The effect of duration of finishing and polishing on the surface roughness of two composite resins

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Abstract

Background and objective: The purpose of this study was to evaluate the effect of duration of finishing and polishing procedures on the surface roughness of two different types of composite resins.

Methods: Forty samples of 6 mm in diameter and 2 mm in depth were prepared, 2 types of composite resins were used (nanocomposite and hybrid composite resin). Twenty samples of each type of material were prepared and divided into two main groups and then each main group subdivided randomly into two subgroups of 10 samples for each subgroup (one). Ten samples of each material were submitted to finishing by using a finishing kit. The available finishing kits used in this study containing discs, cups and points that were used with a slow-speed hand piece in a dry field and with a light intermittent pressure for about 15 seconds. While the other 10 samples of each material were finished for about 30 second; then the analysis of the surface roughness was carried out, three readings were made on each surface using a stylus tip and the extension of each reading was 2 mm stroke.

Results: There was non significant difference between the groups that were finished and polished for 15 second and the other groups that were finished and polished for 30 second for the two different types of composite resin.

Conclusion: Increasing duration of finishing and polishing has no effect on the surface roughness of The two different types of composite resin.

Keywords: Nano composite, Hybrid composite, Finishing bur, Duration.

Introduction

The timing of the finishing/polishing procedure might have an effect on the physical properties of the restorative materials, and might increase the risk of premature failures. Although several authors have proposed a 24-hour delay before the completion of finishing procedures, most clinicians perform finishing/polishing procedures immediately after restoration placement [1]. There was a need for a highly polishable composite resin with optimal physical properties for use in the anterior and posterior regions [2]. Composite resin restorations have evolved rapidly, with the pace of new product development accelerating over the last decade. Advanced composite materials and techniques, new etching and bonding materials, fast curing lights, and new finishing and polishing materials and techniques have all been introduced [3]. As a consequence, irregularities appear on the surface of the restorations. The filler content of the composite resin also affects roughness; similarly, the resin matrix composition may also play a role in the final smoothness of the restoration [4]. A smooth surface on a restoration can be obtained after polymerizing the resin composite against an appropriate matrix strip, but further countering and finishing are required to remove excess material and to obtain a smooth glossy surface [5]. Minimizing finishing and subsequent trauma to the resin surface is critical. This can initially be addressed by diligence during the restorative process itself. Attention to detail and a meticulous technique

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minimize the need for subsequent finishing. The ideal direct resin restoration would require no finishing or polishing once completed. Since most operative conditions are less than ideal, minor finishing requirements must be addressed. Various instruments (e.g. diamond burs, carbide burs, polishing disks, diamond-impregnated rubber points, polishing pastes) are available for sequential finishing and polishing[5,13]. The presence of surface irregularities arising from poor polishing can create clinical problems such as gingival irritation, surface staining, plaque accumulation and secondary caries [3]. However, the durability of the smoothness is difficult to predict and may be influenced by factors related both to the clinical restorative procedure and to the composition of the material, especially the filling particle size [14, 15].

