COMPARATIVE EVALUATION OF WET AND DRY FINISHING AND POLISHING ON SURFACE ROUGHNESS OF COMPOSITE RESINS- AN IN- VITRO STUDY.

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Abstract

Aim- The aim of the present study was to evaluate and compare the effects of dry and wet finishing and polishing on surface roughness of two commercially available composite resins.

Methodology- Sixty samples each of commercially available microhybrid and nanohybrid resin composite were prepared using a customised stainless steel split mould measuring (10 mm x 1mm) The prepared samples were divided into 3 groups based on finishing and polishing procedure as: Group (A): Wet finishing and polishing, Group (B): Dry finishing and polishing and Group (C): Control (No finishing and polishing). After preparation, all the samples were incubated at 37^0C for 7 days. The samples were tested for surface roughness using a Profilometer.

Result- The results of surface roughness were analysed using analysis of variance (ANOVA) followed by Post Hoc Tukey's Test. The highest surface roughness was recorded for nanohybrid composite in Group B2 (Dry) (0.244 ± 0.081) followed by Group A2 (Wet) (0.234 ± 0.131) and Group C2 (Control) (0.030 ± 0.014). For microhybrid composite, Group B1 (Dry) (0.130 ± 0.033) showed highest surface roughness followed by Group A1 (Wet) (0.088 ± 0.050) and Group C1 (Control) (0.040 ± 0.073). The surface roughness of nanohybrid composite was higher than microhybrid composite resins. Statistically significant differences were observed in surface roughness in finishing and polishing under different conditions.

Conclusion- Within the limitations of the present study, it was concluded that dry finishing and polishing increases the surface roughness of microhybrid and nanohybrid composite.

Keywords- Microhybrid composite, Nanohybrid composite, Wet polishing, Dry polishing, Surface Roughness, Microhardness, Profilometer, Vickers hardness tester.

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INTRODUCTION

Composite resin is most commonly used restorative material, due to their unique combination of aesthetic; favorable physical; mechanical properties; simplification of the adhesive procedures and conservation of tooth structure.[1]

Dental restorations must be finished and polished properly, which is a critical clinical step for the aesthetics and durability of the restorations. Finishing is the process of contouring, shaping and smoothing the restoration to give it anatomical contours and to remove excess material at the interface. After finishing, polishing is done when the surface gains a high luster and enamel-like texture.[2]

Restoration's residual surface roughness may have an impact on the preservation of dental biofilm, which may lead to subsequent caries, gingival irritation and superficial discoloration. Therefore, polishing methods support the durability of the restoration and dental health. The polishing capability of resin-based composites is influenced by the filler loading, type, size and morphology as well as by the polishing method and equipment. Because of this, the finishing and polishing procedures are both technique and material dependent. The restoration's form, color, and gloss are produced by the finishing and polishing process and these factors determine the composite resin's aesthetic appeal.[3]

Finishing and polishing can be done in wet and dry conditions. In dry conditions it is done without wetting agents and in wet conditions it is done under water coolant.[4] Many authors prefer to finish and polish without any coolant since it allows better visualization of the restoration margin.[5]

Microhybrid composites are successfully used in the anterior and posterior teeth, due to their mechanical and physical characteristics whereas nanohybrid composites which are produced in recent years, have demonstrated clinical success due to their attractive appearance, durability and biocompatibility as well as physical characteristics like increased wear resistance and surface hardness because they are composed of nanoparticles.[4]

Over the years, many different polishing and finishing procedures and tools have been used, from multi-step systems employing fine and superfine diamond burs, abrasive discs. There is more work to be done in finding the best finishing and polishing condition for composites. Therefore, it is necessary to compare and evaluate the surface roughness properties among commonly used composite restorative resins when finished and polished under dry and wet conditions.[6]

This study was aimed to evaluate and compare the effects of dry and wet finishing and polishing on surface roughness of two commercially available composite resins.

MATERIALS AND METHOD

This in-vitro study was conducted at the Department of Conservative Dentistry and Endodontics, Darshan Dental College and Hospital, Udaipur, Rajasthan and Samruddhi Engineering, Pune, Maharashtra to evaluate and compare the effect of wet and dry finishing and polishing on surface roughness of composite resins.

