Research Article

Comparative Evaluation Of The Surface Texture Of Nanoceramic And Nanohybrid Composite Resin Polished Using One Gloss, Sof-Lex^{tm} And Kenda Polishing Systems - An In-Vitro Study

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ABSTRACT

Background and objectives: To evaluate and compare the surface texture of nanoceramic composite and nanohybrid composite resin polished by One gloss, Sof-Lex^{TM} and KENDA polishing system.

Materials and methods: Seventy-two acrylic resin blocks were prepared using customized mould. Circular cavity was prepared in acrylic resin block and were divided into two groups and restored with nanoceramic and nanohybrid composite resin. It was finished using fine grit diamond bur and each group polished using three different polishing systems. The surface roughness was evaluated using a surface profilometer.

Results: The profilometric results suggested that the surface roughness of nanoceramic composite resin was lesser than the nanohybrid composite group irrespective of the polishing agents used. There was no statistical difference among the surface roughness produced by the polishing agents.

Conclusion: Within the limitations of the present study, it can be concluded that the filler particle size do affect the surface roughness of the composite resins. Nanoceramic composite resins gave a smoother surface compared to that of nanohybrid composite resins. It can also be concluded that the single step polishing system is equally efficient as that of the multistep polishing systems.

Keywords: Finishing, polishing, surface roughness, composite resins, nanoparticles.

INTRODUCTION

The need for tooth coloured restorative material has resulted in newer advancements in the field of aesthetic dentistry, especially composite resins.[1] Incorporation of nanofillers in composites has resulted in superior polishability and optical properties.[2] A composite with good surface texture and decreased surface roughness improves the aesthetics, clinical success and longevity of the restoration.[3] Moreover, the rough surface of a restoration decreases its ability to reflect light, make it more susceptible to external stains and causes increased plaque retention.[4]

Composite resins with smaller filler particle size produce better surface texture and lower surface roughness.[5] Nanoceramic and nanohybrid composites have been introduced which consist of nanofiller particles, which meet these properties. Nanoceramic composites have ceramic and submicron particles and have a spherical filler shape. It consists of non-agglomerated barium glass and ytterbium fluoride in the form a spherical mixture of pre-polymerized sphere TEC^{TM}.[6] Nanohybrid composites consists of nanofillers and nanomer groups with an irregular filler particle shape. It consists of barium glass fillers and has the strength and polish of hybrid and microfilled composites repectively.[6]

Finishing and polishing of restoration is equally important as any other step, as it helps to decrease the surface roughness and maintain the surface texture of the restoration. Traditionally, carbide and diamond finishing burs, abrasive strips, polishing pastes etc were used.[7] Finishing and polishing systems have evolved over the years and more advanced systems have been introduced such as silicon cups and points with aluminium oxide, aluminium oxide impregnated discs and spirals etc.

Conventionally, multi-step polishing was routinely used with different polishing cups and discs that were more tooth specific such as KENDA polishers(silicone or synthetic rubbers with abrasive particles of diamond, silicone carbide and aluminium oxide) which is a three step(multi step) polishing system. Currently, with the advanced two step and single step polishing systems, such as One Gloss (silicon polishers with aluminium oxide) which is a single step polishing system and Sof-Lex^{TM} (diamond or aluminium oxide particles impregnated with thermoplasticized elastomer) which is a two-step polishing system.[1] Ideally, this should reduce the chair side time, cost, meet the aesthetic demands and should be easy to use on a regular basis in the day –to-day clinical setup.

METHODOLOGY:

Seventy-two acrylic resin (DPI RR cold cure, Mumbai) blocks measuring 20 mm in diameter and 20 mm in height was prepared using customized mould of polyvinyl siloxane putty material.Circular cavity measuring 8 mm in diameter and 3 mm in depth was prepared in each acrylic resin block using high speed airotor with round and straight fissure burs.Further, the specimens were divided into 2 groups with 36 specimens in each group. Group 1 was restored using nanoceramic composite resin and Group 2 using nanohybrid composite resin in increments. Each increment was cured for 20 seconds. Last layer was cured along the mylar strip with pressure. The specimens were stored in distilled water for 37^0 C for 24 hours. All the specimens were finished after 24 hours with fine grit diamond burs using a high-speed handpiece under water cooling. Specimens of each group was further divided into 3 subgroups (n=12) and was polished using three different polishing systems. For Subgroup1a (n=12) and Subgroup 2a (n=12) Prepolishing was done using a firmer pressure and the final polishing was done using a feather pressure.(Figure 1). For Subgroup 1b (n=12) and Subgroup 2b (n=12) Prepolishing was done using beige coloured spiral and the final polishing was done using pink coloured spiral. For Subgroup 1c (n=12) and Subgroup 2c (n=12).Polishing was initiated using white coloured discs and/or points(coarse), followed by green coloured discs and/or points(medium) and the final polishing was done by pink coloured discs and/or points (extra fine).

SURFACE TEXTURE EVALUATION

Surface texture of all specimens was evaluated using a surface profilometer. (Figure 2).

