How to Cite:
Raees, F., Naeem, Z., Fayyaz, F., Mahboob, Z., Akram, S., & Syed, M. (2023). One step polishing to compare the mean surface roughness of nanohybrid and microhybrid composite resins. *International Journal of Health Sciences*, *7*(S1), 1803–1808. https://doi.org/10.53730/ijhs.v7nS1.14411

One step polishing to compare the mean surface roughness of nanohybrid and microhybrid composite resins

Farhan Raees
Senior lecturer/demonstrator dental material, Bacha Khan College of Dentistry Mardan
Email: raeesfarhan54@gmail.com

Zahid Naeem
Resident Prosthodontics, Bacha Khan College of Dentistry Mardan
Email: zahidnaeem09@gmail.com

Fawad Fayyaz
Lecturer, KMU-institute of dental sciences, Kohat
Corresponding author email: fawadfayyaz@gmail.com

Zainab Mahboob
Ex-resident operative dentistry and endodontics, Islamic International Dental College, Islamabad
Email: Zainabmahboob06@gmail.com

Sadia Akram
Assistant Professor Dental Materials, Abbottabad International Medical Institute, Abbottabad
Email: doctorsadiaakraam@gmail.com

Mahrukh Syed
Registrar, Operative Dentistry, Abbottabad International Medical Institute, Abbottabad
Email: rukhiamc@gmail.com

***Abstract*---**Objectives: This study's goal was to compare the mean surface roughness of nano hybrid and micro hybrid composites using a one-step polishing method. This comparison was made based on the idea that a material with reduced surface roughness will exhibit superior perishability, aesthetics, surface & optical properties, which means less wear, less staining, low plaque, and low caries rate. Methodology: This comparative study was carried out in April 2023 at the Ayub Medical College in Abbottabad, Pakistan, with a sample size

of 100 (50 in each group), determined by the WHO calculator. Using a mechanical stainless steel template, 120 composite resin specimens mounted on acrylic blocks with dimensions of 2 mm x 3 mm x 3 mm were created. Results: 100 samples, separated into two groups, were used in this study. According to descriptive statistics, mean surface roughness and standard deviations for Nano hybrid composite in Group A were recorded as 0.076+0.025 and for Micro hybrid composite in Group B, they were 0.001+0.036. Conclusion: After polishing with a one-step procedure, there is a noticeable difference between the surface roughness of nano hybrid and micro hybrid composite resins, indicating that the former has higher polish ability than the latter. As a result, nano hybrid composite has better surface and optical properties and may be utilized more frequently with better outcomes than micro hybrid composite.

***Keywords*---**composite resins, dental polishing curing light, surface properties.

Introduction

Dental resin-based Considering their strength and aesthetics, composites are being employed more frequently in restorative dentistry. Composites come in a variety of brands and are applied to both front and back teeth.[1] One technique to categorize composites is based on the filler content since the fillers used in composite resins directly affect their physical features. A more recent class of materials called hybrid composites includes sub-micron (0.02-0.04 micron) and micron-sized (1-3 micron) particles. The mixing of various sized filler particles significantly increases this class's wear resistance.[2] Micron-sized particles make micro hybrid composites unique. By incorporating uniformly stacked micro fillers between bigger particles, the micro hybrids are more publishable and achieve greater optical colour improvement.[1]

The most recent member of the family of resin composites to incorporate pre polymerized nano fillers in an aggregated condition, 0.4 m silica fillers, and independently dispersed nanoparticles of 0.05 m is called a nano hybrid.[3] These resins exhibit improved mechanical qualities, increased surface perishability, less polymerization contraction, and improved aesthetics. Polishing depends on the filler's morphology, composition, and size in a composite. Even after using polishing, the surface will be rougher with larger and more fillers. The success of composite restorations in restorative treatments is greatly influenced by the surface characteristics. Because there is increased friction stress, composite surfaces that are not polished wear more quickly.[4] Additionally, rough surfaces are more likely to attract stains and plaque, aggravate periodontal disease, increase the risk of caries, and are unsightly. Abrasives (polishing pastes), two-step rubber or silica abrasive burs, and one-step optrapol have recently been developed.[5] A revolutionary polishing method called OptraPol® (Ivoclar-Vivadent) uses micro-fine diamond crystals as filler (72 wt.%). OptraPol creates composite restorations that are incredibly aesthetically pleasing and have a lovely gloss. Restorations are polished in a single stage to a high shine.[6]

This study's goal was to compare the mean surface roughness of nano hybrid and micro hybrid composites using a one-step polishing method. This comparison was made based on the idea that a material with reduced surface roughness will exhibit superior perishability, aesthetics, surface & optical properties, which means less wear, less staining, low plaque, and low caries rate. This will aid in gaining a better understanding of the characteristics of composite resins. When compared to other restorations, a polished restoration offers a smooth, shiny surface with a number of advantages, from aesthetics to longevity and survival rate.

