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"*In Vitro* Evaluation of the Effect of Three Different Finishing and Polishing Systems on Surface Roughness of Various Composite Resins"

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Abstract:
Background: *The use of resin composites has significantly expanded in clinical practice over recent years because of the increasing esthetic demands and advancement in composite technology. The introduction of nanoparticle-filled composites with improved mechanical, physical, and optical properties and clinical performance made possible the use of such materials for both the anterior and posterior restorations. Improper finishing and polishing of composite resins always present a problem to the dental practitioner. Advances in composite resin materials and the instruments used for finishing and polishing have revolutionized the art of aesthetic dentistry. This study utilizes the surface roughness of composite resin as a quality of finishing and polishing achieved by various finishing and polishing systems.*
Materials and methods: *120 specimens were fabricated from Filtek Z 350 (n=40), Ceram x mono (n=40), Tetric n ceram (n=40) composite which was further divided into four subgroups according to the finishing and polishing protocol subgroup a - SuperSnap Rainbow system (n=10), subgroup b – Astropol system (n=10), subgroup c – Enhance (n=10), subgroup d - Mylar strip (n=10). The average surface roughness (Ra) of each specimen was measured three times and the mean Ra values were determined using a surface profilometer. Data were analyzed using one-way and two-way ANOVA. $p \leq 0.05$ was statistically significant in all tests.*
Results: *The profilometric evaluation showed that the smoothest surfaces were obtained with Mylar strip for all the composite resins when compared with all three finishing and polishing systems. After the Mylar strip, the Supersnap system showed better polishing efficiency with the smallest Ra values. This was followed by Astropol finishing and polishing system and lastly by Enhance finishing and polishing system. Among the composites, Tetric N Ceram showed the highest polishability followed by Ceram X Mono and Filtek Z 350 when subjected to three different finishing and polishing systems.*
Conclusion: *Although, this study produced mixed results, the surface roughness values (Ra) were within acceptable ranges for all three finishing and polishing systems and the composite resin. Surface roughness of composite resin depends on the composition, number of steps, and flexibility of the finishing and polishing system employed.*
Keywords: *Surface roughness, Profilometer, Nanocomposites, finishing and polishing systems.*

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I. Introduction

It's a challenge for every Dentist to replicate the appearance of teeth to mimic their closest sense and form. The demand for aesthetic restorations has increased substantially in recent years. Resin Composite and Glass Ionomer cement are commonly available tooth-colored restorative materials[1]. Resin composite materials are available with a variety of filler types that affect their handling characteristics and physical properties. Resin materials have progressed from Macrofills to Microfills and from hybrids to Microhybrids, and newer materials such as Nanofilled and Nanoceramic composites have been introduced[2]. The esthetic value of a composite restoration is dependent on the finishing and polishing of the surface of the restoration. The surface roughness of the restoration is determined by the mechanical properties of the resin composites as well as the flexibility, hardness and grit size of the polishing material[3,4,5]. A smooth surface has always been the prime objective of composite restorations not only for esthetic consideration but also for oral health[6]. An increase in surface roughness results in an increase in plaque accumulation, thereby increasing the risk of both caries and periodontal inflammation. Plaque retention can be hindered by the marginal finish of a restoration, surface roughness, and surface integrity, as well as the physicochemical properties of the material itself. The threshold surface roughness for bacterial retention is 0.2 µm, below which no further reduction in bacterial accumulation could be expected[7]. An increase in surface roughness above this threshold roughness however resulted in a simultaneous increase in plaque accumulation, thereby increasing the risk of both caries and periodontal inflammation[7,8]. Therefore, maintaining the smooth surface of restoration is of utmost importance for its success. A variety of instruments are commonly used for finishing and polishing composite resins: carbide finishing burs, diamond finishing burs, rubber cups and points, discs, abrasive strips, and polishing pastes[6,7]. In recent years, efforts have been made to analyze the suitability of numerous systems available for the finishing and polishing of various composites. To date, a paucity of information is available on how to finish and polish these novel resin composites. Hence, the aim of this study is to evaluate the efficiency of finishing and polishing systems on the surface roughness of various newer composite resins available in the market.

II. Material And Methods

This study was conducted in the Department of Conservative Dentistry and Endodontics, Geetanjali Dental and Research Institute, Udaipur, Rajasthan. A total 120 specimens of nanocomposites and three different finishing and polishing systems were evaluated in the present study. The surface roughness (Ra) value was calculated using a mechanical digital profilometer in the Department of Mechanical Engineering, Geetanjali Institute of Technology, Udaipur, Rajasthan.

Study design: An experimental study

Place of study: Department of Conservative Dentistry and Endodontics, Geetanjali Dental and Research Institute, Udaipur, Rajasthan.

