ORIGINAL RESEARCH

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Efficiency of different instruments used for composite filling polishing.

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Abstract

Introduction: Improper finishing and polishing of fillings leads to surface roughness of the restoration which leads to excessive plaque accumulation, gingival irritation, increased surface staining and poor aesthetics of restored teeth. Therefore, it is essential to use polishing instruments and pastes as a final step of simple caries treatment in order to achieve optimal long-time results. The aim of this study is to evaluate the efficiency of 4 different finishing and polishing instruments used for surface smoothening of aesthetic restorative materials in vitro. Materials and methods: 40 composite (Reality X) samples were prepared in vitro. Their surface irregularities were measured along 3 diagonals before and after polishing. Sof-Lex discs (3M Espe), rubber cones (Kenda), Arkansas stone (Fino) and polishing paste and a professional toothbrush (Kerr) were used for polishing. Each sample was polished under 5N pressure for 30 seconds at 3000 rpm. The surface roughness was than measured using a profilometer. Statistic analysis was performed using ANOVA and unpaired T-tests, the significance level was set at a value of $p<0.05$. Results: Based on the mean values, the smallest roughness was found in the control group- 0.11, while the highest in the rubber polishers and Arkansas stone group- 0.47 and 0.48. The values for the Sof-Lex disc group and the polishing paste-toothbrush group were 0.40 and 0.39. Statistical analysis showed no significant differences between the four groups. Conclusion: It is mandatory to use polishing tools in order to obtain a smooth surface of the restoration and avoid the unwanted long-term complications. Polishing using brush and abrasive paste produced the smoothest surface of the composite.

Keywords: polishing, composite, Sof-Lex disc, rubber cone, Arkansas stone, polishing brush.

Introduction

One of the most desirable features of proper tooth restoration is a smooth surface. Adequate finishing and polishing of the rebuilt surface contribute greatly to the correct restoration of the teeth. Very important elements of the critical restoration process are the polishing instruments, which, used correctly, increase both the aesthetics and the longevity of the restored teeth [1-3].

Due to improper finishing and polishing of fillings, the surface of the restored teeth remains rough and can lead to excessive plaque accumulation, gingival irritation, surface staining and poor aesthetics. This can potentially cause demineralization of the enamel, possible appearence of secondary caries and even periodontal problems [4]. Therefore, it is essential to be aware of the properties of the appropriate polishing instruments and materials to achieve optimal results. The smoothness of the restoration is extremely important and crucial in the outcome of the simple caries treatment [5].

The clinical market offers a vaste range of instruments for doctors to choose from. Silicon carbide-coated or alumina-coated grinding discs, impregnated rubber or silicone discs, tungsten carbide finisher, drilling materials and hard-bonded ceramic/ diamond rotary tools are available to smooth the surface of the restorations.

The efficiency of finishing and polishing processes on restored surfaces is an important consideration in the simple caries treatment [6-7].

The aim of this study is to evaluate the efficiency of 4 different finishing and polishing tools used for in vitro surface roughness smoothening of aesthetic restorative materials.

Material and methods

The study was conducted at the George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Faculty of Dentistry, Discipline of Odontology and Oral Pathology in Romania.

As a first step, a template from Zeta Plus (Zhermack Dental) silicone was prepared. A dose of silicone was mixed with the associated activator. A little less activator was used to extend the setting time, which permitted to flatten the silicone onto one glass plate and then apply light pressure to it with another glass plate for a more even distribution. A 3 mm high silicone sheet was obtained, which was punched in a 9x9 ratio with a 5mm diameter metal cutting roller to complete the template.

As a restorative material, a microhybrid, 0,5-1,5 μm anorganic microparticles light curing composite was used (Reality X, P.L. SuperiorDentalMaterials GmbH, Hamburg, Germany). The composite samples were placed in the template between two plates of glass and then polymerized one by one through the glass plate. A total of 40 samples were prepared.

The samples were finally removed from the silicone model. To measure the surface area of the samples, it was necessary to fix them. For this purpose, Optosil Comfort Putty silicone and activator (Heraeus Kulzer, Germany) was used from which four rectangles were prepared. Then, one by one, the composite discs were placed evenly using a pair of tweezers.