Methodology

This comparative study was carried out in April 2023 at the Ayub Medical College in Abbottabad, Pakistan, with a sample size of 100 (50 in each group), determined by the WHO calculator. Using a mechanical stainless steel template, 120 composite resin specimens mounted on acrylic blocks with dimensions of 2 mm x 3 mm x 3 mm were created. 50 specimens of the Nano hybrid composite were in Group A, while 50 of the Micro hybrid composite were in Group B. The molds were attached to a piece of Mylar. It was supported by a 1 mm thick, specifically made glass slide. The study's inclusion requirements called for sound acrylic blocks with dimensions of 2 mm by 3 mm by 3 mm and composition resins that were specified.[6] While specimens that were fractured or porous were not included for the investigation. A single increment of composite resin was applied, followed by the application of another mylar strip, a glass slide, and one more mylar strip. According to guidelines, light cure polimerization was performed using an LED light (Eliper Free Light, 1000 mW/cm2, 3M ESPE, USA) for 30 seconds while moving.[7] Optra pol, a one-step polishing method, was employed. The polished surface of the light-cured samples was then cleaned by running them under water for 10 seconds. The PSRT model no. TR-100, which measured surface roughness (Ra in microns) of composite resin, was then used to take the reading. The outcomes were evaluated and charted in a predesigned proforma.[6]

SPSS version 27.0 was used for the statistical analysis of the data that had been gathered. "Ra" is the major quantitative result variable we are interested in. The obtained data's mean Ra + SD was calculated. The mean surface roughness (Ra) of the aforementioned Nanohybrid and Microhybrid composite resins were compared using the student t test, with a p value of 0.05 being considered statistically significant.

Results

100 samples, separated into two groups, were used in this study. According to descriptive statistics, mean surface roughness and standard deviations for Nano hybrid composite in Group A were recorded as 0.076+0.025 and for Micro hybrid composite in Group B, they were 0.001+0.036, as shown in Table 1. Using a student t test to compare the mean Ra of the two composites, the p value was 0.0012, which is regarded as significant. Table 2 gives a description of this.

Variables	Mean	SDs
Group A (Nano hybrid Composite)	0.076	0.025
Group B (Micro hybrid Composite)	0.001	0.036

Table 1: Mean surface roughness and standard deviation

t value	Df	P value	Cl
2.1608	118	0,00012	95%

Table 2: Student T test to compare mean RA between 2 groups

Discussion

Resin composites, which are tooth-colored filling materials as opposed to amalgam, were first introduced in the early 1960s. Composites have been the material of choice for restorations due to its unmatched aesthetic and mechanical characteristics, minimal intervention techniques, and use in dental implants.[8] Surface features of a material have an impact on its optical properties. The purpose of polishing is to give a surface shine without any blemishes. A polished and shiny resin composite surface makes it more durable and long-lasting. Due to its combined higher strength, increased aesthetics, reduced wear, colour stability, and enhanced polished surface, micro hybrid and nano hybrid composites are utilized widely nowadays.[9]

This study's findings revealed several descriptive data. For the Nano hybrid composite in Group A, the mean surface roughness and standard deviation were calculated as 0.076+0.025. While for the Micro hybrid composite, the mean surface roughness and standard deviation were observed as 0.001+0.036. These findings appear to be consistent with data from a study by Dutta S. et al. who found that nano hybrid composites exhibit the least surface roughness and the best polish ability compared to micro hybrid composites. Contrarily, it was demonstrated in a different study by Gaviria-Martinez et al.[10] that the surface and optical properties of both micro hybrid and nano hybrid composites were nearly identical.

When applying the student t test to compare the mean surface roughness (Ra) of the two composites, the p value was 0.0012, which is regarded as significant. This demonstrates that nano hybrid composites are found to have lower mean surface roughness than micro hybrid composites, demonstrating that the former is more polish able and has superior surface & optical properties than the latter. These findings are in line with studies conducted by Naser-Alavi et al.[11] and Amaya-Pajares et al.[12], which demonstrated that nano hybrid composites show better polish ability than micro hybrid composites. However, it was found in another study by Kim et al.[13] that nano hybrid composite had lower smoothness and polish ability to micro hybrid composite. Because nano hybrid composite has a lower surface roughness and better polish ability than micro hybrid composite, this study's findings are encouraging and consistent with many earlier investigations.[14]

This will aid in the careful selection of composite resins so that it can be determined which one would work best for clinical procedures and educational purposes. The fact that several market brands of micro hybrid and nano hybrid composites may have been examined for their qualities may be one of the study's weaknesses. To boost the accuracy of results, several polishing processes must be employed to compare surface roughness. More comparative and descriptive research is therefore needed in this area.

