

EFFECT OF DIFFERENT POLISHING SYSTEMS ON THE SURFACE ROUGHNESS OF NANO-HYBRID COMPOSITES: A PROFILOMETRIC STUDY

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ABSTRACT: **Aim:** The purpose of this study was to compare the influence of different polishing systems on the surface roughness of nano-hybrid composite resins. **Materials and Methods:** Fourty samples of acrylic blocks were prepared with cold cure acrylic resin in plastic rings of 1 inch diameter. In each acrylic block, a well of 6mm diameter and 2mm depth was prepared by drilling hole in it using a slow speed micromotor. Tetric N-Ceram™ nano composite is placed in the wells prepared using a plastic instrument and covered with a mylar strip. The samples were then cured for 40s through the mylar strips using LED curing light. 60 samples were divided into 4 groups with 15 samples in each group based on polishing regimen used. Group A - Mylar strip, Group B- PoGo diamond polishers, Group C- prophy brushes and Group D- Super-Snap Rainbow kit. The polished resin composite discs were washed, allowed to dry and kept again in 100% humidity for 24 h before measuring the average surface roughness values (Ra). The surface roughness test was performed using a profilometer and surfaces are seen under scanning electron microscope[SEM]. **Statistical analysis:** The data were analysed by using one-way ANOVA using SPSS 17.0 software. **Results:** For all the materials, the smoothest surface was obtained with mylar strip and the roughest with prophy brushes($P < 0.05$). **Conclusion:** Mylar strip produced smoothest surface than other polishing systems.

KEYWORDS: Nano hybrid composite; Mylar strip; Surface Roughness; Profilometer;

INTRODUCTION

Increase in the demand for esthetic restorative materials have led the dentists to adopt nanohybrid composite restorations in the routine dental practice.¹presence of surface irregulaties caused due to poor polishing and finishing procedures increases plaque retention resulting in gingival inflammation, superficial discoloration and secondary caries.²On the contrary, smooth, highly polished restorations are shown to be less susceptible to plaque accumulation and extrinsic discoloration.¹

Furthermore, a smooth surface adds to the patient's comfort as a change in surface roughness of 0.3µm can be detected by the tip of the tongue.^{3,13} Nanocomposites provide the aesthetic properties required for anterior restorations, higher surface quality and superior polish retention. They also exhibit increased wear resistance, low shrinkage and also possess favorable mechanical properties.⁴Polishing is the process carried out after the finishing procedure to remove minute scratches from the surface of a restoration and obtain a smooth, light

reflective luster. The ultimate asthetics of these tooth coloured restoratives is strongly influenced by the final surface polish. Smooth highly polished restorations have been shown to be more easily maintained than restoration with rougher surface.⁵

Several studies have demonstrated that flexible aluminum oxide disks provide the smoothest composite surface. Unfortunately, the use of these disks is not always possible because of the anatomic shape and difficult access to the restoration. Thus, various special shapes of rubbers and abrasive-impregnated strips are necessary. Factors that can influence the surface roughness of composites include the type, size and quantity of load of the composite as well as the type, size and hardness of the abrasives and the finishing and polishing technique used.⁶

A variety of instruments are commonly used for finishing and polishing tooth-coloured restorative materials including: carbide finishing burs, 25-50 µm diamond

finishing burs, abrasive impregnated rubber cups and points, aluminum oxide coated abrasive discs, abrasive strips, and polishing pastes^{5,6,7}. A number of finishing and polishing devices are available, but to decide the efficacy of various materials is still a challenge to the dentists or clinicians. Hence, the study was undertaken to determine the effectiveness of three polishing systems on an aesthetic material by evaluating surface roughness using a Profilometer and scanning electron microscope.

Materials and Methods:

Sixty samples of acrylic blocks were prepared with cold cure acrylic resin in plastic rings of 1 inch diameter. In each acrylic block, a well of 6mm diameter and 2mm depth was prepared by drilling hole in it using a slow speed micromotor.Tetric N-Ceram™ (IvoclarVivadent) nano composite is placed in the wells prepared using a plastic instrument and covered with a mylar strip. The samples were then cured for 40sec through the mylar strips using LED curing light. Samples were divided into 4 groups with 15 samples in each group based on polishing regimen used.

