



A QUALITATIVE SURFACE ROUGHNESS ANALYSIS OF THREE DIFFERENT RESIN COMPOSITES AFTER POLISHING - AN IN VITRO STUDY

Dr S. Anitha Rao

Professor & HOD, Department of Conservative Dentistry and Endodontics, Mamata Dental College, Khammam – 507002.

Dr. Mallela Bhashitha

Postgraduate Student, Department of Conservative Dentistry and Endodontics, Mamata Dental College, Khammam – 507002.

ABSTRACT

Aim: The purpose of the present study is to measure the surface roughness of three resin composites after polishing with polishing paste and discs. **Materials And Methods:** A total of three groups were divided into three groups: Group I (n = 20) Prime Dent, Group II (n = 20) GC Solare X, and Group III (n = 20) VocoPolofil Supra. Sixty composite resin specimens were prepared in standardized stainless steel mold. Mylar strips were placed on both sides of the uncured composite in the ring mould, excess material was removed. The composite was cured for 40 seconds per side with tip of curing light under strip to ensure a standard smooth surface for all samples. Specimens were stored in a container at 37°C and 100% relative humidity for 24 hours in an incubator and later subjected to roughening with #600 grit sandpaper. Specimens were then polished with Prisma gloss polishing paste followed by polishing with soflex discs with micromotor handpiece. Surface roughness (Ra) was measured quantitatively with a digital surface profilometer. **Results:** The least surface roughness was seen with GC Solare X group with value of 0.740um while VocoPolofil Supra has highest surface roughness value with 0.967um. On pairwise comparison of surface roughness values, there was a statistically significant difference among the groups. **Conclusion:** GC Solare X specimens were smoother than Prime Dent and Voco Polofil Supra due to the least surface R_a values which further supports the best surface finish. Prisma gloss paste with soflex discs is an effective polishing agent for minimizing the surface defects and providing a lustrous surface finish.

KEYWORDS : Surface roughness, Composite resin, Polishing, Profilometer.**INTRODUCTION**

Composite resins were introduced to dentistry more than 50 years ago. Resin composites have been widely used for the direct restorations of both anterior and posterior teeth, due to their aesthetics, improved physical properties, better bonding systems, curing refinements, and environmental concerns over amalgam.¹

Over the past few years, various changes have been made in the fabrication of tooth resin composites to obtain better colour stability with time, greater wear resistance, and clinically agreeable surface smoothness of restorations.^{1,2}

Surface roughness is the main reason for extrinsic discoloration of resin composite restorations. This property is ultimately related to inorganic filler composition of the composite, organic matrix and finishing and polishing procedures.^{2,3} It gradually ends in improper finishing and polishing of tooth restorations resulting in surface irregularities and staining along with plaque accumulation, gingival irritation and poor esthetics of restored teeth that could finally lead to demineralization of enamel possible recurrent caries and periodontal problems.⁴

Microhybrid composites are less polishable, tougher to marginate and wear sooner than microfill resins. Nanohybrid composites were recently introduced in order to provide a material which had high initial polishing and superior polish and gloss retention.^{5,6} Nanohybrid is a hybrid resin composite with nanofiller in a prepolymerised filler (PPF) form. Microhybrid composites and nanocomposites are widely used on both anterior and posterior teeth as universal resin composites.⁸

Sof-Lex Strips (3M) are good option for final finishing of proximal areas. These strips have an uncoated area in the center for easy initial placement and come in different colours and with two widths and two pairs of grits, one for finishing and one for polishing.³

Roughness can be measured in a number of ways, but the most commonly used both in dentistry is the surface roughness (Ra) value. Surface roughness value is the arithmetic mean value of movement of profile above and below the center line of the surface. Mechanical profilometer, Scanning Electron Microscopy, Profilometer, etc. are some of the methods used for measuring the surface roughness (Ra) value.⁹ The main aim of the present study is to measure the surface roughness (Ra) of three resin composites after polishing with diamond impregnated polishing paste and discs.

MATERIALS AND METHODOLOGY

A total of three groups were made based on the composite used in the

study: Group I (n = 20) for Prime Dent, Group II (n = 20) for GC Solare X, and Group III (n = 20) for VocoPolofil Supra. Sixty composite resin specimens were prepared and each composite was prepared in standardized cylindrical stainless steel mold with 6mm diameter and 3mm height. The mold was placed on the Mylar strip supported by glass slide of 1mm thickness.

Mylar strips were placed on both sides of the uncured composite in the ring mould, which was then pressed between two glass plates (each 1mm thick) with light finger pressure to extrude the excess material. The composite was cured under a Mylar polyester strip to ensure a standard smooth surface for all samples. Each sample was cured for 40 seconds per side with the tip of the curing light.

After retrieval from the mold, all specimens were stored in a container at 37°C and 100% relative humidity for 24 hours in an incubator. After storage, the specimens were removed and subjected to a baseline roughening with #600 grit sandpaper underwater cooling. The specimens were then polished with Prisma gloss diamond-impregnated polishing paste followed by polishing with soflex discs with micromotor handpiece. Surface roughness (Ra) was measured quantitatively with a digital surface profilometer. The readings were taken and the obtained were tabulated.

