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# Evaluation of surface roughness of composite according to surface treatment

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## ABSTRACT

The purpose of this study was to evaluate the effect of various finishing and polishing procedures on the surface roughness (Ra) of two composite resins: An organically modified ceramic (Definite) and a micro hybrid (Tetric).

Thirty specimens of each composite resin were fabricated using a stainless steel mold of 5 mm in diameter and 2 mm in depth. The composite resin was covered by a Mylar strip and pressed flat with a microscopic glass slide and light cured.

The specimens for each composite resin were divided into three groups, each of ten. The specimens in group one received no treatment, while the specimens in group two and three were finished with diamond bur. After finishing with diamond burs group three were polished with Sof–Lex discs.

The surface profile of the specimens was obtained with a surface profile–testing machine (Profilometer). The roughness value in micrometer (μm) was recorded as the average Ra.

Results showed higher surface roughness in groups finished with diamond burs followed by groups finished with diamond burs and polished with Sof–Lex discs while groups set against Mylar strip showed the lowest roughness values. The result revealed no significant difference in surface roughness values between the two composite resins.

**Key Words:** Composite resin; Surface roughness; Surface treatment.

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## INTRODUCTION

Finishing can improve the esthetics and longevity of tooth colored restorations.[1–4] A highly polished surface minimizes plaque accumulation, gingival irritation, poor esthetics and color change.[5] Therefore, the smoothness of a restoration is very important for its success.[6]

A highly polished surface of composite is somewhat difficult to achieve. The resin matrix and the filler particles of the composite do not abrade to the same degree due to different hardness. For instance, craters are often formed around hard quartz particles of conventional composites after polishing. As a consequence, irregularities appear on surface of the restoration.[7] The filler content of the composite also affects its roughness, as microfilled composites show smoother surface than hybrid composites.[8] The resin matrix composition may also play a role in the final smoothness of the restoration.

Among current esthetic materials, composite resin respond best to polishing. The surface of the composite resin can be polished using a variety of instruments such as burs, discs, pastes and rubber points.[9–13] There would not appear to be a universally accepted method for finishing procedures for these materials. It is well known that few, and possibly, none are as efficient as the Mylar strip. However, the use of this strip is limited by the complexity of the tooth anatomy and by diverse restorative procedures. Discs are non destructive, but their effect on anatomically contoured occlusal surface is limited because they cannot access the narrow fissures on the surface.(14)

The aim of this study was to compare surface roughness (Ra) of two composite resins: An organically modified ceramic (Definite) and a micro hybrid (Tetric) set against Mylar strip and either finished with diamond burs or finished with diamond burs and polished with Sof-Lex discs.

## MATERIALS AND METHODS

Two types of composite resins were used: Organically modified ceramic–matrix Definite (Degussa Hulls AG, Geschaftsbereich, postfach 1364 D–63403 Hanau, Germany) and Tetric (Vivadent, Schann, Lechtenstien) which is a highly–dispersed microhybrid composite with a special filler composition. Thirty specimens of each composite resin were fabricated using a stainless steel mold of 5 mm in diameter and 2mm in depth. The composite resin was covered by a Mylar strip and pressed flat with a microscopic glass slide. Materials were cured according to manufacturers instructions with a curing light Degulux (Degussa Hulls AG, Geschaftsbereich, postfach 1364 D–63403 Hanau, Germany) through the glass and the Mylar strip on the top of the specimens. Following light curing, the specimens were placed in distilled water at room temperature for 24 hours.

The specimens for each composite resin were divided into three groups, each of ten. The specimens in group one received no treatment, while the specimens in group two and three were finished with fissure diamond bur (KG Sorensen, Barueri, SP, Brazil) for 30 seconds with a low–speed handpiece and intermittent water spray. After finishing with diamond burs, group three were polished with aluminum oxide disc: Medium, fine, extra fine (Sof–Lex, 3M, St Paul, MN, USA) with light pressure in a circular motion in one direction only. The medium disc for 10 seconds, the fine disc for 20 seconds and the extra fine disc for 20 seconds. Mylar strip and abrasive discs were discarded after each use, diamond burs were reused in random order.