STATISTICAL ANALYSIS

The group wise averages were analyzed using Student T test or Paired T test or Wilcoxon Rank test at the Level of significance 5.

RESULTS

INTRA-GROUP COMPARISON:

The nanoceramic composite resin group gave a mean roughness values as follows: Group 1A= 1.158 µm, Group 1B= 1.435 µm and Group 1C= 1.347 µm. The standard deviation and variance of Group 1A= 0.498 & 0.248, Group 1B= 0.279 & 0.078 and Group 1C= 0.408 & 0.166 respectively. The p value showed no statistically significant differences among the three subgroups.The nanohybrid composite resin group gave a mean roughness values as follow: Group 2A= 1.586 µm, Group 2B= 1.970 µm and Group 2C= 1.873 µm. The standard deviation and variance of Group 2A= 0.215 & 0.046, Group 2B= 0.673 & 0.453 and Group 2C= 0.595 & 0.354 respectively. The p value showed no statistically significant differences among the three subgroups.

INTER GROUP COMPARISON

Group 1 exhibited lower surface roughness values when compared to Group 2 irrespective of the finishing and polishing agents used. (Table 1 and Graph 1).

DISCUSSION: -

The growing demand for aesthetic restorations has led to newer advancements in the field of restorative dentistry, especially the composite resins. Over the years, there have been changes in the matrix and filler particle size of the composite resins. Incorporation of nanofillers in composites has resulted in superior polishability and optical properties, thus fulfilling the aesthetic demands.

The surface roughness of the composite resins is greatly influenced by its filler particle size. In this study nanoceramic and nanohybrid composites were selected as both have the filler particle size in nanometers and will give lesser surface roughness compared to that of microfilled and megafilled composites. This is in accordance with the studies conducted by Aydun et al and Barbosa et al where they concluded that composites with nanofillers gave the least surface roughness when compared to composites of greater filler particle size.[7,8]

In the present study, nanoceramic composite resin exhibited lower surface roughness compared to the nanohybrid composite resin irrespective of the finishing and polishing agents used. This could be attributed to the filler particle size of the nanoceramic composite resin which consists of nanomer-sized particles with nanocluster formulations that reduced the interstitial spacing of the filler particles and hence provided increased filler loading with better physical properties and improved polish retention. The nanocluster filler particle consists of loosely bound agglomerates of nano-sized filler particles.[9] During polishing, only the nano-sized filler particles were worn away whereas nanoclusters are not plucked out from the resin matrix. Eventually, the surface has smaller defects and better polish retention. On contrary, nanohybrid composite resin contain nanometer-sized particle with more conventional filler technology. This could have resulted in an inferior polishability when compared to that of former.[10]

The study results highlights that the surface roughness values were greater in nanohybrid group among each finishing and polishing agent used. This is in accordance with the study conducted by Yadav et al and Aydin et al where they concluded that nanoceramic composites gave better polishability compared to nanohybrid and microfilled composite resin.[8,11]

This study compared the single and multi-step polishing agents. In the present study the last layer of composite was cured against mylar strip. There are previous literature which states that polymerizing the material in direct contact with a smooth polyester matrix surface gave the smoothest surface for composite restorations (Ra = 0). However, resin-rich surface layer needs to be eliminated and hence finishing and polishing is indispensable.

In this study, fine grit diamond burs under water cooling were used for finishing. This is in accordance with the studies where they have provided evidence that diamond burs allow for the bulk reduction and gross contouring of the composite restorations.[11,12] The finishing and polishing was done after 24 hours as it is the time required for the polymerization reaction of the composite resins to be completed. Moreover, the heat generated during the immediate finishing and polishing would result in the flow of the material and deform the composite, thereby compromising the initial marginal sealing. It is also supported by previous studies which states that composite restorations finished and polished after 24 hours showed greater marginal integrity with increased micro hardness and a lower bacterial adhesion to the surface.[13]

Polishing under dry or wet conditions is always debatable. However, recent studies suggest that dry or wet polishing did not have an impact on the surface roughness of the composites. Hence in this study the finishing was done using fine grit diamond bur under water cooling and polishing of all the three different polishing systems were done under dry conditions as recommended by their respective manufacturers.[8]

The single step polishing agent used in this study was the One gloss polishing system (Shofu). Single step finishing and polishing is attained by altering the contact pressure as you go from finishing to polishing. The surface roughness values obtained by One gloss system were greater for nanohybrid group when compared to the nanoceramic group. However, it was comparable to the other multi step polishing agents that were used in the study. There is less literature highlighting the comparison of One gloss polishing agent with that of other finishing and polishing agents. In a study conducted by Kayalidere et al, they compared the Sof-lex spirals to that of the One gloss polishing system. The study concluded that the Sof-lex spirals gave slightly better polishability compared to that of One gloss system.[13] The advantage of using one step polishing agent is that it reduces the chair side time and operative procedures.[14]

