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Original Research Article

Effect of different finishing and polishing techniques on surface roughness of composite restorations

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ABSTRACT

Background: Esthetic demands have become increasingly important in modern dentistry, and the quality of the restoration finish particularly surface roughness plays a critical role in determining the long-term clinical success of resin-based composite restorations. The purpose of the study is to evaluate the effect of different finishing and polishing techniques on the surface roughness of composite restorations.
Methods: This cross-sectional study at the Department of Science of Dental, Shaheed Suhrawardy Medical College, Dhaka, Bangladesh (June 2023 to May 2024) included 100 participants receiving composite restorations, randomly assigned to Mylar strip, diamond burs, Sof-Lex discs, or multi-step polishing; surface roughness (Ra) was measured and analyzed using ANOVA and Tukey's test ($p<0.05$).
Results: Among 100 participants (mean age 28.5±6.0 years; 48 males, 52 females), surface roughness differed significantly across finishing techniques ($p<0.001$). Mylar strip produced the smoothest surfaces (0.08±0.02 µm), diamond burs the roughest (0.62±0.15 µm), and Sof-Lex discs (0.18±0.04 µm) and multi-step polishing (0.22±0.05 µm) were intermediate. Post-hoc tests confirmed significant differences between most pairs, except between Sof-Lex and multi-step (-0.04 µm, $p=0.120$).
Conclusions: The type and sequence of finishing and polishing techniques significantly affect the surface smoothness of composite restorations, with Mylar producing the smoothest and diamond burs the roughest surfaces.

Keywords: Composite restorations, Finishing techniques, Surface roughness

INTRODUCTION

Esthetic demands have become increasingly important in modern dentistry, and the long-term durability of a restoration remains a primary indicator of its clinical success.[1] Resin-based composites (RBCs) are currently among the most commonly used direct restorative materials due to their favorable esthetic and mechanical characteristics, clinical versatility, conservative nature, reparability, and reliable overall performance.[2-6] Within the field of aesthetic dentistry, resin composites are especially preferred for the direct restoration of anterior teeth, as they adequately fulfill the requirements of tooth preservation, esthetic integration, and medium- to long-term durability.[7,8] Characteristics such as the quality of the

restoration finish, surface roughness, surface integrity, and the inherent physicochemical properties of the material play a crucial role in influencing plaque accumulation, periodontal health, and the development of recurrent caries, ultimately affecting the overall clinical performance of restorative materials.[9]

The surface quality of resin composite restorations is widely recognized as a critical factor in determining their success within the oral environment. Surface roughness of resin-based composites has long been regarded as a parameter of significant clinical relevance.[10] Increased surface roughness contributes to greater plaque retention on composite surfaces, which in turn impacts both the esthetic appearance and the longevity of the restoration.[11,12] Restorations that are inadequately finished or polished are more susceptible to surface wear and plaque accumulation, increasing the risk of extrinsic staining, secondary caries, and gingival inflammation.[13] Therefore, appropriate finishing and polishing procedures are essential to maintain esthetics and enhance the long-term survival of resin-based restorations.[10]

A wide range of techniques has been proposed for finishing and polishing composite resin restorations, with the polyester (Mylar) strip traditionally regarded as one of the most effective methods for achieving smooth surfaces.[14] Various instruments are currently available for finishing and polishing, including carbide burs, diamond instruments, abrasive-impregnated rubber cups and points, abrasive disks, abrasive strips, and polishing pastes. Evidence indicates that multi-step finishing and polishing systems generally produce smoother surfaces on composite materials compared with simplified or diamond-containing systems.[15] Previous investigations have also demonstrated that surface roughness values of flowable and injectable resin composites vary following finishing and polishing procedures, with the Sof-Lex finishing and polishing disk system yielding lower Ra values than several alternative systems.[16] Despite these findings, there remains no universally ideal material or technique capable of consistently producing the smoothest possible surfaces on resin composites, particularly in anatomically complex areas such as posterior teeth.

Despite the availability of multiple finishing and polishing techniques and the evidence supporting their influence on the surface quality of resin composite restorations, existing literature presents variable and sometimes inconsistent findings regarding the degree of surface smoothness achieved by different systems. Many studies are laboratory-based, focus on limited techniques, or evaluate specific composite formulations, which restricts the direct translation of their results to routine clinical practice. Furthermore, comparative clinical data assessing commonly used finishing and polishing techniques under standardized conditions remain limited, particularly within different clinical settings and patient populations. Therefore, further evaluation is required to clarify the relative effectiveness of these techniques in producing optimal surface smoothness in composite restorations. The purpose of the study is to evaluate the effect of different finishing and polishing techniques on the surface roughness of composite restorations. This study aimed to evaluate the effect of different finishing and polishing techniques on the surface roughness of composite restorations.