A total of 40 composite discs were made, their surface irregularities were measured along 3 diagonals before and after polishing. Based on the obtained results, the samples for which the difference between the measured values was too large were eliminated.

Thus, a total of 35 samples remained, of which 7 were polished with Sof-Lex discs (3M Espe, USA), 7 with rubber cones (Kenda, Liechtenstein), 7 with Arkansas stone (Fino, Germany) and 7 with polishing paste (Clean Polish, Kerr, USA) and a professional brush (Kerr, USA) and 7 samples were kept unpolished as a control group.

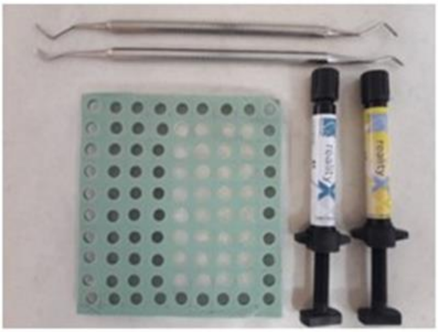

Figure 1. Composite samples placed in the silicone

Figure 2. Polishing instruments

Figure 3. Polishing brushes and paste

Each sample was polished under 5N pressure for 30 seconds at 3000 rpm. The 5 N pressure was controlled with a household scale.

The surface roughness was than measured using a Dektak profilometer with 8 needle. In order to obtain the most accurate results, three measurments were performed on each disk and a mean value was calculated for each sample. Using the contact profilometer along the surface of different samples, three-dimensional mapping with nanometer accuracy is possible. Based on the topography, the curvature and roughness of the surface, the height/ volume of some surface structures, the thickness of thin layers can be determined. The characteristics of the profilometer were Raλc = 0,8 x 3 0,05mm/s.

After eliminating the excessive values, statistic analysis was performed using ANOVA and unpaired T-tests, at a value of $p<0.05$.

Results

The results presented in the table below (Table 1) show the average of the 3 measurements per polishing group and the control group. Data marked in red show the mean value of the average values of the 3 measurments made on each disk. Based on the mean values, the least roughness was found in the control group- 0.11, while the highest values were found in the rubber polishes and Arkansas stones group, 0.47 and 0.48. The values for the Sof-Lex disc group and the polishing paste-brush group were 0.40 and 0.39, respectively.

The obtained values after polishing are presented in the diagram below (Figure 4).

Table 1. The found values after polishing

Control group	Rubber cones	Arkansas stones	Sof-Lex disks	Polishing paste-brush
0,14	0,50	0,45	0,44	0,32
0,11	0,58	0,42	0,36	0,45
0,10	0,45	0,37	0,36	0,45
0,10	0,38	0,40	0,35	0,29
0,12	0,44	0,56	0,37	0,47
0,11	0,59	0,55	0,54	0,44
0,14	0,46	0,54	0,40	0,32
0,11	0,48	0,47	0,40	0,39

