DIFFERENTS TECHNIQUES POLISHING IN COMPOSITES RESINS

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ABSTRACT

The search for the ideal polishing material is still ongoing. Discs and silicone devices followed by abrasive bristles were tested in three resins with different contents of filler particles. The surfaces of a total of one hundred and twenty specimens were prepared. In group *1, the specimens were finished with a fine grain diamond point (gold #2135F) followed by an extra fine grain diamond point (silver #2135FF), each applied for 15s at low speed. All diamond points were used for 30s on the specimens under intermittent water spray. The preference for diamond points instead of Arkansas stone was based on recommendations of several authors. After finishing with diamond points, the specimens were polished with Enhance system. Three grits of abrasives (Sof-Lex) were applied under light pressure in a circular motion, in only one direction under continuous water irrigation. The specimens in* group *2 were finished with diamond points and polished with the aluminum oxide discs (Sof-Lex) and one of diamond discs. In*

group *3, the specimens were polished with Enhance system followed by bristle brushes and ultrafine diamond paste applied at low speed for 20s. The specimens in* group *4 were polished with Aluminum oxide disc (Sof-Lex) and diamond disc followed by bristle brushes and ultrafine diamond paste applied at low speed for 20s. The smoothest and shiniest surface was found for the Z250 composite after finishing with fine and extra fine diamond points and polishing with the abrasive series of Sof-Lex discs followed by a polishing paste of ultrafine diamond*.

KEY WORDS: Composite Resins; Polishing Paste; Roughness

INTRODUCTION

Reconstructions with esthetic materials followed by finishing and polishing are considered a fundamental step in conservative Dentistry (JONIOT et. al., 2000). Luster texture is a vital characteristic to enhance the scattering of light on the surface of composite restorations. Polishing should not be considered an option, but rather the conclusion of all conservative treatments. Various techniques for polishing after placement of direct resin restorations usually employ aluminum oxide discs with medium, fine and ultra fine grits; however, utilization of the discs is limited by the complex tooth anatomy, and access to restorations is not always possible (TURSSI, 2000). Consequently, special approaches are required, which employ abrasive bristle brushes or smooth rubber points with polishing paste.

This study conducted an *in vitro* comparison of the average surface roughness (Ra, μm) of three resins using only polishing systems, or the same method with an additional step represented by utilization of a polishing paste.

MATERIALS AND METHODS

Details on the commercially available resins and polishing pastes used in this study are provided in TABLE 1. All composites are BISGMA-based hybrid resins with different inorganic fillers, and the paste is composed of ultrafine diamond.

TABLE 1 – Composite resins used in this study.

Material	Code	Filler Type	Resin Type	Avarage Particle Size (μm)	W (%)
SUREFIL	SR	Barium borosilicate, fluoride and aluminum	Bisgma Tegma Udma	0.8	82
FILTEK Z250	FI	Zirconium/SiO_2	Bisgma Bisema Udma	0.6	78
SUPRAFILL	SU	$BaSi_2O_4$	Bisgma Tegma Udma	0.8	76

TABLE 2 – Polishing paste used in this study.

Material	Code	Abrasive	Particle Size	Manufacturer
Polisher Paste	DP	Ultrafine Diamond Paste	1,0 (μm)	Microdont, San Paulo, Brazil

The composite resins were placed in a steel matrix measuring 8 mm in diameter and 5 mm in depth, following the manufacturers' instructions. After filling each mold, a polyester matrix strip was pressed on the surface by a glass plate. All materials were light-cured for 60 s with an Optilux 501 (Demetron, Kerr, Danbury, CT, USA) curing unit with an output of 850 mW/cm2. After curing, the specimens were stored in distilled water at 37ºC for 24h.

A total of one hundred and twenty specimens were prepared. The specimens of all groups were finished with a fine grain diamond point (gold #2135F- KG Sorensen, Barueri, SP, Brazil) followed by an extra fine grain diamond point (silver #2135FF – KG Sorensen, Barueri, SP, Brazil), each applied for 15s at low speed. All diamond pointss were used on the specimens under intermittent water spray. The preference for diamond points instead of Arkansas stone was based on recommendations of several authors (ASHIE 1996; KREJCI, LUTZ; BORETTI, 1999). In *group* 1 – after finishing with diamond points, the specimens were polished with Enhance system (Dentsply, USA). *Group* 2 – after finishing with diamond points, two grits of abrasives, on of aluminum oxide discs

(600 mesh) and one of diamond discs (10μm) were applied under light pressure in a circular motion, in only one direction under continuous water irrigation. *Group* 3 – the specimes were polished with the Enhance system followed by bristle brushes and ultrafine Microdont diamond paste – DP (Microdont, SP, Brazil) applied at low speed for 20s. *Group* 4 – was polished with the aluminum oxide discs (Sof-Lex) and diamond discs (10μm), followed by bristle brushes and ultrafine Microdont diamond paste – DP (Microdont, SP, Brazil) applied at low speed for 20s (TABLE 3).

TABLE 3 – Methods of finishing and polishing of the composite resin surfaces.

