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RESEARCH ARTICLE

The Different Polishing Systems Effect on Ormocer and Supranano Spherical Filler Composite Resin Surface Roughness

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ABSTRACT

Background: *The polishing procedure is an essential step in composite resin restoration. There are two types of polishing systems, which are one-step and multi-step polishing systems.* ***Objective:*** *This study aimed to identify the effect of different polishing systems on the surface roughness of ormocer and supranano spherical filler composite resin. Material and Methods: This study was conducted in an experimental laboratory. The specimens were ormocer and supranano spherical filler composite resin filled in a cylindric metal mold. The total of specimens was thirty-two (n=32) of each composite resin. Each composite resin specimen was divided into four groups, then polished using PoGo (group 1 – one-step polishing system), Optrapol (group 2 – one-step polishing system), Sof-lex (group 3 – multistep polishing system), and Optidisc (group 4 – multistep polishing system). Specimens were incubated at 37℃ for 24 hours. Subsequently, specimens were assessed with a stylus profilometer surfcorder SE 1700. Data were analyzed using an independent t-test and one-way ANOVA.* ***Results:*** *There was a significant difference in surface roughness of the one-step and multistep groups (p ≤ 0.05). The lowest surface roughness value was in the Sof-Lex disc group (0.4026μm), and the highest surface roughness was in the PoGo group (1.1036μm).* ***Conclusion:*** *Based on composite resin, supranano spherical filler had less surface roughness than ormocer (p ≤ 0.05). Furthermore, both ormocer and supranano spherical filler polished using a multistep polishing system had lower surface roughness than those polished using a one-step polishing system.*

Keywords: *Surface roughness, polishing system, composite resin, ormocer, supranano spherical filler*

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INTRODUCTION

Composite resin is a dental restorative material currently used as it has good aesthetic and mechanical properties.[1] Composite resin's mechanical and aesthetic properties were influenced by its filler size.[2] Composite resin fillers have been constantly evolving to get better mechanical properties. Some developments of composite resin fillers were supranano spherical fillers and ormocer. Supranano spherical filler is a composite resin with a filler size of nanometers to microns,[3] while ormocer is a composite resin with nano-size filler that produced by hydrolysis and polycondensation reactions (sol–gel processing) to form a molecule with a long inorganic silica chain backbone and organic lateral chains.[4]

The polishing technique is one factor influences composite resin's aesthetic properties.[5] The polishing procedure is an important step in composite resin restorations aiming at removing rough surfaces.[6] There are two techniques of polishing procedures; one-step polishing and multistep polishing.[5,7] The one-step polishing system is a technique that requires only one type of polishing material, while multistep uses several materials in the polishing procedure.[7,8] Previous study by St-Pierre *et al*. concluded that multistep technique produced a smoother surface compared to one-step technique.[9] Another study also showed similar result that the polishing procedure with the multistep technique produced a smoother surface of the composite resin than the one-step technique.[10]

The composite resin's surface quality affects its aesthetic properties and durability in the oral cavity.[9] The smooth surface of composite resin restoration reduces plaque accumulation, gingival irritation, secondary caries, and discoloration of the filling.[7,11] This research aims examine the differences in surface roughness values of ormocer and supranano spherical filler composite resin using one-step and multistep polishing procedures.

MATERIALS AND METHODS

This study was conducted as a laboratory experiment and had ethical clearance from the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta. Each composite resin had thirty-two specimens. Specimens were prepared using a cylindrical metal mold with a diameter of 4 mm and a height of 4 mm and were made by incremental horizontal technique. Composite resin was placed into a mold using plastic filling with a depth of 2 mm increment. The depth measurement used a periodontal probe. Specimens were polymerized using a Light Emitting Diode (LED) light-curing unit (Dentamerica Litex 695 LED Pen-type Curing Light, California, USA) for 20 seconds at a light intensity of 1,200 mW/cm^2.[12] The second incremental layer was applied using a plastic filling. A microscope glass slide was placed on the top of the mold, and a load of 500 grams was applied for 30 seconds.[13] Next, the specimen was polymerized using a Light Emitting Diode (LED) light-curing unit (Dentamerica Litex 695 LED Pen-type Curing Light, California, USA) for 20 seconds at a light intensity of 1,200 mW/cm^2.