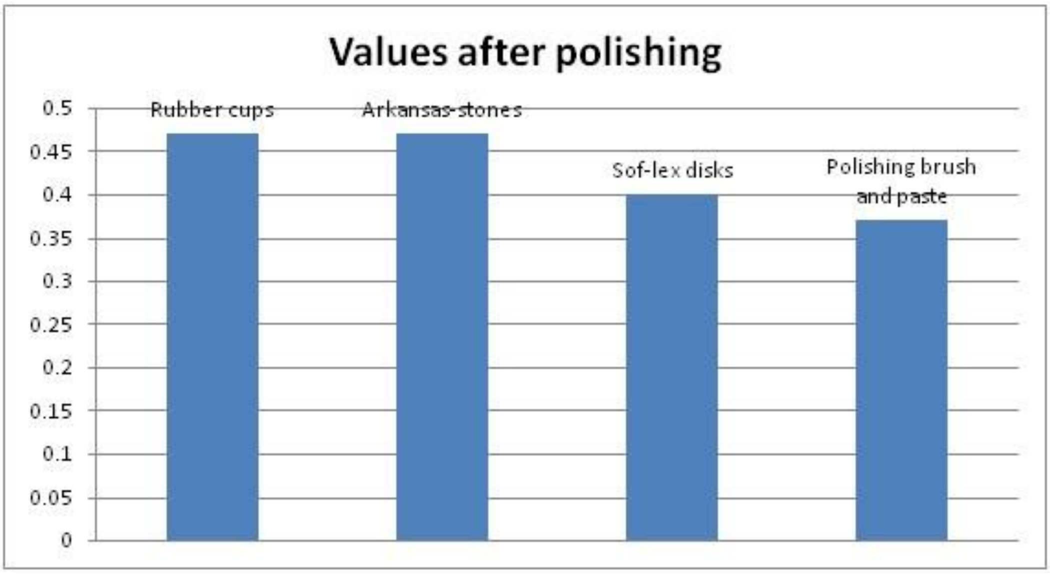

Figure 4. The obtained values after polishing

The surface of the control group shows the least roughness (Figure 5). This is followed by the surface of the composite discs polished using the polishing paste and brush, which at the same time shows a very minimal deviation from the surface polished by the Sof-Lex system (Figure 6).

Finally, the roughness of the surface polished using the rubber polishing and Arkansas stones remained higher compared to the control group.

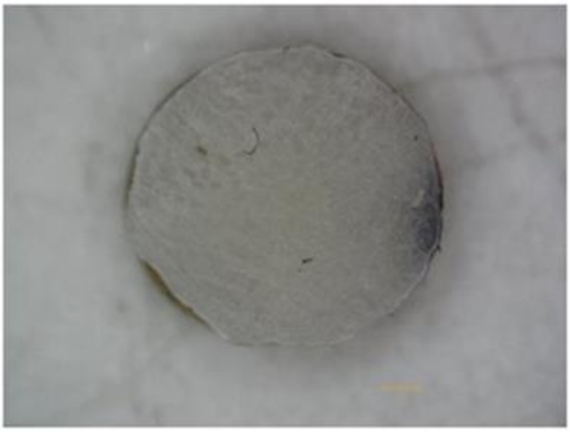

Figure 5. Unpolished control composite disk

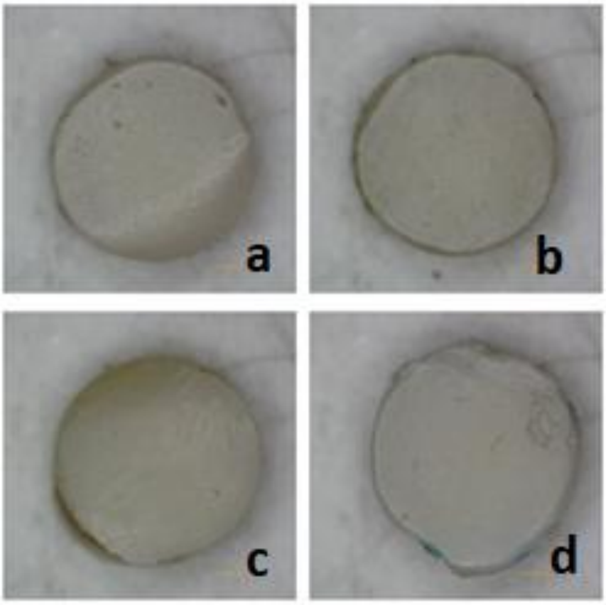

Figure 6. Composite disks surface after polishing with a. rubber cones, b. Arkansas stone, c. Sof-lex disks, d. polishing paste and brush

Using unpaired T-test the 4 group was compared to each other and the control group in order to find significant differences between the used polishing methods. Significance level was set to a value of $p< 0.05$.

