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RESEARCH ARTICLE

FINISHING AND POLISHING EVALUATION OF NOVEL DENTAL COMPOSITES AFTER THREE BODY WEAR AN INVITRO- SCANNING ELECTRON MICROSCOPE STUDY

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ABSTRACT

Finishing and polishing of composite restorative materials plays a major role in success and longevity of restoration. Aim of this study is to analyze the finishing and polishing procedures by measuring the surface roughness of the novel resin composites using profilometer and scanning electron microscopy before and after subjection to three body wear simulation method. The four posterior composites evaluated are p90, filtekz 50 x trafil, filtek z250. The mean surface roughness was found to be highest in group 4 and lowest in group 1 and these findings were confirmed by scanning electron microscope findings.

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INTRODUCTION

Resin based restoratives are increasingly being used in dentistry, to date variety of dental composites is available for clinical use which differ in surface characteristics and polish ability (Venhoven *et al.,* 1996). Aesthetics of restorations is of interest to the dentist and patient (Yap, 1997). Highly polished surface difficult to achieve due to the differences in a. amount of filler b. particle size c. hardness between filler particles and matrix of the resin composite (Tolley *et al.,* 1978). Surface roughness of the restoration influences resistance to staining and gloss of the restoration depends on various material factor such as filler particle size, shape, type, hardness,resin matrix type and chemistry (Janus *et al.,* 2010; Jung, 2007). To overcome the above deficiencies various modifications were made in the filler technology with the introduction of nanohybrid and micro hybrid composites and in the resin chemistry (Ferracane *et al.,* 1997 Musanje *et al.,* 2006). Low shrinkage siloranes based materials were introduced which is a combination of siloxane contributes hydrophobicity and oxirane contributes to the higher hardness and wear resistance for minimizing filler exfoliation during wear (Janus *et al.,* 2010) and better polish retention (Ilie Nicoleta *et al.,* 2006; Lim Bum-Soon *et al.,* 2002).

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Aim

- To quantitatively analyze the finishing and polishing procedures by measuring the surface roughness of the novel resin composites using profilometer before and after subjection to three body wear simulation method
- To qualitatively analyze the finishing and polishing procedures, using scanning electron microscopy before and after subjection to three body wear simulation method

MATERIALS AND METHODS

The four posterior composites evaluated in the study were categorized as Group 1 - Filtek Silorane P-90(Silorane Based Micro Hybrid Posterior Resin Composite) Group 2 - Filtek Z350 (Methacrylate based nanohybrid posterior composite)Group3- x trafil bulk filling posterior composite) Group 4-Filtekz 250 XT(Methacrylate based micro hybrid posterior composite) (Fig.1). A custom jig was made with a square metal block of following dimensions- 15mm length, 15mm width and 4mm depth Fig2.The resin composite material was placed incrementally in 2mm depth using a custom made Teflon instrument and polymerized according to the manufacturer's instruction. After the placement of second increment, the mold spaces were covered with acetate strips, the composites restoratives were then light polymerized according to manufacturer's instructions.

Fig. 1-7.

GROUP1. FILTEK P-90 FIG SEM IMAGES

Fig. 8.

GROUP 2.FILTEK Z350 SEM IMAGES

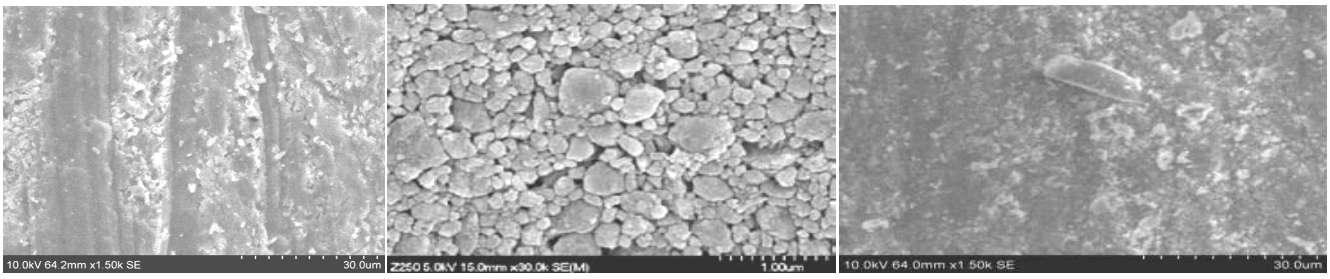

Fig. 9.

