

“The Effect Of Various Polishing Systems On Surface Roughness Of Nano and Microhybrid Composite Restoratives : An In Vitro Surface Profilometric Study ”

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ABSTRACT:

Introduction: The smoothness of the restorative material’s surfaces have a great importance in the success and clinical longevity of the restorations.

Material & Methods: A total of 120 acrylic blocks with a recess of 2mm x 3mm x 3mm dimension were made using a custom made stainless steel template.(Figure 1) Of them, 60 specimens were of (microhybrid composite) and 60 were of (nano composite) .

Results & Conclusion : From present study we were concluded Nanofilled composites (Supreme XT) showed better polish ability when compared with microhybrid composites (Filtek Z-250) with Mylar strip provide the smoothest surface finish for both supreme XT and Filtek Z-250.

Keywords: composites, surface roughness, polishability.
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INTRODUCTION : Use of synthetic resins in restorative dentistry has markedly increased in recent years due to increased demand of aesthetics¹. The surface quality is an important factor in determining the success of resin composite restorations. ² One of the most significant improvements is related to the use of nanotechnology.Nanofillers are described as “the discrete particles which have all of the three dimensions in the range of about 1-100nm”.³The esthetic quality of a restoration may be as important to the mental health of the patient as the biological and technical qualities of

the restoration are to his physical and dental health⁴.Unfortunately, discoloration is still a problem for dental resin composite restorations. A survey of published studies indicated that smooth, highly polished restorations present a host of advantages as compared to restorations with a more roughened surface, ranging from esthetics to survival. They are more esthetically appealing and less susceptible to plaque accumulation and extrinsic discoloration. They exhibit improved mechanical properties⁵.

MATERIALS AND METHODS: This in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics. A total of 120 acrylic blocks with a recess of 2mm x 3mm x 3mm dimension were made using a custom made stainless steel template.(Figure 1) Of them, 60 specimens were of (microhybrid composite) and 60 were of (nano composite) .

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To simulate initial finishing of the restorative material The remaining group were surfaced with a Diamond finishing bur in a rotary motion, for 15 seconds with water coolant. Group IB and IIB: 20 samples of each of the two composite resins were finished and polished with Optra-pol polishing system as specified by the manufacturer with application with light hand pressure using planar motion for 30seconds at 15,000 rpm, using slow speed handpiece

Group IC and IIC: 20 samples of each of the two composite resins were finished and polished with the Sof-Lex system as specified by the manufacturer. After finishing and polishing, all the samples were subjected to Profilometric evaluation and surface roughness parameters (Ra) were recorded from the digital LCD read out. (Fig 2).

RESULTS:

Table 1: Showing mean surface roughness in two materials :

Material	N	Mean	Std Deviation	
Z250	60	0.114	0.051	Student t test p = 0.003 Sig
Supreme XT	60	0.087	0.047	

Table 1 shows the mean surface roughness between the two materials used. Supreme XT showed a mean surface roughness of 0.087 ± 0.047 and Z 250 showed a mean surface roughness of 0.114 ± 0.051 . The difference in mean was statistically significant as compared using student t test ($p < 0.05$).

Table 2a: Showing Mean surface roughness among different polishing systems with material Supreme XT

Polishing System	N	Mean	Std. Deviation	ANOVA
Mylar	20	0.041	0.020	p = 0.000 : Sig
Optra Pol	20	0.126	0.042	
Sof Lex	20	0.095	0.028	
Total	60	0.087	0.047	

Table 2b: Showing post op comparison between groups.

Group	Compared to	Mean Difference	p value (Tukey test)	Sig
Mylar	Optra Pol	-.08481	.000	Sig
	Sof Lex	-.05333	.000	Sig
Optra Pol	Mylar	.08481	.000	Sig
	Sof Lex	.03148	.006	Sig
Sof Lex	Mylar	.05333	.000	Sig
	Optra Pol	-.03148	.006	Sig

Table 2a shows the mean surface roughness between different polishing systems used with Supreme XT material. Mylar showed a mean surface roughness of 0.041 ± 0.020 , Optra Pol showed a mean surface roughness of 0.126 ± 0.042 and Z 250 showed a mean surface roughness of 0.095 ± 0.028 . The difference in mean was statistically significant as compared using ANOVA test ($p < 0.05$).

Table 2b shows showed significant difference in mean between the three groups. ($p < 0.05$)

Table 3a: Showing Mean surface roughness among different polishing systems with material Z 250

Polishing System	N	Mean	Std. Deviation	ANOVA
Mylar	20	0.056	0.026	p = 0.000 : Sig
Optra Pol	20	0.164	0.025	
Sof Lex	20	0.124	0.020	
Total	60	0.114	0.051	

Table 3b: Showing post hoc comparison between groups.

Group	Compared to	Mean Difference	p value (Tukey test)	Sig
Mylar	Optra Pol	-0.108	0.000	Sig
	Sof Lex	-0.068	0.000	Sig
Optra Pol	Mylar	0.108	0.000	Sig
	Sof Lex	0.040	0.000	Sig
Sof Lex	Mylar	0.068	0.000	Sig
	Optra Pol	-0.040	0.000	Sig

Table 3a shows the mean surface roughness between different polishing systems used with Z 250 material. Mylar showed a mean surface roughness of 0.056 ± 0.026 , Optra Pol showed a mean surface roughness of 0.164 ± 0.025 and Z 250 showed a mean surface roughness of 0.124 ± 0.020 . The difference in mean was statistically significant as compared using ANOVA test ($p < 0.05$).