Statistic analysis of the obtained results in the 4 groups compared to the control group showed:

1. **The first group** showed a significant difference compared to the control group. A statistically significant difference was found between the group of surfaces treated with polishing rubber cones and the roughness values of the control group ($p = 0.014$). Thus, the measured values were higher in the group where rubber cones were used.
2. **The second group** includes samples polished with Arkansas stone. There was a statistically significant difference between the control group and the group of surfaces treated with Arkansas stones ($p = 0.016$). The values obtained were higher in the Arkansas stone-polished group.
3. **The third group** includes composite samples with a surface treated with Sof-Lex discs. Statistical difference was found between the group of surfaces polished with the Sof-Lex disc and the roughness values detected in the control group ($p = 0.023$). Thus, the measured values were higher in the case of the group treated with Sof-Lex discs.
4. **The fourth group** is the group of professional polishing paste and rotary brush. A significant difference was found between the surfaces treated with brush and polishing paste and the control group, but not as much as in the previous three groups ($p = 0.026$).
5. Using ANOVA test ($p<0.05$) no significant differences were found between the four groups (Table 2).

Summary of Data

Table 2. Statistical analysis

	Treatments					
	1	2	3	4	5	Total
∑X	82	340	329	282	274	1307
Mean	5.8571	24.2857	23.5	20.1429	19.5714	18.6714
∑X²	978	16866	15835	11638	11084	56401
Std.Dev.	6.1875	25.7336	24.9669	21.4076	20.9788	21.5344

Result Details

Source	***SS***	***df***	***MS***	
Between-treatments	3108.2286	4	777.0571	*F* = 1.74836
Within-treatments	28889.2143	65	444.4495	
Total	31997.4429	69		

Discussions

The last but some of the most important steps of tooth restoration, finishing and polishing, are very decisive for the quality, aesthetics and longevity of the restoration.

In order to avoid possible enamel demineralization, secondary tooth decay, and periodontal disease, it is advisable to use a wide range of polishing and finishing tools [2-3]. They can be used to create less retentive restorations, thus preventing plaque deposition. The smoothness of the restoration is extremely important and crucial to the success of the restoration.

This study is axed on comparing the effectiveness of a total of four polishing tools. In this research the abrasive effects of rubber polishers, Arkansas stones, Soft-Lex discs and polishing paste brushes on the Reality X microhybrid composite were analised. Significant differences were found in the roughness of the control group and the surfaces polished with different polishers. However, comparing the efficiency of the polishing tools used, no significant differences were stated.

Several similar researchers, such as Tosco et al, Scheibe et al, Barbosa et al and Sibel et al studied the surface roughness of restorations [8-11].

Barbosa et al. studied the efficiency of four types of finishing / polishing systems, but for the surface roughness of different types of composites. According to their results, significant differences were found between the initial and postoperative surface roughnesses of the composites, but no significant difference was observed between the surfaces polished using different polishing systems. Our results are similar to this study. Although the finest surface in Barbosa's study was provided by the Sof-Lex discs, no statistically significant difference was found between the finishing and polishing systems ($p > 0.01$) [10]. According to our results, Sof-lex systems provided the second most valuable surface, which contradicts the results of the mentioned research. This can be explained by the fact that the number and type of discs used (degree of grain size) in our study were limited to a given type of grinding discs.

A similar study was conducted by Sibel et al to compare the surface roughness of nanofill, nanohybrid and microhybrid composites after polishing and brushing with a brush, respectively. No significant difference was found between the surfaces of unpolished materials. Surfaces treated with Sof-lex discs resulted in greater roughness than surfaces treated with rubber polishers, as in the results we achieved. After use of the brush, the surface of all materials showed greater roughness than unpolished surfaces or surfaces polished using Sof-Lex discs or rubber polishers [11]. In contrast, in our research, while using the brush the result is the same - after polishing with a brush, each sample had a rougher surface than the control group-, we observed the opposite with the Sof-lex system and rubber polisher - in both cases a rougher surface is created, as in case of polishing using the brush.

Recently, another study has been conducted by Negin Nasoohi et al to investigate the surface roughness and microhardness of four composites, two nanohybrids and two microhybrids under wet and dry polishing with a Sof-Lex polishing system of different roughness (coarse, medium, fine, extra fine). Among the composites, the surface of the samples from the control group, which did not receive polishing, showed significantly lower surface roughness than the dry and wet polished groups ($p < 0.001$), similarly to our own results. For each sample, the surface roughness values of the wet-plated group were significantly higher than those of the control group ($p < 0.001$) [12].