Group-I	n=15	Control group- Mylar strip
Group-II	n=15	PoGo diamond polishers [DENTSPLY]
Group-III	n=15	SMART prophylbrushes [STODDARD]
Group-VI	n=15	Super-Snap Rainbow kit[SHOFU]

Except for the Mylar strip groups, specimens in the other three subgroups were wet-grounded for 30 s with 1200-grit silicon carbide paper on a metallurgical finishing wheel to provide a baseline before applying the polishing systems. The polished resin composite discs were washed, allowed to dry and kept again in 100% humidity for 24 h before measuring the average surface roughness values (Ra). The surface roughness test was performed using a PROFILOMETER [Taylor Hobson Ltd., Leicester, England] and surfaces are examined under scanning electron microscope(SEM) [ZEISIS, Department of physics , Osmania university, Hyderabad] . The data were analyzed by using one-way ANOVA (analysis of variance) for comparison of the groups [Table 1]

Results:

For all the materials, the smoothest surface was obtained with mylar strip and the roughest with smart prophyl brushes[STODDARD]. However, Super-Snap Rainbow kit[SHOFU] created maximum smoothness among all the polishing systems tested.[Graph 1]

Table 1:- Comparison of surface roughness between the study groups

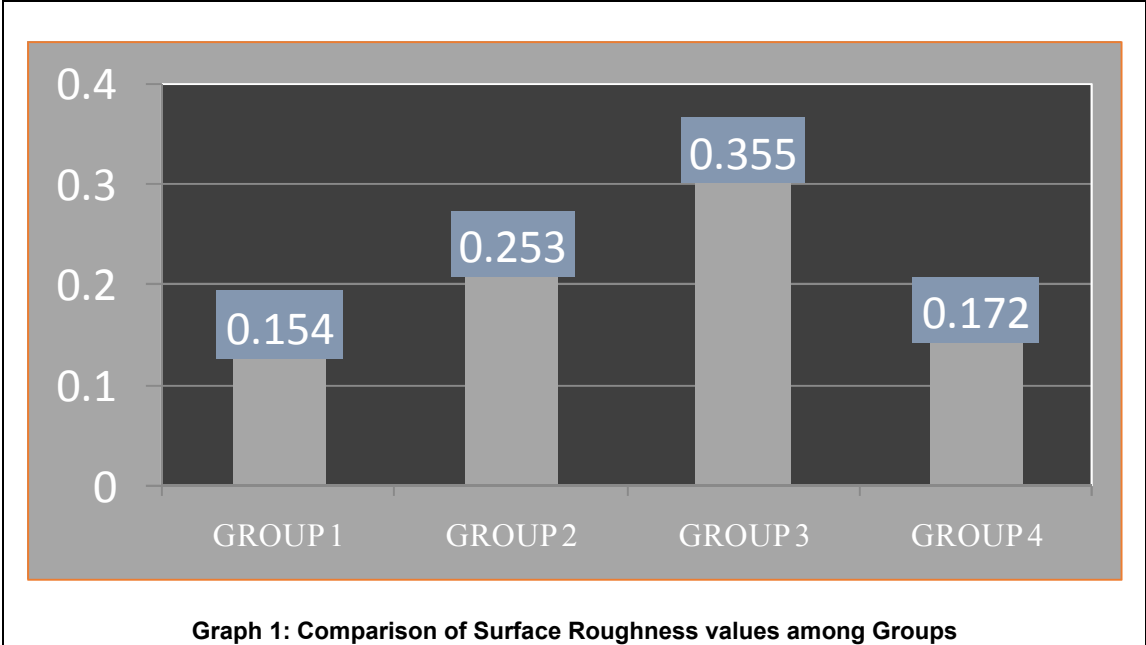
	Mean	SD	ANOVA	
			F-value	p-value
Group 1	0.154	0.005	3649.65	<0.0001*
Group 2	0.253	0.007		
Group 3	0.355	0.006		
Group 4	0.172	0.003		

n=15 for all the groups; *p < 0.05 statistically significant; p > 0.05 Non significant, NS

Discussion:

Finishing is defined as the gross contouring or reduction of a restoration to obtain ideal anatomy. Polishing refers to the reduction of roughness and scratches created by finishing instruments.¹⁰ To increase the esthetics and longevity of restoration proper finishing and polishing of dental restoration is essential. A surface roughness of 0.7-1.4µm increases plaque accumulation on the surface of composites. Previous studies had stated that curing the composite against the mylar strip produced smoothest surface. But in the clinical scenario that finish cannot be obtained.⁸ There are many instruments which are commonly used for finishing and polishing which include finishing burs, abrasive rubber cups, aluminium oxide discs and polishing pastes.^{5,6,7,9,11,12} When we cure with mylar strip some surfaces me exposed which are resin rich and easily abraded in the oral cavity. If these surfaces are not properly polished they may retain as rough surface on which surface plaque may be inhabited. The present study employed wet 1200-grit silicone carbide paper for finishing the resin composite surface to simulate the clinical scenario.¹ After curing the composite when we remove the excess material with contouring instrument it is difficult to retain the natural gloss of that surface. Hence we need proper polishing agent to get a smoother surface.

In this invitro study profilometer is used to measure the surface roughness. Scanning electron microscope is used to qualitatively assess the surface roughness.In this study we use both multiple step and one step polishing systems namely shofu Super Snap and PoGo respectively. Super snap rainbow kit are aluminium discs which causes significant reduction in surface roughness. In this study Super-Snap kit gave smoother surface compared to PoGo one step diamond polishers. Although it is difficult to produce smoother surfaces with aluminium oxide discs in the posterior regions there ability to cut the matrix and filler particle equally increased their capability of producing smoother surfaces than other systems.^{7,5}



Scanning Electron microscope pictures of the surface surfaceness of different groups under study

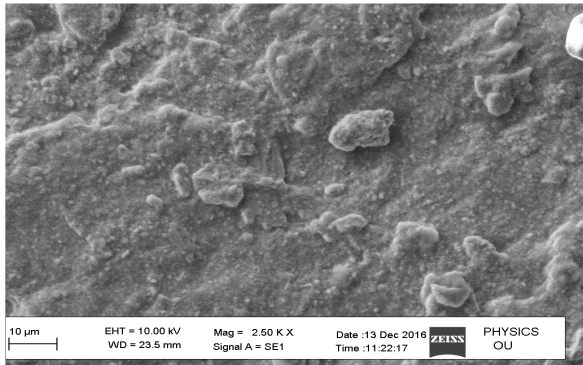


Fig. 1. PROPHY BRUSHES[STODDARD]

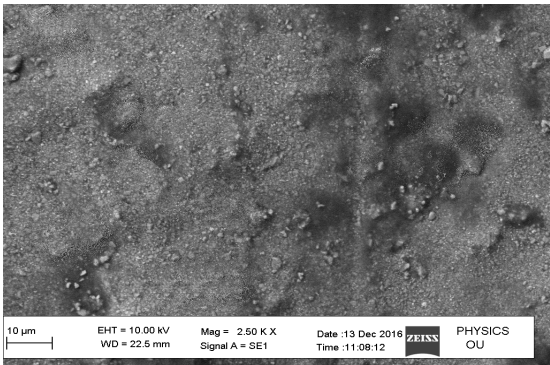


Fig. 2. PoGo [DENTSPLY]

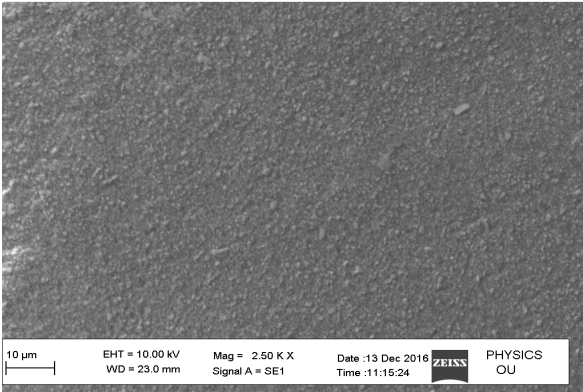


Fig. 3. MYLAR strip

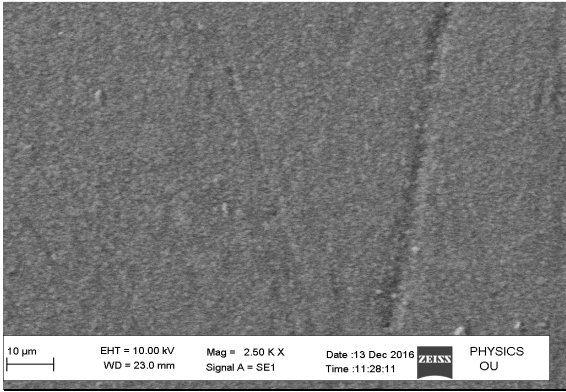


Fig.4. Super Snap [SHOFU]

