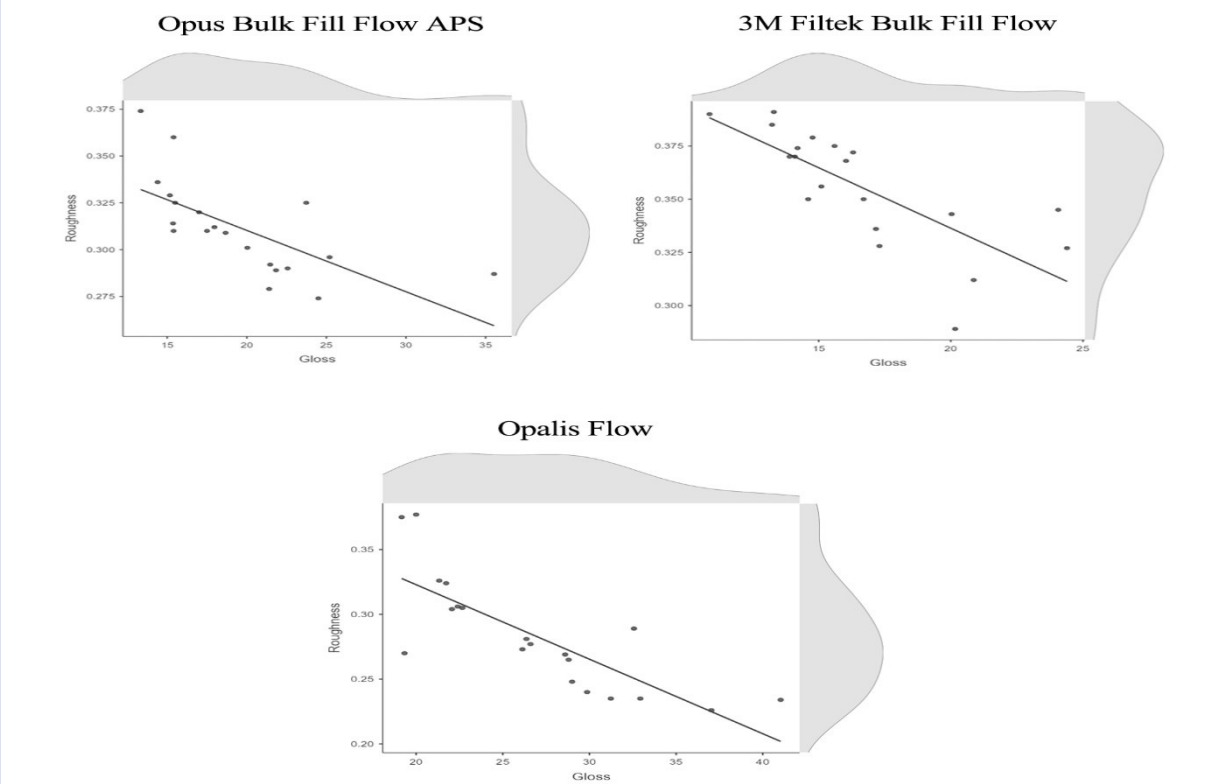

Figure 1. Correlation graph between the gloss and roughness of the composite resins.

In our study, nanohybrid particle resins (Opus Bulk Fill and Opalis Flow) showed better gloss values and lower surface roughness compared to Filtek Bulk Fill resin, which contains nanofiller particles. These results contradict what was indicated by Soliman et al.[18] regarding the direct influence of particle size on resin roughness and gloss. According to Zhang et al.[19] the results could be explained by the possibility that Opalis Flow resin presented well-distributed fillers and better blending with the matrix, resulting in a smoother and glossier surface after polishing. In contrast, Filtek Bulk Fill Flow resin (nanofilled) may contain more heterogeneous aggregates or nanoclusters. Zhang et al.[19] observed that in nanofilled resins, nanoclusters can become detached during polishing, leaving microscopic depressions on the surface. These irregularities increase roughness and light scattering, reducing specular gloss. In fact, the same author also reported that final gloss depends on the distribution and size of the filler particles, as well as on the refractive index of both fillers and matrix. Although theoretically smaller particles favor greater gloss due to less diffuse reflection, the presence of clusters or lack of homogeneity can counteract this effect.

In accordance with the above, surface roughness has been identified as a determining factor for both aesthetics and oral health. Gaviria et al.[22] warn that rough surfaces facilitate plaque accumulation, staining, and the development of secondary caries, in addition to generating friction with the antagonist tooth, which can cause microfractures and wear. Similarly, Picón et al.[23] emphasize that rough surfaces not only compromise aesthetics due to their reduced capacity to reflect light, but also increase susceptibility to stains and bacterial plaque retention. In our study, Filtek Bulk Fill Flow resin presented the highest surface roughness values even after applying a standardized finishing and polishing protocol, negatively affecting the restoration's prognosis. According to various authors,[2,23] a restorative material should maintain an average roughness below 0.2 µm to minimize bacterial plaque retention.