Groups	**Time**
Group 1	
Finishing	
Fine Grain Diamond point (gold #2135F)	15s
Extra Fine Grain Diamond point (silver #2135FF)	15s
Polishing	
Enhance system	10s
Group 2	
Finishing	
Fine Grain Diamond point (gold #2135F)	15s
Extra Fine Grain Diamond point (silver #2135FF)	15s
Polishing	
Aluminum oxide discs and Diamond discs	20s
Group 3	
Finishing	
Fine Grain Diamond point (gold #2135F)	15s
Extra Fine Grain Diamond point (silver #2135FF)	15s
Polishing	
Enhance system	10s
Ultrafine Diamond Paste (DP)	20s
Group 4	
Finishing	
Fine Grain Diamond point (gold #2135F)	15s
Extra Fine Grain Diamond point (silver #2135FF)	15s
Polishing	
Aluminum oxide disc and diamond disc	20s
Ultrafine Diamond Paste (DP)	20s

A single operator, blinded to which material was being processed, polished all specimens in a randomized order. The poly-

ester matrix strips and abrasive systems were discarded after each use. Diamond points were reused in random order.

After polishing, all specimens were thoroughly rinsed with water and allowed to dry for 24h before measurement of the average roughness (Ra).

The average roughness (Ra) of a surface is defined as the average value of the height of the surface profile above and below a centerline through a prescribed sampling length. To eliminate the effects of waviness, the roughness of each disc surface was calculated with a roughness meter Surtronic 3+ (Taylor – Hobson, Leicester, England) using five intervals for each stylus transverse to calculate the Ra. In this study, resolution was 0.01μm, the interval cut-off was 0.8mm, transverse length was 4.0mm and stylus speed was 1mm/s (D'AZEVEDO, 2000).

Three traces were recorded for each specimen at three different locations in each direction (parallel, perpendicular and oblique to the finishing and polishing scratch directions), giving nine tracings per specimen. The average of these nine mean surface roughness measurements was used as the score for each sample.

Data was analyzed by two-way analysis of variance (ANOVA). Surface treatments and products were compared by Tukey-Kramer intervals at a 5% significance level.

RESULTS

The results of the surface roughness tests are shown in TABLE 4. A two-way analysis of variance revealed significant effects related to the material and polishing procedure. Significant interactions were also found, indicating that the different materials did not behave uniformly in relation to the different polishing procedures used.

TABLE 4 – Two-way ANOVA.

Source of variation	Sum of squares	Degrees of freedom	Mean square	"F"	Probab. P<0.05
Resins	0.00990155	2	0.00495078	68.97364	0.000000
Polishing	1.18771127	3	0.39590376	5515.686	0.000000
Interaction	0.08112238	6	0.01352040	188.3646	8.0198
Residue	0.00775200	108	0.00007178		
Total	1.28648720	119			

TABLE 5 reveals that some materials, such as Z250, have excellent inherent smoothness because the mean particle size of the fillers is very small. The Zirconium is synthesized with colloidal silica dioxide particles, consisting of one hybrid monomodal particle. The filler size ranges from 0.01μm to 3.5μm, with an average size of 0.6μm. The filler components of the SureFil Restorative consist of a precise blend of Barium Fluoro Aluminum Borosilicate glasses and fumed silica with distinct distributions and morphologies of particles. The composite is formed of two hybrid bimodal particles with an average size of the filler particle of 0.8μm combined with filler loading of about 82% of the composite density. The Suprafill Restorative resin consists of a precise blend of Barium Silicate glasses and fumed silica with distinct distributions of particle sizes, forming a hybrid bimodal resin.

TABLE 5 – Means and standard deviations of surface roughness (Ra, μm).

Polishing Resins	Enhance system	Microdont Polishers system	Enhance system + polishing paste	Polishers system + polishing paste
Z250	0.491A ± 0.0033	0.479A ± 0.0058	0.387B ± 0.0048	0.311C ± 0.0052
Suprafill	0.578D ± 0.0017	0.503E ± 0.00550	0.354F ± 0.0116	0.305C ± 0.0037
Surefil	0.579D ± 0.0093	0.504E ± 0.0094	0.394G ± 0.0094	0.307C ± 0.0052

* Means followed by a same capital letter are not different to each other as to the material or the treatment.

The texture of the Z250 resin was not statistically different when polishing was performed with the Enhance system or the Microdont polishers system. However, they presented significant variations when followed by an application of ultrafine diamond polishing paste.

The texture of the SureFil resin is highly sensitive to the types of treatment. The surface is changed after each type of polishing and presents high smoothness. There were differences in roughness for the Z250 and SureFil resins using the same treatment and the same instrument. However, no dissimilarities in surface roughness were found after treatment with the Enhance system or Microdont polishers system for the SureFil and Suprafill resins. The resin texture does not display statistical differences when the treatment is per-

formed with the Microdont polishers discs combined to the ultra-fine polishing paste.

TABLE 5 provides the Ra values for each material after the surface treatments. The Tukey interval for comparison between materials and surface treatments was 0.012660.