The surface profile of the specimens were obtained with a surface profile testing machine (Perthenmahr, Perthometer M4P, Feinpruf GmbH–D–3400 Gottingen/ 853,West Germany). The stylus transverse the surface for 5 mm across each specimen in three directions and the other three at 90 degree to the first direction, the roughness value was recorded as the average Ra. The high Ra–value in micrometer (µm) indicates a rough surface while a low value represents a smooth surface.

The data were tabulated and statistically analyzed using analysis of variance and Duncan's Multiple Range Test at 0.001 level of significance.

## RESULTS

The maximum, minimum, means and standard deviations for the Ra in µm for each composite resin and treatment method were shown in Table (1).

Table (1): Mean and standard deviation, maximum and minimum of surface roughness values (Ra) for the tested groups

| | No. | Minimum | Maximum | Mean (µm) + SD |
|---|---|---|---|---|
| Definte–Mylar Strip | 10 | 0.01 | 0.04 | 0.0210 ± 0.00994 |
| Tetric–Mylar Strip | 10 | 0.04 | 0.10 | 0.0760 ± 0.01838 |
| Definite–Sof–Lex | 10 | 0.12 | 0.19 | 0.1500 ± 0.02539 |
| Tetric–Sof–Lex | 10 | 0.10 | 0.19 | 0.1480 ± 0.02974 |
| Definite–Diamond | 10 | 0.26 | 0.41 | 0.3310 ± 0.04886 |
| Tetric–Diamond | 10 | 0.30 | 0.40 | 0.3530 ± 0.03302 |

Table (2) showed significant differences among the tested groups. Duncan's Multiple Range Test (Table 2) demonstrated significantly higher roughness values for groups finished with diamond burs, followed by groups finished with diamond burs and polished with Sof–Lex discs. While groups set against Mylar strip (without treatment) showed the lowest roughness values.

Table (3) showed significant difference between Definite composite resin and Tetric composite resin when set against Mylar strip. The result also revealed that there was no significant difference ($p > 0.05$) in surface roughness between the two composite resins when finished with diamond burs (Table 4) and when finished with diamond burs and polished with Sof–Lex discs (Table 5).

Finally, Table (6) showed no significant difference in surface roughness between Definite and Tetric composite resins. The Figure showed the Ra–values of both composite resins with different treatment groups.

Table (2): Analysis of variance for the tested groups

| | df | Sum of Squares | Mean Square | F–value | Significance |
|---|---|---|---|---|---|
| **Between Groups** | 5 | 0.908 | 0.182 | 200.063 | 0.000* |
| **Within Groups** | 54 | 0.049 | 0.001 | | |
| **Total** | 59 | 0.956 | | | |

df: Degree of freedom.
* Significant difference ($p \leq 0.001$).

Duncan's Multiple Range Test for the tested groups

| Groups | No. | Mean (µm) + SD | Duncan's Grouping* |
|---|---|---|---|
| **Definte–Mylar Strip** | 10 | 0.0210 ± 0.00994 | A |
| **Tetric–Mylar Strip** | 10 | 0.0760 ± 0.01838 | B |
| **Definite–Sof–Lex** | 10 | 0.1500 ± 0.02539 | C |
| **Tetric–Sof–Lex** | 10 | 0.1480 ± 0.02974 | C |
| **Definite–Diamond** | 10 | 0.3310 ± 0.04886 | D |
| **Tetric–Diamond** | 10 | 0.3530 ± 0.03302 | D |

* Means with the same letters were statistically not significant.

Table (3): Analysis of variance for both composites treated with Mylar strip

| | df | Sum of Squares | Mean Square | F–value | Significance |
|---|---|---|---|---|---|
| **Between Groups** | 1 | 0.015 | 0.015 | 69.275 | 0.000* |
| **Within Groups** | 18 | 0.004 | 0.000 | | |
| **Total** | 19 | 0.019 | | | |

df: Degree of freedom.
* Significant difference ($p \leq 0.001$)

Duncan's Multiple Range Test for the tested groups

| Groups | No. | Mean (µm) + SD | Duncan's Grouping* |
|---|---|---|---|
| **Definte–Mylar Strip** | 10 | 0.0210 ± 0.00994 | A |
| **Tetric–Mylar Strip** | 10 | 0.0760 ± 0.01838 | B |

* Means with the same letters were statistically not significant.