Sixty-disc shaped samples, each of microhybrid (Filtek P60, 3M ESPE) and nanohybrid (Filtek Z250, 3M ESPE) were prepared using a customized stainless steel split mould measuring (10) mm x (1) mm according to ISO 4049 standard.

For each composite the prepared sample were divided into 3 groups as **Group A (Wet group) (n=40)**: Wet finishing and polishing of composite. **Group A1(n=20)**: Wet finishing and polishing of microhybrid composite. **Group A2(n=20)**: Wet finishing and polishing of nanohybrid composite. **Group B (Dry group) (n=40)**: Dry finishing and polishing of composite.
Group B1(n=20): Dry finishing and polishing of microhybrid composite.
Group B2(n=20): Dry finishing and polishing nanohybrid composite.
Group C (Control group) (n=40): No finishing and polishing of composite. **Group C1(n=20)**: No finishing and polishing of microhybrid composite. **Group C2(n=20)**: No finishing and polishing of nanohybrid composite.

While preparing the samples all the materials were manipulated as per manufacturer's recommendation.

Manipulation of material for each group was done as follows-

Filtek P60 and Filtek Z250 XT were directly dispensed from syringe into the mould for sample preparation and packed using composite filing instrument. For preparing each sample, the base of the mould was placed on glass slab covered with mylar strip. The test material was then carefully packed into the mould to avoid voids and was covered again with mylar strip on its top surface. A glass slide was placed on top of the mould and gentle pressure was applied to extrude excess material. The samples were light- cured for 20 seconds according to the manufacturer's instructions using LED light curing unit. Immediately after curing, the samples were removed from the mould and finishing and polishing of each sample was done according to the assigned group:

Group A- Wet finishing and polishing.
The samples were finished and polished after 24 hours under water coolant provided by a syringe with flow of 20cc/minute, using Shofu Super Snap Rainbow Technique Kit with discs form coarse to superfine, with a slow-speed handpiece at 5000 rpm for 20 sec in each step with planar movement.
Group B- Dry finishing and polishing.
The samples were finished and polished after 24 hours without water coolant, using Shofu Super Snap Rainbow Technique Kit with discs form coarse to superfine, with a slow-speed handpiece at 5000 rpm for 20 sec in each step with planar movement. After using each disc, the samples were rinsed for 10 seconds to remove debris and dried for 5 seconds.
Group C- This group received no polishing and finishing after removal of mylar strip and served as control group.
After preparation, all the samples were rinsed and dried. Then the samples were incubated at 37^{0}C for seven days prior to measurement of surface roughness.

Mechanical Testing
Surface Roughness Evaluation:
After 24 hours of specimen fabrication and incubation, the surface roughness was measured by a profilometer (TR 200 Surface Roughness Tester; TIME Group, Pittsburgh, PA, USA) with a tracing length of 2mm and 0.25mm cut-off. Tracing was performed in triplicate for each sample and the mean value was calculated.

RESULTS
The data obtained was tabulated and analyzed using SPSS software V.21.0, p value was set for $p < 0.05$ and any value more than this was considered to be non-significant. Effect of wet and dry finishing and polishing on surface roughness of microhybrid and nanohybrid composite was analyzed using Two-way ANOVA followed by Post hoc Tukey's test.

There was a statistically significant difference observed for Surface roughness between the groups of microhybrid composite finished under wet, dry and control condition. Similarly, statistically significant difference was observed for Surface roughness between the groups of nanohybrid composite finished under wet, dry and control condition.

For microhybrid composite, maximum Surface roughness was observed with Group B (Dry) (0.130 ± 0.033) followed with Group A (Wet) (0.088 ± 0.050) and least was observed with Group C (Control) (0.040 ± 0.073), indicating that the microhybrid composite had highest Surface roughness when finishing and polishing was done in dry condition.

Microhybrid composite exhibited least Surface roughness when finishing and polishing was not done.