All specimens were roughened with sandpaper #360 for 5 seconds to get the same surface roughness.[9] Afterward, the specimens were divided into four groups according to the type of polishing system as follows:

Group 1 was polished with PoGo (Dentsply Sirona, Milford, USA), a one-step polishing system, for 30 seconds at a speed of 15,000 rpm.[13]

Group 2 was polished with OptraPol (Ivoclar Vivadent, Schaan, Liechtenstein), a one-step polishing system, for 40 seconds at a speed of 8,000 rpm.[12]

Group 3 was polished with a Sof-Lex disc, a multi-step polishing system, for 30 seconds at each level of the disc at a speed of

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10,000 rpm. The specimens were rinsed using distilled water for 10 seconds to remove debris and were dried for 5 seconds between each roughness level of the disc.[9,12]

Group 4 was polished with an Optidisc, a multi-step polishing system, for 20 seconds at each level of the disc at a speed of 15,000 rpm. The specimens were rinsed using distilled water for 10 seconds to remove debris and were dried for 5 seconds between each roughness level of the disc.[14]

Furthermore, the samples were incubated at 37℃ for 24 hours before being tested for surface roughness. The surface roughness of the samples was tested using a stylus profilometer three times for each specimen, and the average results were obtained. The data were analyzed by the independent t-test and One Way ANOVA using SPSS 16.0.

RESULT

The normality of variances was checked with the Shapiro-Wilk test (p=0.575), while the homogeneity of variances was checked with the Levene statistic (p=0.016). Table 1 and Figure 1 summarize the means and standard deviations of surface roughness of ormocer and supranano spherical filler composite resin.

Table 1. Mean with standard deviation (±) of surface roughness (µm) for both ormocer and supranano spherical filler composite resin and polishing systems tested

Group		Ormocer	Supranano Spherical filler
Polishing System	Instrument		
One-Step Polishing System	PoGo	1.0594 ± 0.2646	1.0108 ± 0.2042
	Optrapol	1.0565 ± 0.2960	1.0642 ± 0.1534
Multi-Step Polishing System	Sof-Lex	0.2924 ± 0.0556	0.5128 ± 0.5588
	Optidisc	0.3406 ± 0.0939	0.5192 ± 0.0499

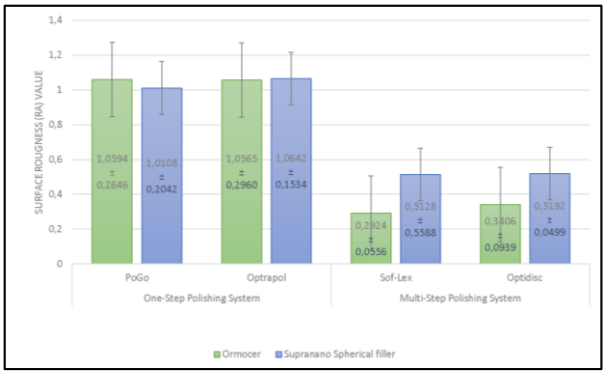

Figure 1. Graphics of mean and standard deviations of surface roughness (µm) for both composite resins and polishing systems evaluated

Regarding the surface roughness of both composite resins, the differences between supranano spherical filler and ormocer were significant (p<0.05) (Table 2). Whereas based on the type of polishing system, Table 3 exhibits that one-step polishing systems produce rougher surfaces than multistep polishing systems significantly (p<0,05). The One-way ANOVA (Table 4) pointed the mean of surface roughness polished using PoGo, Optrapol, Sof-lex disc, and Optidisc was significantly different (p<0,05).

Table 2. Independent t-test of supranano spherical filler and ormocer

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Surface Roughness	Equal variances assumed	2.200	62	.032
	Equal variances not assumed	2.200	51.565	.032

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Surface Roughness	Equal variances assumed	13.406	62	.000
	Equal variances not assumed	13.406	53.827	.000

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Table 3. Independent t-test of one-step and multistep polishing systems

Table 4. One-way ANOVA analysis

F	df1	df2	Sig.
59.712	3	60	.000

Furthermore, each group's differences were analyzed with the Least Significant Different (LSD) test (Figure 2). Figure 2 shows that Group 1 (PoGo) is significantly different ($p<0,05$) compared to Group 3 (Sof-lex disc) and Group 4 (Optidisc). However, it was not significantly different ($p>0.05$) compared to Group 2 (Optrapol). The post-hoc LSD tests were in line with the independent t-test showing that the specimen polished using Soft-lex and Optidisc (multistep technique) produced a smoother surface compared to PoGo and Optrapol (one-step technique) significantly.