METHODS

This cross-sectional study was conducted at the Department of Science of Dental, Shaheed Suhrawardy Medical College, Dhaka, Bangladesh, from June 2023 to May 2024. A total of 100 participants requiring composite restorations were included, selected based on specific inclusion criteria. The study aimed to evaluate the effects of different finishing and polishing techniques on the surface roughness of composite restorations.

Participants were randomly assigned to one of four finishing and polishing techniques: Group I: Mylar strip (control), Group II: Diamond burs (fine-grit), Group III: Sof-Lex disc system (sequential), and Group IV: Multi-step polishing system using rubber cups/points. Each technique was applied to the composite restorations following standardized protocols to ensure uniformity across samples.

Inclusion criteria

Adults aged 18-50 years requiring anterior or posterior composite restorations, healthy individuals with no systemic conditions affecting oral health, participants with sound adjacent teeth and proper occlusion, willingness to provide informed consent and comply with study procedures.

Exclusion criteria

Patients with severe periodontal disease or extensive tooth decay, patients with teeth with existing restorations, fractures, or structural defects, patients with history of bruxism or parafunctional habits affecting tooth surfaces, patients with allergies to dental materials used in the study, patients with medically compromised patients or those on medications affecting salivary flow or oral health were excluded.

After enrollment and allocation, all participants received standardized composite restorations prepared according to manufacturer instructions. Each group underwent its assigned finishing and polishing technique as described above. Surface roughness (Ra, µm) of each restoration was measured using a calibrated profilometer under controlled conditions. All procedures were performed by a single trained operator to minimize variability. Collected data were recorded, and mean Ra values for each group were calculated. Statistical analysis was performed using one-way ANOVA to compare surface roughness among the four groups, followed by post-hoc Tukey's test for

pairwise comparisons, with a significance threshold set at $p<0.05$.

RESULTS

Table 1 summarizes the demographic distribution of the study participants across the four groups. The mean age of participants ranged from 27.9±5.8 to 29.1±6.0 years, with comparable age distribution among all groups. Gender distribution was nearly equal across the study groups.

Table 2 shows the allocation of patients to the four finishing and polishing techniques evaluated in the study. Each group consisted of 25 patients, representing 25.0% of the total sample size.

Table 1: Demographic characteristics of the study participants (n=100).

Variable	Group I (n=25)	Group II (n=25)	Group III (n=25)	Group IV (n=25)	Total (n=100)
Mean age±SD (years)	28.4±6.2	27.9±5.8	29.1±6.0	28.7±5.9	28.5±6.0
Gender (Male/Female)	12/13	11/14	13/12	12/13	48/52

Table 2: Distribution of patients according to finishing and polishing technique (n=100).

Group	Finishing/polishing technique	Number of Patients (n)	Percentage (%)
I	Mylar strip (control)	25	25.0
II	Diamond burs (fine-grit)	25	25.0
III	Sof-Lex disc system (sequential)	25	25.0
IV	Multi-step polishing system (rubber cups/points)	25	25.0
Total		100	100.0

Table 3 presents the mean surface roughness (Ra, µm) values of composite restorations following different finishing and polishing techniques. A statistically significant difference in surface roughness was observed among the groups (one-way ANOVA, $p<0.001$). The Mylar strip group demonstrated the lowest mean surface roughness, while the diamond bur group showed the highest values.

Table 4 shows the results of post-hoc pairwise comparisons between groups to identify specific differences in surface roughness. Statistically significant differences were observed between most group pairs ($p<0.001$), except between the Sof-Lex disc system and the multi-step polishing system, where no significant difference was noted ($p=0.120$).

Table 3: Comparison of mean surface roughness values among different finishing and polishing techniques.

Group	Technique used	Mean surface roughness (Ra µm)	Standard deviation (SD)	P value (ANOVA)
I	Mylar strip (control)	0.08	±0.02	<0.001
II	Diamond burs (fine-grit)	0.62	±0.15	
III	Sof-Lex discs (sequential)	0.18	±0.04	
IV	Multi-step polishing system	0.22	±0.05	

Table 4: Pairwise comparison of surface roughness between study groups (Post-hoc Tukey Test).