Methods

Forty samples were prepared by cutting a pvc pipe (Pvc pipe, Jordan) 2.5 cm in diameter and 2 cm in height with a hot knife and then pouring each plastic tube which is 2.5 cm in diameter and 2cm in height with cold cure acrylic resin (MR, dental, UK) and then cylindrical cavities 6 mm in diameter and 2 mm in depth were cut at the center of cold cure acrylic resin blocks, by placing a metal mold on the acrylic resin at the dough stage of setting of acrylic resin and the excess of acrylic was removed by wax knife before setting and after setting of acrylic resin the metal mold is removed. Two types of composite resins were used (Composan bio-esthetic nano particles composite resin (Promedica, Germany) and Composan ceram hybrid composite resin (Promedica, Germany)).Twenty samples of each type of material were prepared, specimens were divided by simple random method into 2 groups; Group A: 20 samples of nanocomposite, Group B: 20 samples of hybrid composite. Then each group was subdivided randomly into 2 subgroups; 1. 10 finished and polished for 15 seconds [16] 2.10 finished and polished for 30 seconds [17]. Composite was inserted into the mold in one increment with aplastic instrument; a celluloid strip (Hawe transparent strips) and a glass slab were placed over the composite resin under the load of 200 gm [14, 18] to remove excess material, then after removal of the glass slab the sample were light cured by halogen light curing (Dentsply, USA) device for 40 second according to manufacturer instructions between all steps of the procedure, the samples were stored in distilled water in an incubator at 37C [18, 19]. Ten samples of each material were submitted to finishing and polishing by using an ivoclar viva dent finishing kit. The available finishing kits used in this study containing discs, cups and points that used with a slow-speed hand piece in a dry field and with a light intermittent pressure (to avoid the build-up of heat on the material as well as deterioration of the finishing material) for about 15 second. While the other ten samples of each material were finished for about 30 second; then the analysis of the surface roughness was carried out. All specimens were individually positioned in a surface recorder profilometer to verify the roughness (Ra) values of the material surface, three readings were made on each surface using a stylus tip, and the extension of each reading was 2 mm stroke.

Results

By using paired t- test, the result revealed that there was non significant difference between the groups of finishing and polishing of 15 seconds and groups of finishing and polishing of 30 but generally the groups that have been finished and polished for 30 seconds shows a smoother surface if compared to groups that have been finished and polished for 15 seconds however the difference was non significant at $p > 0.05$, Table 1, 2 and Figure 1, and there was non significant difference between the two different materials (nano composite and hybrid composite). But generally the nano fill composite groups have smoother surface at both 15 and 30

seconds duration of finishing and polishing if compared to the micro hybride composite resin groups at both duration but the difference was non significant at p> 0.05 ,Table 3.

Table 1: The descriptive statistic of reading

Types of composite resin	Duration of finishing and polishing	No. of samples	Mean of Ra in Mm	SD	Std. Error Mean
Nano-fill composite resin	15 second	10	0.338	± 0.071	0.022
Micro hybride composite resin	15 second	10	0.410	± 0.159	0.050
Nano-fill composite resin	30 second	10	0.307	± 0.051	0.016
Micro hybride composite resin	30 second	10	0.358	± 0.086	0.027

Table 2: t-test for difference between the groups in the duration of finishing and polishing

Technique	df	t-statistic	P-value	Sign.
Finishing for 15 and 30 seconds of nano composite	18	1.123	0.276	NS
Finishing for 15 and 30 seconds of micro-hybride composite	18	1.912	0.374	NS

Table3: t-test for difference between the groups in the filler contain of composite

Technique	df	t-statistic	P-value	Sign.
Finishing for 15 second	18	-1.307	0.208	NS
Finishing for30 second	18	-1.616	0.124	NS

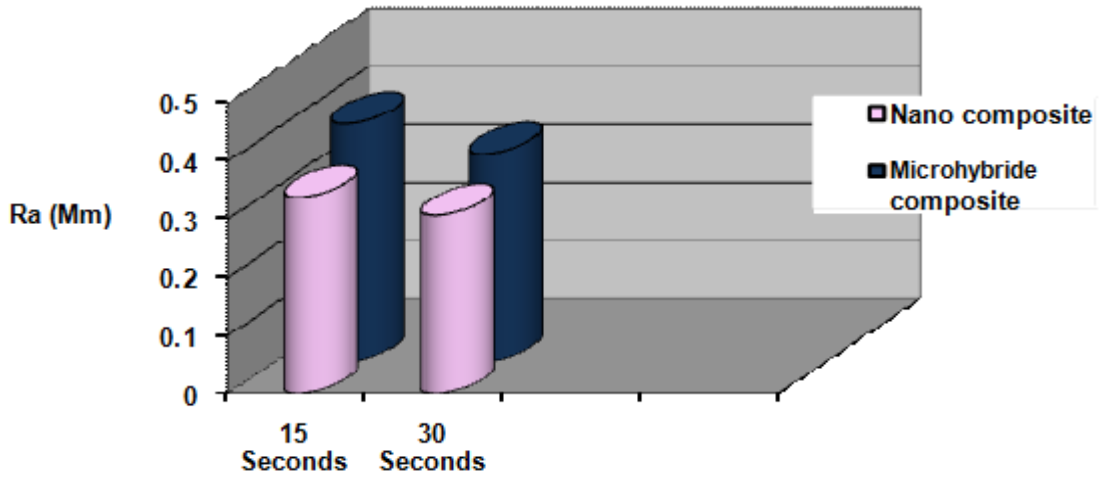

Figure 1: Bar chart for the surface roughness study results for duration of finishing and polishing of two composites.