Table (4): Analysis of variance for both composites finished with diamond burs

| | df | Sum of Squares | Mean Square | F–value | Significance |
|---|---|---|---|---|---|
| **Between Groups** | 1 | 0.002 | 0.002 | 1.392 | 0.253 |
| **Within Groups** | 18 | 0.031 | 0.002 | | |
| **Total** | 19 | 0.034 | | | |

df: Degree of freedom.

Table (5): Analysis of variance for both composites finished with diamond burs and polished with Sof–Lex

| | df | Sum of Squares | Mean Square | F–value | Significance |
|---|---|---|---|---|---|
| **Between Groups** | 1 | 0.000 | 0.000 | 0.026 | 0.873 |
| **Within Groups** | 18 | 0.014 | 0.001 | | |
| **Total** | 19 | 0.014 | | | |

df: Degree of freedom.

Table (6): Analysis of variance for the two types of composite

| | df | Sum of Squares | Mean Square | F–value | Significance |
|---|---|---|---|---|---|
| **Between Groups** | 1 | 0.002 | 0.002 | 0.097 | 0.756 |
| **Within Groups** | 58 | 0.955 | 0.016 | | |
| **Total** | 59 | 0.956 | | | |

df: Degree of freedom.

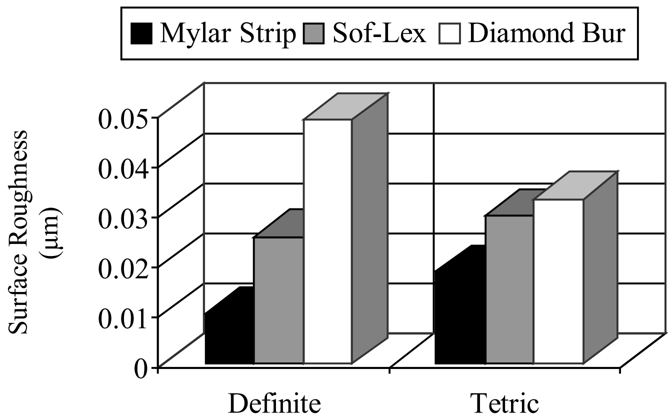


Figure: The surface roughness (Ra) of both composites with different treatment groups

## DISCUSSION

Diamond burs are less effective than Mylar strip and Sof–Lex discs for finishing the composites. These findings were in accordance with Hoelscher *et al.*[7] and Jung,[15] who reported higher values of Ra for polishing with diamond burs. Also, in accordance with Germain and Meiers[16] and Geiger *et al.*,[17] who reported superiority of Mylar strips over other methods in achieving very smooth surface. While Filho *et al.*[18] claimed that Mylar strip and Sof–Lex discs produced the same roughness values.

There are differences in roughness for the different resins using the same treatment with the same instrument.[8] In this study, the burs produced roughness in the two composite resins effectively. This is perhaps due to the pressure used with the burs on resin surfaces. In groups two and three, the diamond burs are reusable finishing instruments and with continuous use could damage the uniform wear. Abrasion irregularities are dependent on the composition and hardness of the particles and also on the pressure used with the diamond burs on the resin surface.

Although dissimilarity in Ra of materials may mainly be attributed to the differences in the size and content of filler particles, type of filler, degree of conversion of the polymer matrix and the silane coupler, which may also influence polishing.[19–20] 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.[21]

This study demonstrated that the polishing technique with Sof–Lex discs was effective method for the materials evaluated. These were in agreement with those reported by Bouvier *et al*.,[22] who reported the superiority of Sof–Lex discs in polishing of anterior restorations.

## CONCLUSION

The smoothest surface was produced using Mylar strip followed by Sof–Lex discs while diamond burs showed rough surface. Definite and Tetric composite resins showed the same roughness. Polishing technique with Sof–Lex discs was effective method for these materials.