For nanohybrid composite, maximum Surface roughness was observed with Group B (Dry) (0.244 ± 0.081) followed with Group A (Wet) (0.234 ± 0.131) and least was observed with Group C (Control) (0.030 ± 0.014), indicating that nanohybrid composite had highest Surface roughness when finishing and polishing was done in dry condition. Nanohybrid composite exhibited least Surface roughness when finishing and polishing was not done.

Table 1 : Two-way ANOVA for Surface roughness of microhybrid composite

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.081	2	0.041	13.602	0.000
Within Groups	0.171	57	0.003		
Total	0.252	59			

Table 2 : Two-way ANOVA for Surface roughness of nanohybrid composite

	Sum of	df	Mean	F	Sig.

	Squares		Square		
Between Groups	0.582	2	0.291	36.538	0.000
Within Groups	0.454	57	0.008		
Total	1.036	59			

Table 3 : Descriptive statistics of Surface roughness of microhybrid composites

Group	N	Mean	Standard deviation
Group A- Wet	**20**	**0.088**	**0.050**
Group B- Dry	**20**	**0.130**	**0.033**
Group C- Control	**20**	**0.040**	**0.073**

Table 4 : Descriptive statistics of Surface roughness of nanohybrid composites

Group	N	Mean	Standard deviation
Group A- Wet	**20**	**0.234**	**0.131**
Group B- Dry	**20**	**0.244**	**0.081**
Group C- Control	**20**	**0.030**	**0.014**

DISCUSSION

Composite resins are complex, tooth-colored filling materials that offer excellent esthetic potential and acceptable longevity without the need for extensive tooth preparation, allowing minimally invasive preparation or sometimes no preparation while still providing high aesthetic potential and appropriate lifespan. In recent years, the use of dental composite resins has become a routine clinical practice due to increased patient aesthetic expectations, convenience of use, advancements in material composition, cost and conservation.[7]

It was suggested that rough surfaces in the oral cavity accumulate 2–3 times more bacteria compared with smooth surfaces. Additionally, surfaces with greater roughness may cause abrasion of opposing teeth as a result of friction in occlusal contacts. Therefore, finishing is performed to achieve the contours suitable for the restoration, to eliminate overflows and obtain a smooth surface. Polishing is the final step to confer enamel-like surface features to the teeth such as gloss and slipperiness.[8]

Polishability of resin-based composites relies on the filler particle size and morphology, the filler loading, the type of filler and on the polishing method and instruments. Therefore, the finishing and polishing procedures are both affected by the technique and are material sensitive. [9]

Finishing and polishing can be done in wet or dry conditions. In dry conditions it is done without irrigation or lubricant and in wet conditions it is done under water coolant.[4]

Many authors prefer to finish and polish without any coolant since it allows better visualization of the restoration margin. However, dry finishing and polishing results in increased heat generation because of friction and thus, reduces the surface damage to the body and margins of the restoration.[4] Clinicians should finish the restoration in an environment in which margins are discernible and where minimal heat is generated. thus, wet finishing should be preferred.[10]

The surface roughness (Ra) refers to fine irregularities in the surface texture that usually result from the action of the production process or material's characteristics and is measured in micro meters (μm). A profilometer was used to evaluate the surface roughness of the tested materials. [11]

Therefore, in the present study the surface roughness of composite resins was evaluated after finishing and polishing under dry and wet conditions.

The results of this study showed that the highest surface roughness for micro-hybrid composite was exhibited by Group B (Dry) (0.130 ± 0.03), followed by Group A (Wet) (0.088 ± 0.05). Whereas Group C (Control) (0.040 ± 0.07) showed least values. The results indicated a statistically significant difference was seen for surface roughness of microhybrid composite between all groups i.e., wet, dry and control groups. The nano-hybrid composite showed highest surface roughness was exhibited by Group B(Dry) (0.244 ± 0.081), followed by Group A (Wet) (0.234 ± 0.131). The least values were seen for the Group C (Control) (0.030 ± 0.014). The surface roughness of nanohybrid composite resin was higher than microhybrid composite resins. Statistically significant difference was seen between Group C (Control) when compared with Group A (Wet) and Group B (Dry) for surface roughness of nanohybrid composite. There was no statistically significant difference seen between Group A (Wet) and Group B (Dry) for surface roughness of nanohybrid composite.