Conclusion

After polishing with a one-step procedure, there is a noticeable difference between the surface roughness of nano hybrid and micro hybrid composite resins, indicating that the former has higher polish ability than the latter. As a result, nano hybrid composite has better surface and optical properties and may be utilized more frequently with better outcomes than micro hybrid composite.

References

1. Augusto MG, de Andrade GS, Mathias-Santamaria IF, Dal Piva AM, Tribst JP. Comparison of Polishing Systems on the Surface Roughness of Resin Based Composites Containing Different Monomers. Journal of Composites Science. 2022 May 17;6(5):146.
2. Nila P, Bhargava R, Punia SK, Kumar Y, Kushwaha S. COMPARATIVE EVALUATION OF WET AND DRY FINISHING AND POLISHING ON SURFACE ROUGHNESS OF COMPOSITE RESINS-AN IN-VITRO STUDY.
3. Elwassefy N, ElEmbaby A, Elkholany N. Correlation between surface roughness and color stability of nano-and micro-hybrid resin composites using different surface treatment protocols. Egyptian Dental Journal. 2023 Jan 1;69(1):705-13.
4. Nezhadnasrollah F, Fotovat F, Yousefi H, Fatahi M, Rasoolinia M. The effect of four disc-shaped polishing systems on the surface roughness and micro-hardness of clearfil AP-X esthetics composite resin. International Journal of Scientific Research in Dental and Medical Sciences. 2022;4(1):16-20.
5. de Oliveira AG, Rocha RS, Spinola MD, Batista GR, Bresciani E, Caneppele TM. Surface smoothness of resin composites after polishing—A systematic review and network meta-analysis of in vitro studies. European Journal of Oral Sciences. 2023 Apr;131(2):e12921.
6. Tărăboanţă I, Geleţu G, Stoleriu S, Iovan G, Tofan N, Tărăboanţă-Gamen AC, Georgescu A, Popa CG, Andrian S. In Vitro Evaluation of Gastric Acid and Toothbrushing Effect on the Surface State of Different Types of Composite Resins. Medicina. 2022 Sep 15;58(9):1281.
7. Bozoğulları HN, Büyükerkmen EB, Büyüközer Özkan H. Comparison of Surface Roughness and Color Stability of Different Denture Characterizing Composite Resins: The Effect of Different Surface Treatments. Journal of Prosthodontics. 2023 Apr;32(S1):53-60.
8. Unsal KA, Karaman E. Effect of additional light curing on colour stability of composite resins. International dental journal. 2022 Jun 1;72(3):346-52.
9. Elmarsafy SM, Abdelwahab SA, Hussein F. Influence of polishing systems on surface roughness of four resin composites subjected to thermocycling aging. Dental Research Journal. 2023;20.

10. Gaviria-Martinez A, Castro-Ramirez L, Ladera-Castañeda M, Cervantes-Ganoza L, Cachay-Criado H, Alvino-Vales M, Garcia-Luna G, López-Gurreonero C, Cornejo-Pinto A, Cayo-Rojas CF. 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 Dec;22(1):1-3.
11. Naser-Alavi F, Salari A, Moein N, Talebzadeh A. Effect of oral irrigation device and its solution type on the surface roughness and topography of Bulk-fill composite resins. Journal of Clinical and Experimental Dentistry. 2022 Feb;14(2):e123.
12. Amaya-Pajares SP, Koi K, Watanabe H, da Costa JB, Ferracane JL. Development and maintenance of surface gloss of dental composites after polishing and brushing: Review of the literature. Journal of Esthetic and Restorative Dentistry. 2022 Jan;34(1):15-41..
13. Kim H, Lee J, Kim H, Park H. Surface Roughness and Cariogenic Microbial Adhesion after Polishing of Smart Chromatic Technology-based Composite Resin. Journal of the Korean Academy of Pediatric Dentistry. 2023 Feb 21;50(1):65-74.
14. Ozdemir B, Ilday NO, Ozdemir SB, Suleyman F, Duymus ZY. The effect of erosive beverages and polishing systems on the surface properties of nanohybrid composite resin. Nigerian Journal of Clinical Practice. 2022 Mar 1;25(3):248-54.