## REFERENCES


1. Berastegui E, Canalda C, Brau E, Miquel C. Surface roughness of finished composite resins. *J Prosthet Dent*. 1992; 68: 742-749.
2. Jefferies SR, Barkmeier WW, Gwinnett AT. Three composite finishing systems: A multisite *in vitro* evaluation. *J Esthet Dent*. 1992; 4: 181-185.
3. Tate WH, Deschepper EJ, Cody T. Quantitative analysis of six composite polishing techniques on a hybrid composite material. *J Esthet Dent*. 1992; 4: 30-32.
4. Prateen DH, Johnson GH. An evaluation of finishing instruments for anterior and posterior composites. *J Prosthet Dent*. 1988; 60: 145-158.
5. Jefferies SR. The art and science of abrasive finishing and polishing in restorative dentistry. *Dent Clin North Am*. 1998; 42: 613-622.
6. Joniot SB, Gregoire GL, Auter AM, RoquesYM. Three dimensional optical profilmetry analysis of the surface states obtained after finishing sequences for three composite resins. *Oper Dent*. 2000; 25: 311-315.
7. Hoelscher DC, Neme AM, Pink FE, Huges PJ. The effect of three finishing systems on four esthetic restorative material. *Oper Dent*. 1998; 23: 36-42.
8. Roeder LB, Tate WH, Powers JM. Effect of finishing and polishing procedures on the surface roughness of packable composites. *Oper Dent*. 2000; 25: 534-543.
9. Setcos JC, Tarim B, Suski S. Surface finish produced on resin composites by new polishing systems. *Quint Int*. 1999; 68: 742-749.
10. Chung KH. Effects of finishing and polishing procedures on the surface texture of resin composites. *Dent Mater*. 1994; 10: 325-329.
11. Asche MJ, Tripp GA, Eichmiller FC, Meiers JC. Surface roughness of glass ceramic insert composite restorations: Assessing several polishing techniques. *J Am Dent Assoc*. 1996; 127: 1495-1500.
12. Small KL, Goldfogel MH, Newman SM. Effectiveness of reciprocal–action instrumentation for polishing composite resin: An *in vitro* study. *J Esthet Dent*. 1992; 4: 208-211.
13. Strassler HE. Polishing of composite resins. *J Esthet Dent*. 1992; 4: 177-181.
14. Setcos JC, Tarim B, Suski S, Cox CF. Surface roughness of composite resins polished with new polishing systems. *J Esthet Dent*. 1996; 8: 382-389.
15. Jung M. Surface roughness and cutting efficiency of composite finishing instruments. *Oper Dent*. 1977; 2: 98-104.
16. Germain JrHA, Meiers JC. Surface roughness of light–activated glass–inonomer cement restorative materials after finishing. *Oper Dent*. 1996; 21: 103-109.
17. Geiger S, Ravchanukayaev M, Libwerman R. Surface roughness evaluation of resin modified glass–inonomers polished

utilizing poly (acrylic acid) gel. *J Oral Rehabil*. 1999; 26: 704-709.

18. Filho HN, Dazevedo, MTFS, Nagem HD, Marsola FP. Surface roughness of composite resin after finishing and polishing. *Braz Dent J*. 2003; 14: 37-41.
19. Jaarda MM, Wang RF, Lang BR. A regression analysis of filler particle content to predict composite wear. *J Prosthet Dent*. 1997; 77: 57-67.
20. Tanoue N, Matsumura H, Atsuta M. Wear and surface roughness of current prosthetic composite after toothbrush dentifrice abrasion. *J Prosthet Dent*. 2000; 84: 93-97.
21. Cho BH, Heo SJ, Chang CG, Son HH, Kwon HC, Um CM. Colorimetric and roughness changes of ceramic blocks by polishing systems and glazing. *Oper Dent*. 2001; 26: 186-192.
22. Bouvier D, Drupez IP, Lissac M. Comparative evaluation of polishing systems on the surface of three aesthetic materials. J Oral Rehabil. 1997; 24: 888-889.