RESULTS

The mean surface roughness (Ra) values for Prime Dent, GC Solare X and VocoPolofil Supra were 0.919um, 0.740um and 0.967um respectively. There is a statistically significant difference between the three groups with a value of 0.004. (Table 1)

The depth of surface roughness (Rz) values for Prime Dent, GC Solare X and VocoPolofil Supra were 5.211, 4.219 and 5.028um respectively. One way Analysis of variance was applied for determining surface roughness and depth of surface roughness. (Table 2)

Pairwise comparison of surface roughness (Ra) values among three groups was done by Posthoc Tukey's test. There is a statistically significant difference between Prime Dent versus GC Solare X with a mean value of 0.030 and also between GC Solare X versus VocoPolofil Supra with a mean value of 0.004. (Table 3)

On graphical representation of surface roughness values among the three groups, the least surface roughness was seen with GC Solare X group with value of 0.740um while VocoPolofil Supra has highest surface roughness value with 0.967um. (Graph 1)

Table 1: Comparison Of Surface Roughness Values Among Three Groups

Group	Mean	SD	SE	Lower Mean	Upper Mean	Minimum	Maximum	P value
Prime Dent	0.919	0.194	0.043	0.828	1.010	0.559	1.229	0.004
GC Solarex	0.740	0.170	0.038	0.661	0.820	0.404	1.025	0.004
VocoPolofil Supra	0.967	0.271	0.061	0.840	1.094	0.565	1.598	0.004

One-way ANOVA test; *indicates significant difference at $p \leq 0.05$

Table 2: Comparison Of Depth Of Surface Roughness Values Among Three Groups

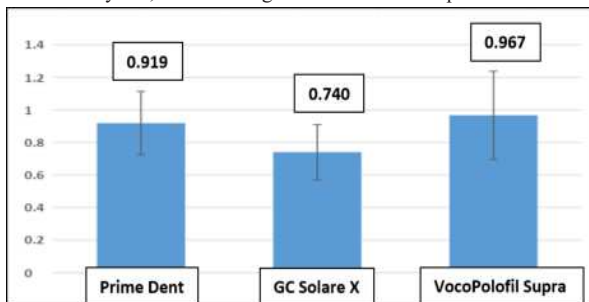
Group	Mean	SD	SE	Lower Mean	Upper Mean	Minimum	Maximum	P value
Prime Dent	5.211	1.403	0.314	4.554	5.867	2.840	7.967	0.095
GC Solarex	4.219	1.236	0.276	3.640	4.797	2.636	7.004	0.095
VocoPolofil Supra	5.028	1.823	0.408	4.175	5.881	2.423	8.803	0.095

One-way ANOVA test

Table 3: Pairwise Comparison Of Ra Values Among Three Groups

Pair	P value
Prime Dent vs GC Solarex	0.030*
Prime Dent vs VocoPolofil Supra	0.763
GC Solarex vs VocoPolofil Supra	0.004*

ost hoc tukey test; *indicates significant difference at $p \leq 0.05$



Graph 1: Graphical Representation Of Mean Ra Values Among Three Groups

Statistical Analysis

The samples were subjected to statistical analysis with software IBM SPSS Version 23.

Pair wise comparison between groups was done using Post hoc tukey's test. Mean Ra values among three groups was done using One-way ANOVA test. Significance level was set to $p < 0.05$.

DISCUSSION

Esthetic dentistry demands duplicity of the natural tooth as well as imperceptibility to the naked eye.¹⁵ Surface roughness, along with irregular finishing and polishing, can cause increased wear rates and plaque accumulation, which compromise clinical performance of the restoration.⁸

VocoPolofil Supra used in the present study was a microhybrid composite and are fit to support the microfill enamel layer on account of greater opacity and higher strength and have less polishability, tougher to marginate and wear away sooner than microfill resins. Micro-hybrid composites have a particle size of 0.7- 5 μm . Nanohybrid composites have mean particle size of 0.3-1 μm and Nanofilled composites have a mean particle size of 0.02-0.05 μm fillers. Nanohybrid composites provide a material which had high initial polishing and superior polish and gloss retention.²

In the present study GC Solare X is a nanofilled composites containing nanoparticles that can fill the gaps between large particles which result in lesser and smaller voids in resin composites. Due to small particle size of the filler, the surface area of the fillers has increased dramatically, and the interaction between the matrix and filler surface is also increased.¹⁰

Gc solare X- Nanocomposites are claimed to combine features of good mechanical strength of hybrids and the superior polish of the microfills. Nanocomposites has various advantages like good mechanical strength with less shrinkage, cusp wall deflection,

marginal leakage, colour changes, bacterial penetration and post-operative sensitivity due to lower particle size which effectively reduces the presence of microfissures in the enamel edges.¹²

PrimeDent composite used in the present study was a nanohybrid composite and was chosen for its low polymerisation shrinkage and low modulus of elasticity, providing a more flexible and less brittle composite. Low shrinkage is achieved through resin formulation and with use of new-generation prepolymerised fillers.¹

When the mean value of all the composite systems were compared, the smoothest surface obtained was of GC Solare X, which might be due to the small size of inorganic filler particles because of which this composite system provides the best polished surface and lowest surface Ra average.

