ORIGINAL ARTICLE

COMPARISION OF MEAN SURFACE ROUGNESS OF NANOHYBRID AND MICROHYBRID COMPOSITE RESINS USING ONE STEP POLISHING SYSTEM (AN IN VITRO STUDY)

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ABSTRACT

The objective of this comparative study (in vitro) was to compare mean surface roughness (Ra) of Nanohybrid and Microhybrid composite resins using one step polishing system. A total of 120 composite resin samples were prepared with 60 samples of Nanohybrid composite in Group A and 60 samples of Microhybrid composite in Group B. The specimens were mounted on acrylic blocks while comparing their mean surface roughness (Ra in microns) using one step polishing system (optrapol) after light cure polymerization. The Ra reading was taken with portable surface roughness tester (PSRT). As per descriptive statistics, mean Ra and SDs for nanohybrid composite resin in Group A was recorded as 0.087+0.036 whereas mean Ra and SDs for microhybrid resin in Group B was recorded as 0.112+ 0.047. The comparison between mean Ra of both composites using student t test showed p value as 0.0014, which is considered as significant. Significant difference exists between surface roughness of nanohybrid and microhybrid composite resins after polishing using one-step technique which means polishability of the former is higher than the latter. Nanohybrid composite therefore has superior surface & optical characteristics and can be used frequently with enhanced results than microhybrid composite. However, further studies are required to compare their surface roughness using a different polishing system, and to determine the effects of the polishing technique on mechanical properties & surface characteristics of composite resins.

Keywords: *Composite resins; Dental polishing; Curing Light; Surface properties; Esthetics*

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INTRODUCTION

Resin based dental Composites are being increasingly used in restorative dentistry because of their esthetics and strength. There are various brands of composites, used in both anterior and posterior teeth.[1] The fillers used in Composite resins directly affect their physical characteristics therefore one way to classify composites is based on their filler content.[2]

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Hybrid composite is a newer class containing a range of particle sizes (1-3 micron) and sub-micron sized (0.02-0.04 micron). Due to the combination of different sized filler particles, the wear resistance of this class is remarkably increased.[2] Microhybrid composites are one of a kind having micron particles. The microhybrids are more polishable, attain better optical enhancement of color by incorporation of evenly layered micro fillers in between larger particles.[3]

Nanohybrids are the latest addition to the family of resin composites containing prepolymerized nanofillers in agglomerated state, 0.4 µm silica fillers and separately dispersed nano particles of 0.05 µm. These resins show lesser polymerization contraction, superior mechanical properties, better polishability of surface and enhanced esthetics.[4] Polishing is dependent on filler size, content and its morphology in composite. With larger & more fillers, surface would be rougher even after use of polishing.[5]

In restorative procedures, the surface character-

istic is an important factor in determining the success of composite restorations. Non polished surfaces of composites increase the rate of wear because of more friction load.[6] Moreover rough surfaces will capture more stains, plaque, cause periodontal irritation, are prone to caries and looks unaesthetic.[7]

The finishing procedure removes excessive material with particle size of more than 25 µm, while polishing removes particles of size less than 25 µm. Final finishing of composite depends on its filler size, hardness, filler load, quality, and polishing material used.[8] Traditionally finishing and polishing of composite resins utilize multistep procedures like use of fine diamonds, abrasive coated disks and cutting devices like carbide burs and stones.[9]

Recently, one-step optrapol, two-step rubber or silica abrasive burs and abrasives (polishing pastes) have been introduced.[9,10] OptraPol® (Ivoclar-Vivadent) is a novel polishing system comprising micro-fine diamond crystals (filler: 72 wt. %). OptraPol produces highly esthetic composite restorations which shines with a beautiful lustre. Restorations are polished to a high gloss in just single step.[10]

According to a study conducted by Jung M et al, the surface quality of nanohybrid composite is more polishable than microhybrid composite resin because there is strong integration of nano particles, high filler loading and larger number of filler particles present on the surface thus establishing a larger contact area with the rotating polishing instrument.[11] Yet in another study by Mitra SB et al, they assumed that there is a strong chemical integration of nanoparticles into the resin matrix resulting in a smoother surface and that nanoclusters are less prone to be sheared off during wear mechanisms.[12]

The objective of this study was to compare mean surface roughness of nanohybrid and microhybrid composites using one step polishing system which is based on the fact that a material having decreased surface roughness, will show superior polishability, esthetics, surface & optical properties which means lesser wear, lesser stains, low plaque and low caries rate. This will guide in attaining better knowledge of properties of composite resins. A polished restoration presents smooth lustrous surface which has a host of benefits as compared to others, ranging from esthetics to durability and survival rate.