Additionally, Biçer et al.[24] reinforce this idea by stating that a roughness of 0.3 µm can already be perceived by the patient's tongue, which not only affects the subjective perception of the treatment but also coincides with the 0.2 µm threshold as a critical value for bacterial adhesion. In this context, the results of our study suggest that despite finishing and polishing, certain resins such as Filtek Bulk Fill Flow may require adjustments to the clinical protocol to achieve roughness values that improve both

patient comfort and the durability and aesthetics of the restoration.

According to Bansal et al.[25] appropriate selection of the protocol and finishing/polishing instruments reduces surface roughness. In addition, Aydin et al.[26] emphasize that factors such as hardness, grit size, and flexibility of the polishing systems also influence the results. Considering these aspects, in our study we used the Sof-Lex (3M ESPE) polishing system, applying a three-step technique with a decreasing abrasiveness sequence. However, despite following this standardized protocol, the results showed that Filtek Bulk Fill Flow resin had significantly higher surface roughness compared to the other resins evaluated.

The results of the present study reveal a statistically significant inverse correlation ($p < 0.05$) between surface roughness and gloss in all analyzed resins. This negative relationship suggests that the higher the surface roughness, the lower the gloss level achieved, which agrees with other studies.[18,27,28]

Although Mizutani et al.[27] studied high-viscosity resins, different from those used in our study, they reported an extremely strong negative correlation between roughness and gloss values in different resin composites, similar to what was found in our research. These findings reinforce the premise that surface texture has a direct impact on the optical behavior of these materials, regardless of the finishing/polishing method used. This is relevant considering that, in our study, although this variable was not included, the same correlation pattern was observed.

Soliman et al.,[18] in their evaluation of nanohybrid resins and different polishing systems, emphasize how the combination of resin type and finishing technique significantly influences roughness and gloss, observing that smoother surfaces obtained with Sof-Lex discs showed higher gloss values. Lower roughness results in greater surface gloss, as was particularly evident in the Opus Bulk Fill Flow group of our study. In this regard, the results of the present investigation agree with much of the current literature by demonstrating that surface roughness directly affects resin gloss and that this relationship is inverse. This evidence highlights the importance of considering not only the type of restorative material but also the surface characteristics resulting from its clinical handling, as these directly impact the aesthetics and durability of restorative treatment.

Finally, Nithya et al.[28] mentioned that the irregular shape of filler particles in microhybrid and nanohybrid resin composites can affect the formation of a smooth and reflective surface, resulting in decreased gloss as surface roughness increases. This finding is consistent with the results obtained in the present study, which show a strong inverse relationship between roughness and gloss ($p < 0.01$), suggesting that composites with higher roughness values, such as Filtek Bulk Fill Flow resin, also showed lower gloss values, and vice versa for Opus Flow resin.

This study presents certain limitations that should be acknowledged. Surface roughness was assessed using a contact profilometer, which, although widely accepted and commonly employed for evaluating restorative materials, may not capture fine micro and nanoscale surface irregularities that could be detected by non-contact methods such as optical profilometry or atomic force microscopy (AFM). In addition, other factors that could influence surface roughness and gloss were not considered, including mechanical abrasion, oral cavity acidity, and exposure to chemical agents. The incorporation of advanced surface characterization techniques and aging-related variables in future studies could provide a more comprehensive evaluation of surface properties and strengthen the understanding of the relationship between roughness and gloss in resin-based composite materials.

Conclusions

In conclusion, the selection of flowable resin composites should be based on balancing surface roughness and gloss according to clinical needs. Opalis Flow stands out for providing smoother and glossier surfaces, whereas Filtek Bulk Fill Flow results in a finish with lower gloss and greater roughness, which could promote bacterial adhesion. An inverse relationship was observed between surface roughness and gloss, regardless of the type of resin composites evaluated.

Given the inverse relationship between surface roughness and gloss, minimizing roughness through proper material selection and finishing procedures is essential to enhance restoration gloss and aesthetics.

Acknowledgement

None.

Conflicts of Interest Statement

The authors declare no conflicts of interest.

References

1. Chapman RJ, Nathanson D. Excessive wear of natural tooth structure by opposing composite restorations. J Am Dent Assoc 1983;106:51-53.
2. Kreulen CM, van Amerongen WE. Wear measurements in clinical studies of composite resin restorations in the posterior region: a review. ASDC J Dent Child 1991;58:109-123.
3. Pirmoradian M, Hooshmand T, Jafari-Semnani S, Fadavi F. Degree of conversion and microhardness of bulk-fill dental composites polymerized by LED and QTH light curing units. J Oral Biosci 2020;62:107-113.
4. Schneider LFJ, Pfeifer CSC, Consani S, Prahl SA, Ferracane JL. Influence of photoinitiator type on the rate of polymerization, degree of conversion, hardness and yellowing of dental resin composites. Dent Mater 2008;24:1169-1177.
5. Daugherty MM, Lien W, Mansell MR, Risk DL, Savett DA, Vandewalle KS. Effect of high-intensity curing lights on the polymerization of bulk-fill composites. Dent Mater 2018;34:1531-1541.
6. Rezaei S, Abbasi M, Sadeghi Mahounak F, Moradi Z. Curing depth and degree of conversion of five bulk-fill composite resins compared to a conventional composite. Open Dent J 2020;13:13-422.

