The Influence Of Different Polishing Techniques On The Surface Roughness And Micro Hardness Of Resin Composites

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DEDICATION
This work is dedicated to
My parents and my wife
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INTRODUCTION
Over the years, several changes have been made in the fabrication of dental resin composites to obtain better color stability, greater wear resistance, and clinically acceptable surface smoothness of restorations (Sectos et al., 1999). To achieve the last goal, manufacturers predominantly have reduced the the average size of the filler particles, so they have been able to produce composites with a good mix of polishability and strength. The hybrid resin composite contain a blend of microscopic (averaging 1–5µm), submicroscopic glass and nanofiller particles. The combination of filler particles allows the highest levels of filler loading among resin composites, and a corresponding improvement in physical properties. The small-particle hybrid composites can be divided into three categories: nanohybrid, minifill or microhybrid and midifill. (Turssi et al., 2000).

Resin composite also contain a high concentration of nanosized fillers have also been introduced and are called “nanofills.” These nanofill composites were developed to be used in all areas of the mouth, with high initial polish and superior polish retention, as well as excellent mechanical properties suitable for high stress-bearing restoration. The manufacturers claim that these “new” composites have the strength of the hybrids and the polish of a microfill. (Mitra et al., 2003).

Finishing and polishing of composite resin restorations are essential steps in restorative dentistry. The esthetics and life span of tooth-colored restorative materials are dependent on the quality of the surface finish. The presence of surface irregularities arising from poor finishing/polishing techniques and/or instruments may create clinical problems such as staining, plaque retention, gingival irritation, and recurrent caries. So proper finishing of restorations is desirable not only for esthetics but also for oral health considerations by preventing plaque retention (Yap et al., 2004).
Finishing refers to gross contouring of a restoration to obtain the desired contour. However, polishing refers to smoothness as well as to reduction of the scratches created by the finishing instruments. It has been shown that the longevity and the maintenance of a restoration can be achieved by having a smooth, highly polished surface than a rough one (Marghalani and Hanadi., 2010) So various tools and techniques have been developed to obtain highly finished and polished surfaces of resin composite restorations, ranging from one-step polishing system to multiple-steps systems. (St-Georges et al., 2005).

Therefore, this study was carried out to analyze the influence of different polishing techniques on surface roughness and micro-hardness of resin composites.
REVIEW OF LITERATURE
Dental composite resins

The term “Composite” refers to a multi phase material formed from a combination of materials that differ in composition or form, remain bonded together, and retain their identifies and properties. (Terry and Leinfelder., 2004). In the early 1960s, dimethacrylate polymers, such as Bis-GMA, were developed and their use in dental restorative material was proposed. They were chemically cured and the filler particles were large and filler content was low. They were not polishable and tended to discolor over time. (Leinfelder et al., 1980).

A major step in composite technology occurred in 1970s with the introduction of light cured composite resins which were more resistant and more colour stable, than the auto polymerized composite resin. (Power., 1980). In the early 1980s, by reducing the particles size even further, to 0.04µm, manufacturers were able to introduce microfill products around this time. The particle size of this generation of composite resins was less than the wave length of light. Consequently, the surface could be polished to high luster. The next major change in composite resin came in the mid 1980s with the introduction of the universal material that could be used in both anterior and posterior restorations and were called hybrids because they had a mixture of particles sizes from 0.04-3µm. (Leinfelder et al., 1995).

Further refinements in these materials lead to the introduction of microhybrids resin composite with the mean particle sizes of 0.6-0.7 µm. Generally, the particles in these composite resins were more uniform in size. These materials were reported to have excellent physical properties, relatively non sticky and finish and polish well. (Jackson and Morgan., 2000).
Recently, the introduction of nanotechnology is based on the production of functional materials and structures in the range of 1 to 100 nanometers using various physical and chemical methods. Nano filled composites have many advantages, including reduced polymerization shrinkage, increased mechanical properties, improved optical characteristics, better gloss, retention and diminished wear. (Bayne et al., 2002).

**Surface roughness**

Is a measure of the texture of a surface. It is quantified by the vertical deviations of a real surface from its ideal form. If these deviations are large, the surface is rough; if they are small the surface is smooth. Roughness plays an important role in determining how a real object will interact with its environment; rough surfaces usually have higher friction coefficients and wear more quickly than smooth surfaces. Irregularities in the surface may form nucleation sites for cracks and mechanically retain surface stains more than smooth surface (Iazzetti et al., 2000). Surface roughness is measured by parameters such as profile roughness parameters and Areal roughness Parameters.( Degarmo et al., 2003).

Also many authors have used the scanning electron microscope to study the results of various finishing sequences for composite restorations. More recently, mechanical profilometry has been used, allowing the results to be assessed quantitatively. Surface roughness can be expressed numerically by several parameters: Ra (arithmetic mean value of the movement of the profile above and below the centre line of the surface); Rt (depth of the maximum roughness); Rp (roughness with maximum depth within the Rz) and Rma (mean depth of roughness among five adjacent spaces) (Joniot et al., 2000).
Ryba et al., (2002), compared the surface roughness of five packable resin composite materials (Alert, Filtek P-60, Pyramid, Solitaire II, Surefil) and one hybrid resin composite materials (Z100) which polished with aluminum oxide discs (Sof-Lex) or a rubber polishing system (Enhance). Sixteen specimens were fabricated. Each specimen group was polished with either Sof-Lex discs or Enhance rubber polishers followed by fine and superfine polishing pastes. The specimens were evaluated for surface roughness using surface profilometry. Mean values were calculated for each material type and method of polishing. They found that, there were no significant interaction between materials and polishing method existed. No significant difference in surface roughness among polishing techniques were found; however, a strong trend that aluminum oxide discs provided a smoother surface than rubber polishers in all materials except Filtek P-60, was noted. They concluded that, the method of finishing and polishing of packable resin composite materials does not significantly affect the final polished surface of all the materials. The Filtek P-60 achieved a significantly smoother surface than Alert when using a rubber polishing technique.