The two step polishing agent used in this study was the Sof-lex spirals. Aluminium oxide in Soflex spiral wheel promotes a homogenous abrasion of fillers and the resin matrix. Moreover, the design of the Soflex spirals allows them to efficiently adapt to the surface of the composite resin. In the current study, Sof-lex spirals gave a higher surface roughness in nanohybrid composite resin group compared to that of nanoceramic composite resin group. This is in accordance with the study conducted by Barbosa et al, Abzal et al, Pala et al and Andrian et al.[7, 15, 16, 17]

The three step polishing agent used in the study was Kenda polishing system (Coltene). The purpose of selecting three step polishing system for the current study was in accordance with the study conducted by Lolita et al were they stated that greater the steps of finishing and polishing lower is the surface roughness.[9] This is largely due to the fact that the procedure involves a series of steps starting with coarse, medium and ultra fine grit, making shallow strokes with wavelengths smaller than 0.5 µm. Moreover, the study conducted by Andrian et al concluded that the Kenda and Sof-lex spirals gave comparable results and gave lowest surface roughness compared to other groups.[17] The present study results also highlighted that Kenda polishing agent gave a higher surface roughness on the nanohybrid composite resin compared to that of nanoceramic composite resin group.

This study also concluded that there was no statistically significant difference among the finishing and polishing agents irrespective of the composite resin used. This highlights that the polishability attained by one step polishing system is comparable to that of multi-step polishing agents used. And this is in accordance with the studies conducted by the Erdemir et al, Atabek et al, Andrian et al and Kovacs-Ivacson et al.[18,19,20] However, there are contradictory studies by Ereifej et al and Alfawaz et al where they stated that one step polishing agents gave the highest polishability, but Kayalidere et al concluded that two step polishing system was superior and Lolita et al stated that multistep polishing agents gave the lowest surface roughness.[14.]

Within the limitations of the present study, it can be concluded that nanoceramic composite resin exhibited superior polishability due to its greater filler load and smaller filler particle size when compared to that of nanohybrid composite resin. Single and multistep polishing agents gave comparable results on both nanoceramic and nanohybrid composite resin

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TABLE 1:- INTERGROUP COMPARISON

	Group 1			Group 2			Statistics	
	Sub Groups	**Average**	**SD**	**Sub Groups**	**Average**	**SD**	**T Value**	**P-value**
Ra (n = 12)	1a	1.158	0.498	2a	1.586	0.215	2.616	0.024
	1b	1.435	0.279	2b	1.970	0.673	2.434	0.033
	1c	1.347	0.408	2c	1.873	0.595	2.419	0.034

FIGURE 1:-POLISHING OF THE COMPOSITE RESTORATION IN PLANAR MOTION

GRAPH 1:- INTERGROUP COMPARISON

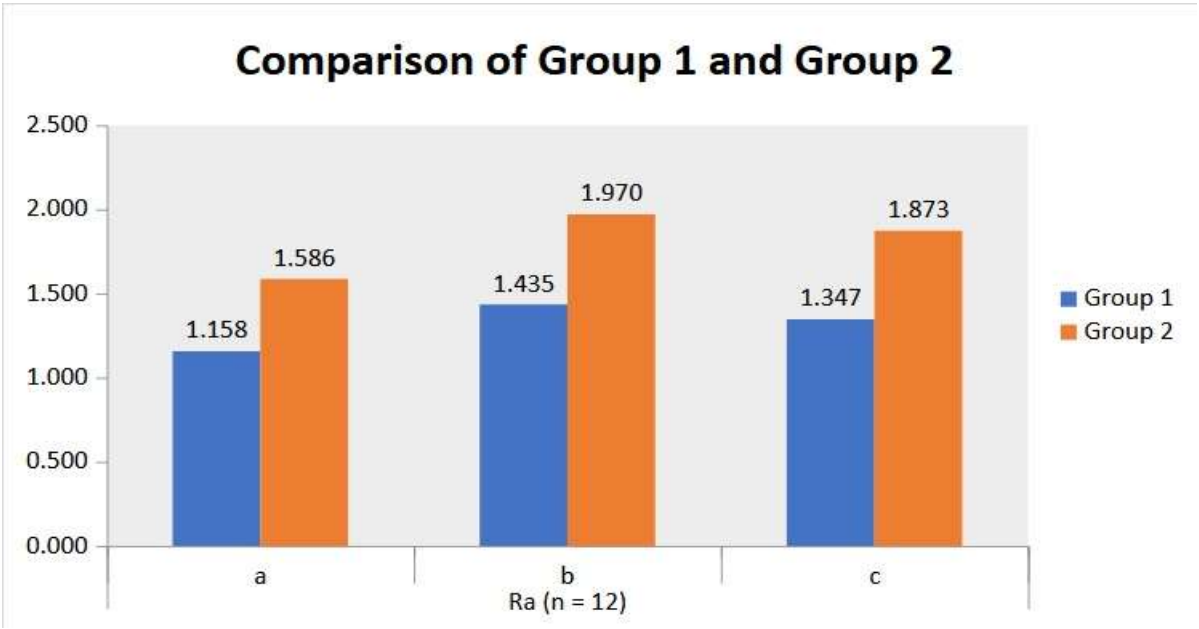

FIGURE 2:- SURFACE ROUGHNESS EVALUATION USING SURFACE PROFILOMETER.