DISCUSSION

The trimming of composite resin restorations encompasses gross finishing, contouring, fine finishing, polishing and luster. A series of aluminum oxide coated flexible discs or diamond discs commercially available are suitable for this purpose. However, their use is confined to directly accessible convex surfaces. For concave areas and occlusal surfaces, different shapes of abrasive instruments are necessary (HOELSCHER, 1998). The Enhance system provides less smoothness, yet the final texture isn't clinically significantly different.

The texture surface after polishing and application of polishing diamond paste depends on the characteristics of the filler particles in the composite such as size, hardness, and amount of these particles. Previous studies have reported that aluminum oxide discs provide smoother surfaces than any silicone tips utilized (NAGEM FILHO, 2003). In the current study, polishing with aluminum oxide discs and diamond discs followed by polishing diamond paste showed the smoothest surface, with a significantly different texture. The utilization of silicone tips for polishing of posterior teeth and occlusal surfaces is in accordance with Setcos (1999) and Lutz, Imfeld (2002), who consider them as clinically acceptable.

Because of its monomodal characteristic, removal of particles in the Z250 resin is more difficult because it presents a high density of strongly interlocked filler particles firmly bonded to the resin matrix. The SureFil and Suprafill are bimodal; however, the diluents Bisgma or Tegma bring about more difficulty for the bonding of particles to colloidal silica. The larger the number of particles, the higher will be the probability of their removal and consequent creation of craters, making the surface rougher (TANOUE, MATSUMURA; ATSUTA, 2000).

In this study, silicone instruments effectively produced roughness in all composites, regardless of differences in the organic and inorganic phases. This is probably because of the pressure exerted by the points on the resin surfaces. The level of irregularities and wear depends on the hardness of the particles and on the uncon-

trolled pressure exerted by the silicone points on the resin surface. This variable texture is therefore exclusively induced by the dentist.

However, the durability of the smoothness achieved 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 particle size of the filler (CHO, 2001). This study demonstrated that the polishing technique with diamond discs and water was an effective method for the materials evaluated. Besides drawing off heat, the water leaches the eroded particles, which must be immediately removed from the restoration surface. This study is in accordance with Bouvier, Drupez; Lissac (1997). Moreover, the scratches produced on the resin surface by the particles of the extra fine discs may be thinner than the visible light wavelength, accounting for the final smoothness observed. The quality of the disc is significant. Its particles must be harder than the composite surface and must be firmly adhered to the disc surface to avoid their loosening during utilization, therefore preventing loss of abrasiveness. This loss may initially lead to displacement of the abrasive grain, which may remain on the surface and produce scratches on the surface during the movement, therefore making it rougher.

Isolated utilization of the disc obviously does not provide a smooth and luster texture; the polishing process must be followed by application of a luster paste for the achievement of an effective polishing. The utilization of Microdont diamond discs followed by a ultrafine paste provided the smoothest and most uniform surface, because the grains are so small that the scratches left on the surface are thinner than the visible light wavelength. In this context, the Z250 composite resin displayed a larger statistically significant difference, with the smoother surface, compared to the SureFil and Suprafill resins.

RESUMO

A busca do material ideal para o polimento das resinas ainda continua. Os discos e os dispositivos do silicone seguidos de pasta para polimento aplicado com cerdas abrasivas foram testados em três resinas com índices diferentes de partículas inorgânicas. As superfícies de um total de cento e vinte espécimes foram preparadas. No *grupo* 1, os espécimes receberam acabamento seqüencial de pontas diamantadas finas, (ouro # 2135F) seguidas por extrafinas (prata # 2135FF); cada uma aplicada por 15s em baixa velocidade. No *grupo* 1 – após o acabamento com as pontas diamantadas, os

espécimes foram polidos com sistema Enhance (Dentsply, USA). *Grupo* 2 – após o acabamento com as pontas diamantadas, os espécimes foram polidos com dois discos abrasivos, um com disco de óxido de alumínio (Sof-Lex) outro com disco diamantado (10μm) foram aplicados sobre discreta pressão em movimentos circulares, em uma única direção sob contínua irrigação de água. *Grupo* 3 – Os espécimes foram polidos com sistema Enhance system seguido por aplicação de ultrafina pasta de diamante Microdont – DP (Microdont, SP, Brazil) com escovas em baixa velocidade for 20s. *Grupo* 4 – foi polido com discos de óxido de alumínio (Sof-Lex) e discos diamantados (10μm) seguido por aplicação de ultrafina pasta de diamante Microdont – DP (Microdont, SP, Brazil) aplicada com escovas de cerda, na velocidade baixa de 20s. As superfícies mais lisas e as mais brilhantes foram encontradas para a resina composta Z250 após acabamento seqüencial de pontas diamantadas finas, (ouro # 2135F) seguidas por extrafinas (prata # 2135FF); e polimento com a série abrasiva dos discos Sof-Lex seguidos por uma pasta de pó de diamante do ultrafino.

PALAVRAS-CHAVE: resinas compostas; pasta para polimento; rugosidade

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