Halim et al., (2003), evaluated the effect of two polishing systems on the surface roughness of seven composite materials (Filtek Z250, Solitaire, Alert, Suprafil, Fill Magic, Surefil and Definite). One hundred and twenty-six conical specimens of each material were prepared in stainless steel molds against a polyester strip and each material group was subdivided into three subgroups, one as a control group (unpolished) and the rests were by using one of the following techniques: diamond burs or diamond burs + aluminum oxide discs (Sof-lex). A profilometer was employed in this study to measure the surface roughness. They found that, the diamond burs provided the highest surface roughness for all composites. While a control group and aluminum oxide discs provided lowest surface roughness for all composites. They
Concluded that, the diamond burs were less effective than the aluminum oxide discs (Sof-lex) for finishing composite materials.

Amal et al., (2004), evaluated the effect of four polishing techniques on the surface roughness of two composite materials (Filtek Z 250 and Pertac II). Each material group was subdivided into five subgroups, one as a control group (unpolished) and the rests were polished by using one of the following techniques: Arkansas stone, aluminum oxide discs (Sof-Lex), diamond point and silicone point. A 3D Profilometer was employed in this study to measure the surface roughness. They found that, the optimum smoothness was realized with diamond point and aluminum oxide discs (Sof-Lex) and the most surface irregularities were realized with control and specimens polished with silicone point. They concluded that, the diamond point provided the lowest roughness parameters whereas the silicone points and control recorded the highest roughness parameters.

Borges et al., (2004), studied the surface roughness of four packable composite materials (Surefil, Predigy Condensable, Filtek p60 and Alert) and one microhybrid composite resin (Filtek Z250) after polished with various systems. Each material group was subdivided into five subgroups, one as a control group (unpolished) and the rests were polished by using one of the following techniques: Sof-Lex, Enhance, Composite finishing kit and Jiffy polisher cups. A profilometer was employed in this study to measure surface roughness. They found that, the SureFil polished with Sof-Lex was significantly lower surface roughness than that polished with composite finishing kit, Prodigy Condensable polished with Enhance showed a significantly less rough surface than when polished with Sof-Lex, Filtek P60 did not exhibit a significant difference with the various polishing systems and Alert showed that the lowest roughness surface
Was obtained with Sof-Lex and the highest roughness surface with composite finishing kit. While the Filtek Z250 polished with composite finishing kit and Jiffy points resulted in a lower roughness surface than when polished with Enhance. They concluded that, the Sof-Lex discs and the Jiffy points produced the smoothest surfaces for the tested resin composites.

Baseren et al., (2004), studied the different finishing and polishing systems on the surface roughness of Nanofill (Filtek Supreme) and Nanohybrid (Grandio) composites and Ormocer (organically modified ceramic)(Admira) based tooth colored restorative material. Each material group was subdivided into five subgroups, one as a control group (using Mylar strips) and the rests were polished by using one of the following techniques: Diamond bur/ Super Snap Rainbow technique, diamond bur/ Astropol and Astro-brush system, tungsten carbide bur/ Super Snap Rainbow technique and tungsten carbide bur/ Astropol and Astro-brush. The Mahr Perthometer S4P surface roughness tester was employed in this study to measure the surface roughness. They found that, the control group was produced the smoothest surface for all materials while Ormocer showed the lowest surface roughness among tested materials. Also, the diamond bur/ Super Snap produced a smoother surface than diamond bur/ Astropol and Astro-brush for all materials. They concluded that, the Ormocer performed the lowest variability in initial surface roughness among the tested materials.

Watanabe et al., (2004), studied the influence of different polishing systems on the surface roughness of two different composite materials (Clearfil and Lite-fil AII). Cylindrical blocks of light-cured resin composite, were prepared in a Teflon mold. Resin composites were inserted and pressed into the mold, then polymerized with a
Curing unit for 40 sec through transparent strips on the both sides of the specimen. Resin blocks were finished to a uniform surface using 600 grit silicone carbide papers. After 24 hrs, each material group was subdivided into two subgroups according to polishing systems (One-step versus Multi-steps polishing systems). The subgroup (Multi-step polishing systems) was divided into four classes (Super Snap Rainbow technique kit, Enhance system, Foam polishing cup with prisma gloss composite polishing paste and a foam polishing cup with prisma gloss extra-fine composite polishing paste). While the other subgroup (One-step polishing system) was divided into two classes (Compomaster and Silicone point C). A profilometer was employed in this study to measure the surface roughness. They found that, the multi-steps polishing systems (Super Snap Rainbow and Enhance system) were showed the lowest roughness value for resin composites tested, followed by the one-step polishing system (Compomaster and Silicone point C). They concluded that, the multi-steps polishing systems produce smoother surfaces than one-step polishing system but one-step polishing system may be clinically recommended, as considering the time and cost savings.

Gedik et al., (2005), evaluated the influence of different finishing and polishing techniques on the surface roughness of four microhybrid resin based composite materials (Esthet-X, Venus, Inten-S and Point 4). Thirty samples of each material were cured under Mylar matrix strips. Each material group was subdivided into five subgroups, one as a control (unpolished) and the others were finished with multifluted carbide bur then were polished using one of four polishing systems: Sof-Lex finishing system, Enhance finishing system followed by prisma gloss polishing paste, Astropol finishing followed by high gloss polishing system and Astrobrush polishing system.