On intergroup comparison of Ra value showed that readings of Prime dent is similar to VocoPolofil supra. GC Solare X showed that least mean Ra value compared to Prime dent and Voco Polofil Supra. VocoPolofil supra showed highest surface roughness with overall significant difference between three groups.

In the present study, soflex disks were used in combination with the aluminium oxide pastes to achieve a three-body abrasion which promotes polishing, also helps in dissipation of any heat generated. The aluminium oxide paste causes finer abrasion in comparison to impregnated discs or points used alone.⁹

Uppal M et.al, stated that aluminium oxide paste causes finer abrasion in comparison to impregnated discs or points used alone. This is in accordance with the present study.⁹ Yadav et al., the prolonged application of the Sof-Lex Discs system, friction heat generated by the discs causes microcracks in the polymer matrix that creates a rougher surface for hybrid composites.⁷

In a study by Kaizera et al., it was concluded that there are no statistically significant differences in the polishing and of composite resins with nano-filled particles vs nano-hybrid particles. Finishing and polishing of composites is critical to obtaining resistance, color stability, longevity and esthetics of the restorations.⁷

Limitations:

The present study is an in-vitro study that does not replicate the intraoral conditions and it might present results that are different from the clinical situation.

Some factors present in the oral cavity like saliva, enzymes, foods and acidic beverages with varied pH levels and temperatures can affect surface roughness and micro hardness of composites.

CONCLUSION

Prisma gloss paste with soflex discs is an effective polishing agent for minimizing the surface defects and providing a lustrous surface finish for all the composite systems in this study. GC Solare X specimens were smoother than Prime Dent and Voco Polofil Supra due to the least surface R_a values which further supports the best surface finish.

REFERENCES

- Mangat P, Masarat F, Rathore GS. Quantitative and qualitative surface analysis of three resin composites after polishing – An in vitro study. J Conserv Dent 2022;25:448-451.
- Schmitt VL, Puppim-Rontani RM, Naufel FS, Nahsan FP, Alexandre Coelho Sinhoret M, Baseggio W. Effect of the polishing procedures on colour stability and surface roughness of composite resins. ISRN Dent 2011;2011:617-72.
- Reddy VRB, GSB, Madhu A P, Jaiswal S, Chandrashekar B, Chandra A, Priyanka M. Finishing and polishing of composite's- A review. IP Indian J Conserv Endod 2021;6(1):7-10.
- Ghada Alharbi, Hend NA Nahedh , Loulwa M. Al-Saud , Nourah Shono and Ahmed Maawadh. Effect of different finishing and polishing systems on surface properties of universal single shade resin-based composites. BMC Oral Health (2024) 24:197.
- D Kritzing, PD Brandt, FA De Wet. The effect of different polishing systems on the surface roughness of a nanocomposite and a microhybrid composite. S. Afr. Dent j. 2017;72(6):249-257.
- Anuradha Vitthal et .al. Surface Hardness of Nanohybrid and Microhybrid Resin Composites Cured by Light Emitting Diode and Quartz Tungsten Halogen Light Curing Systems: An Invitro Study. Journal of Clinical and Diagnostic Research. 2020;14(7): 01-06.
- Robinson Jaramillo et. Al. Effect of Polishing Systems on the Surface Roughness of Nano-Hybrid and Nano-Filling Composite Resins: A Systematic Review. Dent J (Basel). 2021;9(8):95.
- Gonulol N., Yilmaz F. The effects of finishing and polishing techniques on surface roughness and color stability of nanocomposites. J. Dent. 2012;40(Suppl. 2):64-70.
- Uppal M, Ganesh A, Balagopal S, Kaur G. Profilometric analysis of two composite resins' surface repolished after tooth brush abrasion with three polishing systems. J Conserv Dent. 2013 Jul;16(4):309-13.
- Shree Roja RJ, Srman N, Prabhakar V, Minu K, Subha A, Ambalavanan P. Comparative

- evaluation of color stability of three composite resins in mouthrinse: An in vitro study. *J Conserv Dent* 2019;22:175-80.
11. Abhijit Ghosh, Priti D Desai, Ipsita Maity, Paromita Mazumdar. Comparison of Surface Roughness of Class V Cavity Preparation using Diamond Abrasive Point and Ultrasonic Tip and Measurement of Shear Bond Strength after Restoration with Composite Resin: An In-vitro Study. *J Clin D Res*. 2024; 18(11): 24-27.
 12. Jimish Rajiv Shah and Srinidhi Surya Raghavendra. Fracture Resistance of a Fiber Reinforced Composite Substructure with Nanofilled Composite Overlay. *Oral health and Dentistry* 3.1 (2018): 567-573.
 13. Juliana Da Costa, Leslie Roder, Jack Ferracane. The Effect of Different Polishing Systems on Surface Roughness and Gloss of Various Resin Composites. *J Esthet Restor Dent*. 2007;19:214–226.