Comparison	Mean Difference (Ra µm)	P value
Group I (Mylar) vs Group II (Diamond burs)	-0.54	<0.001
Group I (Mylar) vs Group III (Sof-Lex)	-0.1	<0.001
Group I (Mylar) vs Group IV (Multi-step)	-0.14	<0.001
Group II (Diamond burs) vs Group III (Sof-Lex)	0.44	<0.001
Group II (Diamond burs) vs Group IV (Multi-step)	0.4	<0.001
Group III (Sof-Lex) vs Group IV (Multi-step)	-0.04	0.120

DISCUSSION

Surface smoothness of composite restorations is a critical factor influencing both the esthetic and functional success of restorative procedures. Surface roughness, commonly expressed as Ra, affects plaque accumulation, staining, wear resistance, and the overall longevity of restorations. The findings of this study demonstrate that different finishing and polishing techniques produce significantly different surface roughness values, with Mylar strips

yielding the smoothest surfaces and diamond burs the roughest. These results highlight the clinical importance of selecting an appropriate finishing and polishing method to optimize restoration surface quality, minimize plaque retention, and enhance long-term performance.

The demographic characteristics of the study participants were comparable across all four groups, with a total of 100 participants evenly distributed into each group (n=25). The mean age of the participants ranged from 27.9±5.8 to 29.1±6.0 years, with an overall mean age of 28.5±6.0 years, indicating a relatively young adult population. Gender distribution was nearly balanced, with 48 males and 52 females across the study population, and each group contained a similar proportion of males and females. This uniform distribution in both age and gender among the groups suggests baseline homogeneity, minimizing the potential influence of demographic variables on the study outcomes and ensuring that observed differences in surface roughness can be attributed primarily to the finishing and polishing techniques rather than participant characteristics.

The study included an equal number of participants assigned to four different finishing and polishing techniques: Mylar strip (control), diamond burs, Sof Lex disc system, and multi-step polishing system, allowing a balanced comparison of their effects on surface roughness. This design is consistent with previous investigations, such as Daud et al, which reported that surfaces formed under a Mylar strip were the smoothest, while diamond burs produced significantly higher roughness compared to other polished groups.[17] By employing a comparable multi-group approach, the present study ensured homogeneity across groups and enabled a clear assessment of how each finishing and polishing technique influenced the surface characteristics of composite restorations.

The results of this study demonstrate significant differences in surface roughness among the various finishing and polishing techniques evaluated. Surfaces formed under the Mylar strip (control) exhibited the smoothest finish, while those treated with diamond burs showed the highest roughness values. The Sof Lex disc system and multi-step polishing approach produced intermediate Ra values, indicating effective polishing while maintaining surface integrity. These findings are consistent with previous studies: Chour et al reported that Mylar control surfaces were the smoothest and Sof Lex discs produced lower roughness than diamond tips and other polishing methods; Altınışık et al observed that Ra values following Sof Lex polishing were comparable to Mylar control, whereas other systems resulted in higher roughness; and Barbosa et al found that diamond burs generally caused the greatest roughness while Sof Lex discs yielded some of the lowest Ra values among polished groups.[18-20] Collectively, these studies support the present observation that both the type of polishing system and its application sequence have a marked impact on the surface texture of composite restorations.

The post-hoc pairwise comparisons in this study further demonstrated statistically significant differences in surface roughness among most finishing and polishing techniques. Surfaces formed under the Mylar strip (control) exhibited the smoothest finish, while those treated with diamond burs showed the highest roughness values. The Sof Lex disc system and multi-step polishing system produced intermediate Ra values, reflecting effective polishing while maintaining surface integrity. These results are consistent with previous studies: Chour et al reported significant differences between unpolished control, Sof Lex discs, diamond tips, and Astrobrush groups, with Sof Lex discs yielding lower Ra values than diamond burs, aligning with the observed differences between diamond burs and Sof Lex in the present study.[18] Similarly, Avsar et al. found that Mylar control and aluminum oxide disc groups exhibited the lowest surface roughness, whereas diamond burs resulted in significantly higher Ra values, supporting the trend seen in the current comparisons.[21] Collectively, these findings emphasize that both the type of polishing system and the sequence of application significantly influence the surface texture of composite restorations, with diamond burs producing the roughest surfaces and Mylar control producing the smoothest, while disc- and multi-step polishing systems achieve intermediate outcomes.

This study had some limitations. It was a single-center study. A larger, multi-center study is needed to reach more definitive conclusions. The sample was not randomly selected. The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

CONCLUSION

Smooth and well-polished surfaces of composite restorations are essential for their longevity, esthetics, and resistance to plaque accumulation. This study demonstrates that different finishing and polishing techniques significantly influence surface roughness. The Mylar strip produced the smoothest surfaces, while diamond burs resulted in the roughest. Sof-Lex discs and the multi-step polishing system provided intermediate results with comparable outcomes. These findings highlight that the choice and sequence of polishing methods play a critical role in achieving optimal surface quality and clinical performance of composite restorations.

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