The surface finish obtained by the mylar strip was used as a control group in our study, although this surface finish is perfectly smooth, it is resin-polymer rich and may contain some voids. Therefore, removal of the outermost resin by finishing is essential to produce a relatively standard and stable surface.[6] The surface roughness of the composite increased after finishing and polishing irrespective of the method used. This can be attributed to the fact that finishing and polishing removes the matrix between the filler particles and results in filler particles sticking out of the composite surface which in turn increases the surface roughness.[12] More detrimental effect was seen in dry finishing and polishing which might be because composite surface roughness may increase because the abrasive particles separated from the polishing tool may be embedded into the composite surface. Moreover, accumulation of separated particles on the surface of polishing tool can decrease its efficiency in smoothing the surface.[4]

The heat generated during dry finishing and polishing can degrade the filler/matrix bond and result in separation of filler particles from the matrix and subsequently increase the surface roughness.[4]

CONCLUSION

Within the limitations of present in-vitro study, it was concluded that dry finishing and polishing increases the surface roughness of microhybrid and nanohybrid composite.

CONFLICTS OF INTEREST

Authors declare that there are no conflicts of interest.

REFERENCES

1. Kaminedi RR, Penumatsa NV, Priya T, Baroudi K. The influence of finishing/ polishing time and cooling system on surface roughness and microhardness of two different types of composite resin restorations. Journal of International Society of Preventive & Community Dentistry 2014;4(2):99-104.
2. Jung M, Sehr K, Klimek J. Surface texture of four nanofilled and one hybrid composite after finishing. Operative Dentistry 2007;32(1):45-52.
3. Ehrmann E, Medioni E, Brulat-Bouchard N. Finishing and polishing effects of multiblade burs on the surface texture of 5 resin composites: microhardness and roughness testing. Restorative Dentistry and Endodontics 2018;44(1):1-12.
4. Nasoohi N, Hoorizad M, Tabatabaei SF. Effects of Wet and Dry Finishing and Polishing on Surface Roughness and Microhardness of Composite Resins Journal of Dentistry 2017;14(2):69-75.
5. Vishwanath S, Kadandale S, kumar Kumarappan S, Ramachandran A, Unni-krishnan M, manjiri Nagesh H. Finishing and Polishing of Composite Restoration: Assessment of Knowledge, Attitude and Practice Among Various Dental Professionals in India. Cureus 2022;14(1):1-16.
6. Afifi RH, Aly SM. Effect of Wet and Dry Finishing and Polishing on Surface Roughness and Microhardness of Bulkfill Resin Composites. Egyptian Dental Journal 2019; 65 (1):747-754.
7. Lavnya D, Divya B, Mantena SR, Madhu Varma K, Bheemalingeswara Rao D, Chandrappa V. Recent Advances in Dental Composites: An Overview. International Journal of Dental Material 2019;1(2): 48-54.
8. The art and science of abrasive finishing and polishing in restorative dentistry 1998 Dental Clinics of North America 1998;42(4):613-627.
9. Yazici AR, Tuncer D, Antonson S, Onen A, Kilinc E. Effects of delayed finishing/ polishing on surface roughness, hardness and gloss of tooth-coloured restorative materials. European Journal of Dentistry 2010;4(1):50-56.
10. Reddy VR, Jaiswal S, Chandrashekar B, Chandra A, Priyanka M. Finishing and polishing of composite's–A review. IP Indian Journal of Conservative and Endodontics 2021;6(1):7-10.
11. Lins FC, Ferreira RC, Silveira RR, Pereira CN, Moreira AN, Magalhães CS. Surface

roughness, microhardness, and microleakage of a silorane-based composite resin after immediate or delayed finishing/polishing. International Journal of Dentistry 2016;6(1):7-10.

12. Rodrigues-Junior SA, Chemin P, Piaia PP, Ferracane JL. Surface Roughness and Gloss of Actual Composites as Polished with Different Polishing Systems. Operative Dentistry 2015;40(4):418-429.