DISCUSSION:

It is clinically important to determine the finishing technique that will result in the smoothest surface using minimum time and instruments. Composite surface roughness is basically dictated by the size, hardness and amount of filler, all of which influence the mechanical properties of the resin composites, and by the flexibility of the finishing material, hardness of the abrasive and grit size⁶.

It is known that surface roughness would harbor more bacteria leading to problems like excessive plaque accumulation, gingival irritation, increased surface staining, and poor or less than optimal esthetics of the restored teeth⁸.

The trimming procedure for resin- based restorations comprises four steps:

- Coarse finishing or reduction of excess: instruments with high grinding effectiveness are preferred but, due to the coarse abrasiveness, they should only be used on restorative material.
- Contouring: the aim to achieve final form of the restoration as prescribed by functional and aesthetic criteria.
- Fine finishing: this comprises the final, precise adjustment of restoration margins and improvement in surface smoothness.
- Polishing: a smooth and glossy, but nonetheless textured surface is the final objective of any polishing procedure⁹.

Group I (Nanocomposite Supreme XT) showed significantly smoother surface than Group II (Filtek-250 Microhybrid composite) with mean roughness value 0.087 for Group I and 0.114 for that of Group II. This is contributed to the fact that in addition to making possible the synthesis of nanosized filler particles, nanotechnology is believed to have a beneficial effect on the stable chemical integration of such particles within the composite matrix. This is thought to contribute to the low wear rates of nanoparticle composites. In the case of surface alteration caused by contact with abrasive polishing instruments, a surface that is composed of nanoparticles is less likely to suffer particle loss. This might explain the low surface roughness found on Supreme-XT specimens.¹¹

M Jung et al (2007)¹² explained that in addition solid filler particles in hybrid or microhybrid materials are considerably larger than nanosized particles. Another point which might be attributed to good surface quality is the fact that nanotechnology enables for obtaining high filler loading. Compared to microhybrid Filtek-250, Supreme-XT the nanocomposites had higher filler content by volume. Thus, it can be expected that, in nano composites, a greater number of particles will be present on the surface, establishing a larger contact area with rotating instruments. Moreover, the strong integration of nano particles within the composite material might further explain the results of this study. Mitra and others (2003)¹³ assumed that, due to a strong chemical integration of nanoparticles into the resin matrix, nanocomposites wear by breaking off individual primary particles

rather than by breaking off larger particles, as with hybrid composites. This finding was supported by Turssi and others the authors reported that, in the case of Filtek Supreme, so-called nanoclusters were less prone to be sheared off during wear mechanisms. Even if it was possible, further contouring and finishing are usually required.¹⁴

In a similar study by Duygu Sarac et al (2006)¹⁵ it was reported that lowest Ra values were obtained with the specimens polymerized against the polyester matrix group and while the aluminium oxide abrasive disc group showed lower Ra value than Optra-pol group. For a composite finishing system to be effective the cutting particles (abrasive) must be relatively harder than the filler materials, otherwise the polishing agent will only remove a soft resin matrix and leave the filler particles protruding from the surface. The hardness of aluminium oxide is significantly higher than silicon dioxide, and generally, higher than most filler materials used in composite formulations. The trend of Sof-Lex discs is to provide a slightly smoother surface with the aluminium oxide abrasive on rigid matrix as this has the ability to flatten the filler particles and abrade the softer resin matrix at an equal rate. In the present study also Sof-Lex discs provided smoother surfaces than the optra-pol system.

It was shown that a greater number of polishing steps produced better smoothing effects. A multi-step system (soflex) achieved the best results; whereas, and one-step system (optra-pol) was consecutively less efficient, which is in accordance with the study done by M Jung et al (2007).¹² The multiple-step technique demonstrated to be most effective in obtaining a smoother surface, even for the microhybrid composite resin.

This fact can be explained by the operationalization of using these materials, as they are usually structured in sequential order of using with abrasiveness decreasing, favoring the final surface texture. This scenario does not occur with the one-step materials.

Group IB and IIB (The single-step system, Opra-pol) was used in the present study with no surface pretreatment. This system presented higher surface roughness values in comparison with the Group IC and IIC (Sof-Lex discs), regardless of the evaluated composite resin. Similar results were obtained by Yap et al (2004)¹⁷

According to Willems & others (1991)¹⁸ the inherent surface roughness of a restoration must be equal to lower than the surface roughness of enamel on enamel-to-enamel occlusal contact areas (Ra=0.64micron).⁸

A study by Kaplan and others (1996)¹⁹ indicated that Ra values less than 10 µm are clinically Undetectable and, hence, any system that produces a surface roughness less than 10 µm is acceptable. With roughness values closer to 1 µm than to 10 µm, the polished specimens in this study showed acceptable surface finish.¹⁴

Aluminum oxide disks (Sof-Lex) are used to polish plane resin composite surfaces (Hondrum & Fernandez, 1997)²⁰, and they are particularly convenient for refining embrasure forms of posterior and anterior resin composite restorations.

In this invitro study, all systems were found to be effective in polishing the resin composite tested. However Since there are several physiological and biological processes that may be related to the increase in the surface roughness, further studies are needed to determine which finishing techniques are best suited to clinical situations in

which access is limited and restoration surface are complex. Therefore further studies should attempt to simulate concave and convex surfaces.²⁴

CONCLUSION : From present study we were concluded Nanofilled composites (Supreme XT) showed better polish ability when compared with microhybrid composites (Filtek Z-250) with Mylar strip provide the smoothest surface finish for both supreme XT and Filtek Z-250.

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