MATERIALS AND METHODS

This was a comparative study (in vitro) conducted at Peshawar Dental College, Peshawar, Pakistan with a sample size of 120 (n=60) calculated by WHO calculator and total duration was 1 month, conducted in April 2017. 120 composite resin specimens mounted on acrylic blocks of 2mm x 3mm x 3mm dimensions were fabricated using a mechanical stainless steel template. Group A contained 60 specimens of Nanohybrid composite and Group B constituted 60 specimens of Microhybrid composite. The molds were mounted on Mylar strip. It was supported by a customized glass slide of 1 mm thickness. Composite resin was dispensed in single increment only and then covered by another mylar strip followed by a glass slide. Light cure polimerization was carried out with LED Light (Eliper Free Light, 1000 mW/cm^2, 3M ESPE, USA) for 30 seconds in a moving action according to recommended instructions. One step polishing system (Optra pol) was used. The light cured samples were then washed with water for 10 seconds to clean the polished surface. The reading was then taken with the help of PSRT model No: TR – 100, which indicated surface roughness (Ra in micron) of composite resin. The results were assessed & charted down in a predesigned proforma. Inclusion criteria for this study was to include sound Acrylic blocks with dimensions of 2mm x 3mm x 3mm with given composing resins. Any cracked and porous specimens were excluded from study.

The collected data was analyzed using statistical software SPSS version 25.0. Our main outcome variable is quantitative, i-e., "Ra". The mean Ra $\pm$ SD of the collected data was calculated. To compare the mean surface roughness (Ra) of the mentioned Nanohybrid and Microhybrid composite resins, student t test was used; keeping $\boldsymbol{p}$ value < 0.05, considered as statistically significant.

RESULTS

This study was carried out on 120 specimens divided into 2 groups (n=60). As per descriptive statistics, mean surface roughness and SDs for Nanohybrid composite in Group A was recorded as 0.087$\pm$0.036 whereas mean surface roughness and SDs for Microhybrid composite in Group B was recorded as 0.112$\pm$ 0.047 which is shown in Table 1.

The comparison between mean Ra of both composites using student t test showed p value as 0.0014, which is considered as significant. This is described in Table 2.

DISCUSSION

Resin composites were introduced in early 1960s and are tooth colored filling materials as opposed to amalgam.[13] Combining minimum intervention techniques, their unprecedented esthetic and mechanical properties, composites have been used as a material of choice for restorations.[14]

Optical property of a material is related to their surface characteristics. The aim of polishing is to impart

TABLE 1: MEAN SURFACE ROUGHNESS & SD

Quantitative Variables	(n=60)	(n=60)
	Mean	SDs
Group A - Nanohybrid Composite	0.087	0.036
Group B - Microhybrid Composite	0.112	0.047

TABLE 2: STUDENT T TEST TO COMPARE MEAN RA BETWEEN 2 GROUPS

t value	Df	P value	CI
3.2709	118	0.0014	95%

shine to the surface with no irregularities.[15] A polished & lustrous surface of resin composite render it to have longer life and durability.[16]

Microhybrid and Nanohybrid composites are used frequently nowadays owing to their combined superior strength, improved esthetics, low wear, color stability and enhanced polished surface.[17]

The results of this study showed varying descriptive statistics. The mean surface roughness and standard deviation for Nanohybrid composite in Group A was recorded as 0.087 ± 0.036. While mean surface roughness and standard deviation for Microhybrid composite was recorded as 0.112 ± 0.047. These results seem to be comparable with the statistics presented by Dutta S et al in a study who showed nanohybrid composites show least surface roughness and better polishability than microhybrid composites.[18] Unlike this, in another study which was conducted by Melander J et all, it was shown that both microhybrid and nanohybrid composites almost shared similar surface and optical properties.[19]

The comparison between mean surface roughness (Ra) of both composites using student t test showed ***p*** value as 0.0014, which is considered as significant. This shows that nanohybrid composites are found to have lesser mean surface roughness than microhybrid composites which proves the former is more polishable and have superior surface & optical properties than the latter which is in accordance with the results of studies conducted by Jung M et al and Mitra SB et al who showed that nanohybrid composites show better polishability than microhybrid composites.[11,12] Yet in another study conducted by Jiang H et al, it was concluded otherwise that nanohybrid composite possessed inferior smoothness and polishability than microhybrid composite.[20]

This study proves to show promising results and were in accordance with various previous studies as nanohybrid composite has low surface roughness and enhanced polishability than microhybrid composite. This will help in selection of composite resins carefully as to which one might perform better during clinical procedures and also for education purpose. But this study might be having certain limitations in that different market brands of microhybrid & nanohybrid composites could have been compared for their properties. Various polishing systems must be used to compare surface roughness to increase precision of results. Therefore more comparative & descriptive studies are required in this regard.

CONCLUSION

Significant difference exists between surface roughness of nanohybrid and microhybrid composite resins after polishing using one-step technique which means polishability of the former is higher than the latter. Nanohybrid composite therefore has superior surface & optical characteristics and can be used frequently with enhanced results than microhybrid composite.

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3 Umair ul Haq:	Abstract, literature search and introduction.
4 Imran Khattak:	Results and conclusion.
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