7. Fronza BM, Abuna GF, Braga RR, Rueggeberg FA, Giannini M. Effect of composite polymerization stress and placement technique on dentin micropermeability of class I restorations. J Adhes Dent 2018;20:335-363.
8. Van Ende A, De Munck J, Lise DP, Van Meerbeek B. Bulk-fill composites: a review of the current literature. J Adhes Dent 2017;19: 95-109.
9. Miletic V. Dental composite for direct restorations. 1ª ed. Springer International Publishing; 2018.
10. Hasani E, Panahandeh N, Shamszadeh S, Abrandabadi AN, Sheikh-Al-Eslamian SM. Hygroscopic expansion of bulk fill composites: a three-month report. Braz Dent Sci 2018;21:172-176
11. Canali GD, Ignácio SA, Rached RN, Souza EM. One-year clinical evaluation of bulk-fill flowable vs. regular nanofilled composite in non-carious cervical lesions. Clin Oral Investig 2019;23:889-897.
12. Engelhardt F, Hahnel S, Preis V, Rosentritt M. Comparison of flowable bulk-fill and flowable resin-based composites: an in vitro analysis. Clin Oral Investig 2016;20:2123-2130.
13. Silikas N, Kavvadia K, Eliades G, Watts D. Surface characterization of modern resin composites: a multitechnique approach. Am J Dent 2005;18:95-100.
14. Jung M, Eichelberger K, Klimek J. Surface geometry of four nanofiller and one hybrid composite after one-step and multiple-step polishing. Oper Dent 2007;32:347-355.
15. Zimmerli B, Lussi A, Flury S. Operator variability using different polishing methods and surface geometry of a nanohybrid composite. Oper Dent 2011;36:52-59.
16. Lefever D, Perakis N, Roig M, Krejci I, Ardu S. The effect of toothbrushing on surface gloss of resin composites. Am J Dent 2012;25:54-58.
17. Van Dijken JWV, Ruyter IE. Surface characteristics of posterior composites after polishing and toothbrushing. Acta Odontol Scand 1987;45:337-346.
18. Soliman HAN, Elkholany NR, Hamama HH, El-Sharkawy FM, Mahmoud SH, Comisi JC. Effect of different polishing systems on the surface roughness and gloss of novel nanohybrid resin composites. Eur J Dent 2021;15:259-265.
19. Zhang L, Yu P, Wang XY. Surface roughness and gloss of polished nanofilled and nanohybrid resin composites. J Dent Sci 2021;16:1198-1203.
20. da Costa JB, Ferracane JL, Amaya-Pajares S, Pfefferkorn F. Visually acceptable gloss threshold for resin composite and polishing systems. J Am Dent Assoc 2021;152:385-392.
21. Altınışık H, Özyurt E. Effect of different polishing systems on surface roughness and gloss values of single-shade resin composites. BMC Oral Health 2024;24:1391.
22. Gaviria-Martinez A, Castro-Ramirez L, Ladera-Castañeda M, Cervantes-Ganoza L, Cachay-Criado H, Alvino-Vales M, et al. Surface roughness and oxygen inhibited layer control in bulk-fill and conventional nanohybrid resin composites with and without polishing: in vitro study. BMC Oral Health 2022;22:258.
23. Picón Rentería AD, Tamariz Ordóñez PE. Efectividad de los diferentes sistemas de pulido sobre la rugosidad superficial de las resinas compuestas. Revisión bibliográfica. Rev Odontol 2023;26:67-74.
24. Biçer Z, Yaman BC, Çeliksöz Ö, Tepe H. Surface roughness of different types of resin composites after artificial aging procedures: an in vitro study. BMC Oral Health 2024;24:876.
25. Bansal K, Gupta S, Nikhil V, Jaiswal S, Jain A, Aggarwal N. Effect of different finishing and polishing systems on the surface roughness of resin composite and enamel: a in vitro profilometric and scanning electron microscopy study. Int J Appl Basic Med Res 2019;9:154-158.
26. Aydın N, Karaoğlanoğlu S, Oktay EA, Ersöz B. Superficial effects of different finishing and polishing systems on the surface roughness and color change of resin-based CAD/CAM blocks. Odovtos-Int J Dent Sc 2021;23:87-97.
27. Mizutani K, Takamizawa T, Ishii R, Shibasaki S, Kurokawa H, Suzuki M, et al. Flexural properties and polished surface characteristics of a structural colored resin composite. Oper Dent 2021;4:117-131.
28. Nithya K, Sridevi K, Keerthi V, Ravishankar, P. Evaluation of surface roughness, hardness, and gloss of composites after three different finishing and polishing techniques: an in vitro study. Cureus 2020;12:7037.