Discussion

Finishing and polishing of resin composite restorations are steps critical to enhancing the esthetic and longevity of restored teeth [20]. Finishing refers to gross contouring or reducing of the restoration to obtain the desired anatomy. Polishing reduces the roughness and scratches created by finishing instruments. Rough, poorly polished surfaces contributed to staining, plaque accumulation, gingival irritation and recurrent caries [21]. The factors determining the micro morphology of the surface composite resin restorations after finishing and polishing include composite characteristics such as size, hardness, type and amount of particles and factors related to the abrasive system such as flexibility of the material in which the abrasive is impregnated, hardness of the abrasive, and geometry, speed and form of application of the instruments used [22]. Finishing and polishing procedures require sequential use of instrument with gradual decrease in particles abrasiveness, aiming to obtaining a brighter and smoother surface [20].This study sought to investigate the influence of duration of finishing and polishing on the surface roughness of Composan bio-esthetic nano particles composite resin and Composan ceram hybrid composite resin. The results revealed that Composan bio-esthetic nano composite finished with finishing kit for 30 second showed the lower surface roughness average value (Ra=0.307Mm), due to their small filler particle size and their filler arrangement. The average size of nano composite filler particle is 25 nm and nano aggregates of approximately 75 nm[23]. while Composan ceram hybrid composite finished with finishing kit for 15 second showed the higher surface roughness average value (Ra= 0.410Mm), due to their harder and larger filler particle size 0.6 to 1 Mm [23]. Resins with a large quantity of small particles, such as Composan bio-esthetic nano composite, investigated in this study, show greater smoothness, once the reduction in size of the particles enables a better distribution in the resinous matrix. This assumption is reinforced by Reis et al [24], Nagem Filho et al [10], Turkun, Turkun [25], who emphasized that the composite resins with higher percentage of loading and better distributed particles in the resinous matrix have greater surface smoothness. Resin composites with harder and larger filler particles like Composan ceram hybrid composite are expected to have higher Ra value after polishing. Harder filler particles are left protruding from the surface during polishing as the softer resin matrix is preferentially removed. Also this study corroborated with Duygu et al [26], who demonstrated that hybrid composite showed high roughness average value Ra, likely due to the size of the filler particles that were exposed after polishing or dislodge. Also in this study, it was found that there was no significant difference between the groups that finished and polished for 15 seconds and those for 30 seconds (for the same material). This result may contribute to the effectiveness of finishing kit used in this study with a relatively short polishing duration in removing the scratches from the surfaces of composite resin and produced a smooth surface. Morgan [27] reported that the ability to produce a smooth surface with the use of the finishing kit depends on their cutting filler particles and matrix resin equally. This result came corroborate with those of Vera et al [20], who stated that increasing the polishing time did not result in significant improvements on surface smoothness. While, this study disagree with Tamayo et al [17], who showed that Surface roughness of the resin composites had a tendency to decrease with longer polishing duration. Miyazaki et al [28], Fruits et al [29] and Yap et al [30], reported that the polishing results depended on the amount of time spent with each polishing system. Further studies are needed to investigate the effect of immediate and delayed finishing and polishing procedures on the surface roughness, hardness and marginal sealing

of different composite restorations.

Conclusion

Within the limits of this in vitro study; it has been found that increasing duration of finishing and polishing of the two different types of composite resins has no significant effect on the surface roughness of these two types of composite resins and there is no significant difference between these two types of composite resins in surface roughness.

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