Though diamonds (PoGo) abrasives gave a good surface finish, they were found to be rougher than the surface finish produced by aluminum oxide (Super-snap) discs.^{7,10} This could be attributed to the fact that diamond (PoGo) discs are less flexible as compared to the extremely flexible aluminum oxide discs.^{5,6,7} This results are in accordance with the study conducted by **watnable et al.**⁸ The highest level of roughness for all composites was observed after the application of prophy brushes [STODDARD]. The abrasive potential of prophy brushes proved to be relatively low and thus, the surface irregularities following finishing were not sufficiently removed.

Qualitative Evaluation

Qualitative assessment of the SEM photomicrographs accorded well with the quantitative results. The surface roughness increased in the order with Mylar strip being the finest followed by Super-Snap polishers and the PoGo discs with the proxy brush creating the highest level of surface roughness.

The highest level of roughness for all samples was observed after the application with prophy brushes (**Fig.1**). Surfaces after treatment with PoGo discs were mainly characterized by the remaining minor grooves and surface irregularities (**Fig. 2**). Mylar strip group produced minor roughness and very smooth surface when compared with all the three polishing systems (**Fig.3**). Super-Snap polishers had the greatest smoothing effect and achieved the largest number of smooth and homogeneous surfaces among all polishing systems used (**Fig. 4**).

CONCLUSION:

Within the limitations of the present study, it can be concluded that mylar strip provided a smoother surface than Super-Snap discs and PoGo discs. Furthermore, Super-Snap discs produced smoother surfaces than PoGo discs. Super-Snap and PoGo systems produced clinically acceptable surface roughness for nanohybrid composites.

References

1. Patel B, Chhabra N, Jain D. Effect of different polishing systems on the surface roughness of nano-hybrid composites. J Conserv Dent, 2016;19:37-40.
2. Bashetty K, Joshi S. The effect of one-step and multi-step polishing systems on surface texture of two different resin composites. J Conserv Dent 2010;13:34-8
3. Jones CS, Billington RW, Pearson GJ. The in vivo perception of roughness of restorations. Brit Dent J, 2004;196:42-45.
4. 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(4): 347-355.
5. G S Gulati, R S Hegde. Comparative Evaluation of two Polishing Systems on the Surface Texture of an aesthetic material (nano-composite): A Profilometric Study. People's Journal of Scientific Research, 2010 ;3(2):17-20.
6. Scheibe KG, Almeida KG, Medeiros IS, Costa JF, Alves CM. Effect of different polishing systems on the surface roughness of microhybrid composites. J Appl Oral Sci. 2009;17(1):21-6.
7. Uçtaşı MB, Arisu HD, Omürlü H, Eligüzeloğlu E, Özcan S, Ergun G. The effect of different finishing and polishing systems on the surface roughness of different composite restorative materials. J Contemp Dent Pract, 2007;8(2):89-96.
8. Nair VS, Sainudeen S, Padmanabhan P, VijayaShankar LV, Sujathan U, Pillai R. Three-dimensional evaluation of surface roughness of resin composites after finishing and polishing. J Conserv Dent 2016;19:91-5.
9. Media A. Saeed, Intesar S. Toma, Razawa K. SaeedZanco, The effect of two finishing and polishing systems on the surface roughness of two composite resins. J. Med. Sci, 2013;17(3):484-489.
10. Korkmaz Y, Ozel E, Attar N, Aksoy G. The influence of one-step polishing systems on the surface roughness and microhardness of nanocomposites. Oper Dent 2008 Jan-Feb;33(1):44-50
11. Senawongse P, Pongprueksa P. Surface Roughness of Nanofill and Nanohybrid Resin Composites after Polishing and Brushing, J Esthet Restor Dent, 2007;19:265-73
12. Sibel A. Antonson a, A. RuyaYazici b, EvrenKilinc c, Donald E. Antonsona, Patrick C. Hardigan d, Comparison of different finishing/ polishing systems on surface roughness and gloss of resin composites, Journal of dentistry 39 s(2011) e 9- e 17.
13. B S H Itanto, M Usman and A Margono, Comparison of surface roughness of nanofilled and nanohybrid composite resins after polishing with a multi-step technique, 2017 J. Phys Conf. Ser. 884 012091.

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