GROUP 3. X TRAFIL SEM IMAGES

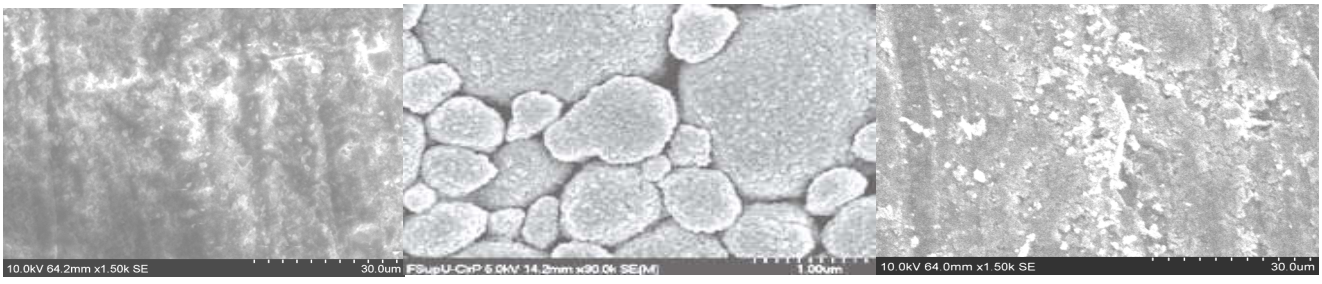

Fig. 10.

GROUP4. FILTEK Z250XT SEM IMAGES

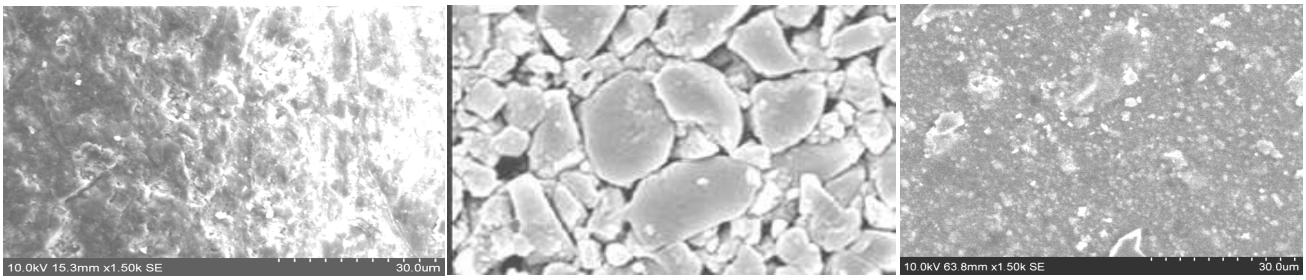

Fig. 11.

Table 1. Evaluation Of Finishing And Polishing Through Evaluation Of Surface Roughness Values (Ra) of Composites Before And After Wear

Groups	Surface Roughness	Initial finishing and polishing values of composite specimens before wear	Surface roughness values of composite specimens after wear	Final finishing and polishing values of composite specimens
Group-1	Mean (6)	0.6267	0.687	0.655
P-90	SD	±0.02160	±0.0163	±0.02258
Group-2	Mean (6)	0.715	0.78	0.7467
Filtek Z-350	SD	±0.02739	±0.0283	±0.02582
Group-3	Mean(6)	0.8267	0.887	0.8533
Xtrafil	SD	±0.02944	±0.0308	±0.02944
Group-4	Mean(6)	0.9067	0.983	0.9467
Filtekz250	SD	±0.02160	±0.0234	±0.02160
P Value		0.000**	0.000**	0.000**

After light polymerization, the acetate strips were discarded. The samples were then stored in distilled water for 7 days. The specimens were subjected to three body wear test. The wear instrumentation used was a abrasion tester (DUCOM TR 50 BANGALORE) customized with stainless steel wheel, distilled water was used as lubricant (Fig.3). The surface of the specimens was analyzed using a contact type surface profilometer. (TIME TR 100 CHINA) to quantitatively evaluate the surface roughness values. After (i) initial finishing and polishing procedures before subjection to wear procedures ii) immediately after wear procedure (iii) the surface roughness value were measured after final finishing and polishing procedures (Fig.4-7). The surface of the specimens was analyzed using Scanning electron microscope (HITACHI) to characterize the qualitative data's. after (i) initial finishing and polishing procedures before subjection to wear procedures, (ii) immediately after wear procedure and(iii) the surface roughness value were measured after final finishing and polishing procedures (Fig 8-11).