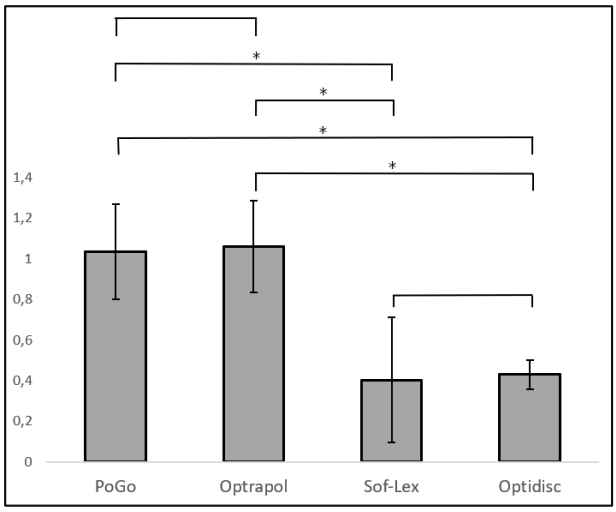

Figure 2. Graphic of post-hoc least significant different tests

DISCUSSION

This study evaluated the influence of various polishing systems on the surface roughness of ormocer and supranano spherical filler composite resin. Polishing systems used in this study were PoGo and Optrapol as the one-step polishing system and Sof-lex disc and Optidisc as the multistep polishing system. The one-step technique was a polishing technique using only one abrasive material, while the multistep technique was a polishing technique using more than one abrasive material.[7,8]

The results of this study were similar to previous studies showing that the polishing procedure with the multistep technique produced a smoother surface of the composite resin than the one-step technique. [9,10] The composite resin polished with a multistep technique exhibited a smoother surface than polished one-step technique due to the polishing procedure performed in stages from coarse to fine particles. Thus, reduced scratches occurred due to polishing in the previous step. The polishing procedure's duration influenced the surface roughness of the composite resin. The longer the polishing time, the smoother the surface will be because the matrix and filler erasure employed were of higher quality.[15] The polishing time was longer in the multistep technique than in the single-step technique. The surface roughness of the multistep group was therefore less than that of the one-step group.

Polishing systems have a different hardness of the embedded abrasive particles and the shape of applied instruments that affect the polishing procedures efficiency.[16] The previous study stated that the abrasive particle size in the polishing system should be fine to prevent scratches and filler release from the surface layer of the composite resin during polishing.[9] According to their manufacturer's instructions, the PoGo's abrasive particle had a roughness of 7 µm, Optrapol had a 12 µm, Soft-lex disc had a roughness of 60, 29, 14, 5 µm, and Optidisc had a roughness of 80, 40, 20, 10 µm, respectively. Based on the particle size, it can be concluded that the one-step group had a larger particle size than the multistep tested. Furthermore, the surface produced on the multistep was smoother than the one-step. The size and strength of the abrasive particle of the polishing system were highly important to get a low surface roughness.[9] The abrasive particle of the polishing system must be harder than the filler particle of composite resin to avoid erasure of the resin matrix, which leaves

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residual particles of composite resin filler. The particle type in Soft-lex was aluminum oxide. This type of particle has a higher strength than composite resin. Thus, aluminum oxide was an ideal abrasive particle for obtaining low surface roughness. The polishing system with aluminum oxide in its abrasive particle may scrape the filler particle and resin matrix without removing it from the composite resin restoration.[17,18]

On the other hand, this study's results were contrary to the previous study revealing that. In the previous study, the surface roughness polished using the one-step technique produced a smoother surface than the multistep technique.[19] It might happen because the disc used in the multistep had a metal in the center, which might cause scratches on the surface. Another explanation for different results was the polishing instrument used on different types of resin composite produced different surface roughness.

CONCLUSION

There were significant differences in surface roughness of ormocer and supranano spherical filler composite resin polished using Soft-lex, Optidisc, PoGo and, Optrapol. Ormocer and Supranano Spherical Filler Resin Composite Resin polished using Soft-lex and Optidisc (multistep technique) produced a smoother surface than PoGo and Optrapol (one-step technique).

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