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# Impact of a novel polishing method on the surface roughness and micromorphology of nanofilled and microhybrid composite resins

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ABSTRACT

*Objective:* This study aimed to evaluate the effects of different finishing and polishing techniques, including a novel polishing method (silicon carbide brush), on the surface roughness and morphology of nanofilled (Filtek Z350XT) and microhybrid (Filtek Z250) composite resins.

*Methods:* Thirty-five specimens of each resin were fabricated and assigned randomly to receive the following finishing/polishing treatments ($n = 5$ per group): none (control), Sof-Lex Pop-On discs (POP), Praxis discs (PRA), POP + felt discs with diamond paste, POP + silicon carbide brush, PRA + felt discs with diamond paste, and PRA + silicon carbide brush. Average roughness (Ra) in μm was evaluated using a 3D profilometer. Scanning electron microscopic images were also obtained and descriptively analyzed. Two-way analysis of variance and Tukey's test ($p < 0.05$) were used to evaluate the effects of resin type, finishing/polishing system, and interactions between these two variables on Ra values.

*Results:* For the microhybrid resin, greater surface smoothness was obtained using POP or PRA + silicon carbide brush. For the nanofilled resin, the smoothest surface was obtained with POP + felt discs with diamond paste or silicon carbide brush.

*Conclusion:* The surface roughness of a composite resin depends on its composition and finishing and polishing technique used.



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## Impacto de um novo método de polimento na rugosidade e micromorfologia superficial de compósitos a base de partículas nanométricas e microhíbridas

*Palavras-chave:*
Materiais dentários
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RESUMO

*Objetivo:* Este trabalho objetivou avaliar os efeitos de diferentes técnicas de acabamento e polimento, incluindo uma nova técnica de polimento (escova de carbeto de silício), na rugosidade superficial e micromorfologia de resinas compostas nanoparticulada (Filtek Z350XT), e microhíbrida (Filtek Z250).

*Métodos:* Trinta e cinco amostras de cada resina composta foram confeccionadas e, aleatoriamente, distribuídas entre os seguintes métodos de acabamento/polimento ($n$ = 5 por grupo): nenhum (controle), discos Sof-Lex Pop-On (POP), Praxis TDV (PRA), POP + discos de feltro com pasta diamantada, POP + escova de carbeto de silício, PRA + discos de feltro com pasta diamantada e PRA + escova de carbeto de silício. A média de rugosidade (Ra), em micrômetro, foi averiguada utilizando-se um perfilômetro 3D. Imagens foram também obtidas por meio de microscopia eletrônica de varredura (MEV) e analisadas descritivamente. Os testes de análise de variância (ANOVA) – dois critérios, e de Tukey ($p < 0,05$) foram empregados para avaliar os efeitos do tipo de resina, do método de acabamento/polimento, bem como a interação entre ambos.

*Resultados:* Para a resina composta microhíbrida, a superfície mais lisa foi obtida utilizando-se POP/PRA associado à escova de carbeto de silício. Para a resina composta nanoparticulada, a superfície mais lisa foi gerada após uso do POP associado ao disco de feltro com pasta diamantada ou à escova de carbeto de silício.

*Conclusão:* A rugosidade superficial de uma resina composta depende de sua composição e do método de acabamento/polimento utilizado.



## Introduction

With the application of nanotechnology to dental composites, nanocomposites have been proposed as restorative materials.[1] Nanofilled dental composites were introduced in the market with the goal of combining strength and smoothness in a single product that offers reduced polymerization shrinkage and improved mechanical and esthetic characteristics.[2]

However, the presence of irregularities on restoration surfaces can influence esthetics, allows for biofilm retention and discoloration, and contributes to secondary caries.[3] A high surface roughness can compromise the physical properties of composites and contributes to the wear of restorations.[4–6] In this context, the use of finishing and polishing techniques for composite resins is necessary. Highly polished, smooth restorations have demonstrated several advantages, including esthetic properties and restoration longevity.[7]

Various finishing and polishing systems have been introduced in the market. They must be tested in combination with different composite resin types, as differences in composition may affect the final result of surface smoothness. With the evolution of composite resins and finishing and polishing materials, more studies are necessary to determine the best indications of their use to achieve restoration longevity. The effectiveness of the silicon carbide brush system for final polishing in producing smooth restoration surfaces should be evaluated. Thus, this *in vitro* study was conducted to evaluate and compare the surface roughness of two esthetic restorative materials subjected to different finishing (aluminum-oxide finishing discs) and polishing techniques (a classical instrument – felt discs – or a novel polishing instrument – carbide brush system). The hypothesis tested is that finishing techniques associated to the new polishing instrument carbide brush system would perform better for both composites.

## Materials and methods

Two composite resins were used in this study, one was nanofilled (Filtek Z350XT; 3M ESPE, St. Paul, MN, USA) and the other was a microhybrid resin (Filtek Z250; 3M ESPE). The chemical components of these composites are listed in Table 1. A single operator fabricated 35 circular specimens (8-mm diameter, 2-mm height) per composite. A Teflon custom mold was placed on a glass plate and filled with composite. The composite surface was then covered with a polyester strip and photoactivated for 20 s with a Coltolux light-emitting diode (1264 mW/cm$^2$ irradiance; Coltène/Whaledent, Altstatten, Switzerland). The specimens were removed from the mold and stored in plastic containers containing distilled water at 37 °C for 24 h before finishing/polishing procedures.

Two aluminum-oxide finishing discs (Sof-Lex Pop-On, 3M ESPE; and Praxis TDV, TDV Dental Ltda., Pomerode, Brazil) and two polishing materials (felt discs – TDV Dental Ltda., and