RESULTS

Surface roughness estimated by profilometer in micron meters were represented as Ra values for each samples with n (6) Mean and standard deviations were estimated from the samples with n (6) for each study group data's were tabulated in Table (1) All statistical analysis was done at the 0.05 significance level. SPSS version 16.0 was used to perform all statistical analysis. The Ra value was recorded and subjected to statistical analysis using One-Way *ANOVA* at 0.05 Significance Level. In the present study one way ANOVA showed statistically significance difference between the groups for wear depth, with p value of 0.000 which denotes significance at 1% level and data's were tabulated in Table (1). *To summarize the results the inter group analysis showed;*The mean surface roughness values at the end of final finishing and polishing procedures was found to be highest in *GROUP4* and lowest in *GROUP1* with a significance level of 1% .

The intra group analysis showed. The mean wear depth values was found to be *highest* in all the groups at the end of wear process and was found to be *lowest* before wear and initial finishing and polishing procedures with a significance level of 1%

DISCUSSION

In restorative procedures, surface characteristics such as roughness determine the aesthetic appearance, brightness, texture and behavior of restorative materials. Resin composite with larger filler particles are expected to have higher Ra values after polishing (Tatsuo Endo *et al.,* 2010). The clinical significance of the present study is that most of studies regarding finishing and polishing have not given enough consideration to the wear process which is most significant for the success of a restorative material. In this descriptive study have compared the finishing and polishing ability initially prior to the wear process, immediately after wear process and finally subjected to finishing and polishing, the surface roughness ra value was measured. The results of the present study showed that siloranes and nano hybrid resin composite have similar surface roughness values in the range of 0.6µm that makes clinically acceptable for finishing and polishing after subjection to wear. Roughness value of 0.2 µm is the ideal threshold level of surface roughness beyond which plaque accumulation occurs .The lower amount of filler particles with a relatively small size may have contributed to its ability to obtain smaller roughness values (Tatsuo Endo *et al.,* 2010). The values of roughness (Ra) ranged numerically from 0.6 to 0.9µm. Nano hybrid composites on the other hand have high surface roughness values, due to the exfoliation of glass filler particles from the resin matrix. *According to ASTMG 65* guidelines and the recommendation made by Condon and Ferracane in 1997 the specimens were subjected to a maximum period of 30,000 cycles, an amount which procedures roughly the same amount of wear which occurs during six months of in vivo service (Turssi Cecilia Pedroso *et al.,* 2015). For a

finishing system to be rendered effective, the cutting particles must be harder than the filler particles. Otherwise the abrasive medium may abrade the softer matrix only (venhoven B.A.M,A.J.DeGee. A Warner. C. L 1996). Sof-Lex finishing and polishing discs were used for finishing and polishing procedures in this study due to following unique features produce an excellent final polish need less inventory because the abrasive surface can be aligned as needed using same disc (Yap Auj 1997). Sof-Lex urethane paper backed discs are more flexible which are slightly stiffer, thinner, and made with a polyester film, generates less heat, and survives sterilization procedure in a steam autoclave (Yap Auj 1997)In this study, surface roughness measurements were used for relative comparisons. Additionally changes in the surface texture were examined with SEM (Turssi Cecilia Pedroso *et al.,* 2005). S.E.M image analysis of resin composites revealed plucking away of the particles, scratches and damaged surfaces eventually after the wear procedure. The Filtek p90 specimens because of its smaller filler size and improved resin chemistry revealed no filler particle dislodgement with smaller surface defects and revealed better polish retention. Rough texture with pits or craters were observed in nano hybrid composites filtek 350 and tetric evoceram specimens because of the dislodgement of the glass fillers leaving voids or craters after finishing and polishing before and after subjecting to wear procedure. The micro hybrid composite filtekz 250 displayed a large surface roughness after the polishing because of presence of glass fillers, along with large particle size of fillers. The results of present study showed that Ra value measured was directly related to the filler particle size (Tatsuo Endo1 *et al.,* 2010). Filler volume on wear resistance follows a linear relationship. It was observed that profilometric measurements were largely confirmed by SEM analysis. The effectiveness of the polishing systems was material dependent.

Conclusion

Within the limitation of the present study it can be concluded that the Silorane based composites showed comparable polishablity to that of nano hybrid composites and superior tot of micro hybrid composite. The longevity and esthetics of the material is not only dependent on polishablity but also to the inherent ability of material per se to resist degradation.

Future scope;From this investigative study it can be summarized that the clinical performance and longevity of a posterior resin composite could be enhanced by a scientific decision making in selection of the materials based on compositional factors such as filler particle size ,filler loading, color stability, wear resistance and polymerization shrinkage.

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