Similarly, Senawongse et al and Kritzinger et al studied the surface roughness of nanocomposite and microcomposite after the usage of different polishing systems. Two types of composites and six polishing systems have been studied, also in combination with polishing paste. The surface of the control group showed a significant difference compared to all surfaces treated with the polishing system [13-14]. Our results are similar to what the researchers found in their study.

Based on the results presented, we did not find a significant difference between the polishing systems. However, when compared with the control groups, results showed significant differences in surface roughness. Although not satistically significant, but according to the found values the brush-paste group produced the smoothest surface, followed by the Sof-lex discs, Arkansas stone and rubber polishers in ascending order of roughness.

Conclusions

1. It is mandatory to use polishing tools in order to obtain a smooth surface of the restoration and avoid the unwanted long-term complications.
2. Polishing using brush and abrasive paste produced the smoothest surface of the composite.

Conflict of interest: None declared.

References

1. Bansal K, Gupta S, Nikhil V, Jaiswal S, Jain A, Aggarwal N. Effect of different finishing and polishing systems on the surface roughness of resin composite and enamel: an in vitro profilometric and scanning electron microscopy study. Int J Appl Basic Med Res. 2019;9(3):154-158.
2. Lesage B, Milnar F, Wohlberg J. Achieving the epitome of composite art: creating natural too esthetics, texture and anatomy using appropriate preparation and layering techniques. Int. Dent S.A. 2009;11: 34–48.
3. Kameyama A, Nakazawa T, Haruyama A, Haruyama C, Hosaka M, Hirai Y. Influence of finishing/polishing procedures on the surface texture of two resin composites. J. Open Dent. 2008;2:56–60.
4. Yadav RD, Raisingani D, Jindal D, Mathur R. A comparative analysis of different finishing and polishing devices on nanofilled, microfilled, and hybrid composite: a scanning electron microscopy and profilometric study. Int J Clin Pediatr Dent. 2016;9(3):201-208.
5. Madhyastha PS, Hegde S, Srikant N, Kotian R, Iyer SS. Effect of finishing/polishing techniques and time on surface roughness of esthetic restorative materials. Dental Research Journal. 2017;14(5):326.
6. Babina K, Polyakova M, Sokhova I, Doroshina V, Arakelyan M, Novozhilova N. The effect of finishing and polishing sequences on the surface roughness of three different nanocomposites and composite/enamel and composite/cementum interfaces. Nanomaterials (Basel). 2020;10(7):1339.
7. Guler AU, Guler E, Yucel AC, Ertas E. Effect of polishing procedures on color stability of resin composites. J. Appl. Oral Sc. 2009;17(2):108–112.

8. Tosco V, Monterubbianesi R, Orilisi G et al. Effect of four different finishing and polishing systems on resin composites: roughness surface and gloss retention evaluations. Stomatol. 2020;69(4):207-214.
9. Scheibe KG, Almeida KG, Medeiros IS, Costa JF, Alves CM. Effect of different polishing systems on the surface roughness of microhybrid composites. J. Appl. Oral Sci. 2009;17:21–26.
10. Barbosa H, Zanata RL, Navarro MF, Nunes OB. Effect of different finishing and polishing techniques on the surface roughness of microfilled, hybrid and packable resin composites. Braz.Dent. J. 2005;16:39–44.
11. Sibel A, Yazici AR, Kilinc E, Antonson DE, Hardigan PC. Comparison of different finishing/polishing systems on surface roughness and gloss of resin composites. J Dent. 2011;39(1):e9-16.
12. Nasoohi N, Hoorziad M, Tabatabaei SF. Effects of wet and dry finishing and polishing on surface roughness and microhardness of composite resins . J Dent (Tehran). 2017;14(2):69-75.
13. Senawongse P, Pongprueksa P. Surface roughness of nanofill and nanohybrid resin composites after polishing and brushing. J Esthet Restor Dent.2007;19:265–275.
14. Kritzinger D, Brandt PD, De Wet FA. The effect of different polishing systems on the surface roughness of a nanocomposite and microhybrid composite. S Afr Dent J. 2017; 72(6):249-257.

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