Duration of the study: 1.5 Year

Sampling method:

Total no. of specimen: 120

The samples were equally divided into 3 groups (n = 40 samples per group):

- Group I (n=40): Ceram X Mono (Nanoceramic)
- Group II (n=40): Tetric N Ceram (Nanohybrid)
- Group III (n=40): Filtek Z350 XT (Nanocomposite)

3 groups were further divided into 4 subgroups (n = 10 samples per each sub groups):

- Subgroup a (n=10): Super-Snap Rainbow Finishing and Polishing Kit
- Subgroup b (n=10): Astropol Finishing and Polishing Kit
- Subgroup c (n=10): Enhance Finishing & polishing kit
- Subgroup d (n=10): control group against mylar strip

Inclusion criteria:

- Homogenously cured composite specimens.

Exclusion criteria:

- Specimens with visible cracks on its surface.

Procedure methodology:

Preparation of specimens

Forty disk-shaped specimens were prepared for each type of composite resin from a total of 120 specimens. Each material was inserted into a plastic mould and confined between two opposing Mylar strips. A microscopic glass slide (1 mm thick) was placed on the mould, and constant pressure was applied to extrude the excess material. The composite resins were polymerized for 40 seconds with a light-curing unit. The guide of the light curing unit was placed perpendicular to the specimen surface at a distance of 1 mm. Immediately after the light curing and setting cycle, specimens were removed from the mould and immersed in distilled water at room temperature for 24 hours before the finishing and polishing procedures.

Finishing and Polishing Procedure

Slow speed handpiece was used for all the finishing and polishing systems. The handpiece was used with a constantly moving repetitive stroking action to prevent heat buildup and the formation of grooves. There was a conscious effort to standardize the stroke, downward force and polishing time for all the instruments used. Finishing and polishing was done as per the manufacturer's instructions in sub-group a, Sub-group b and Sub-group c of each group. Sub-group d (Mylar strip) is a control group that was not subjected to any finishing and polishing systems.

Profiling procedure

The polished composite resin specimens were washed, allowed to dry, and kept in 100% humidity for 24 hours before measuring the average surface roughness values using a mechanical digital Profilometer (Mitutoyo SJ-400 U.S.A). This device essentially consists of a stylus attached to a long lever arm, which is traced along the surface and records the up-and-down movement of the stylus. It also allows the quantification of the surface roughness by calculating average surface roughness (Ra) values, which is the arithmetic average height of the roughness component irregularities from the mean line measured within the sampling length. The higher this value, the rougher the surface. Three profilometric measurements were accomplished on each specimen and then averaged to obtain the surface roughness of that specimen.

Statistical analysis

Data was analyzed using statistical software – SPSS Version 21.0 to calculate descriptive data and ANOVA test with post hoc Tukey test and unpaired t-test were applied for the analysis of data. All statistical testing was performed at significance level P-value less than 0.05.

III. Results

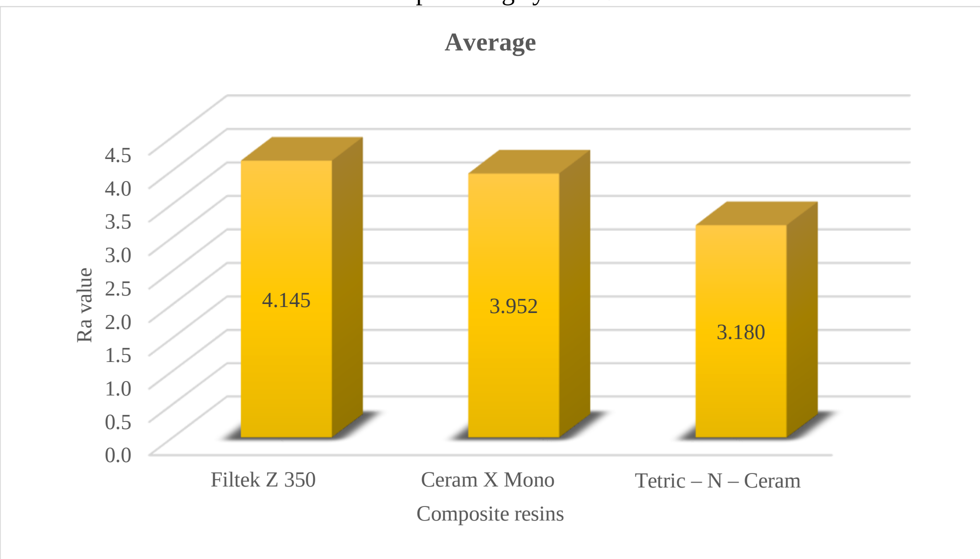
The data obtained in this study was subjected to One-Way ANOVA, and Tukey's HSD test which showed statistical difference in mean surface roughness among the composite resins when finished and polished using Astropol, Enhance and Super Snap finishing and polishing systems. In this study three different types of nanocomposite resins were finished and polished with three different finishing and polishing systems and results show Tetric N Ceram gave superior polishability compared with Ceram X mono and Filtek Z 350. Among the finishing and polishing systems Super Snap system showed better surface finish when compared with the Astropol and Enhance system for all composite resins.

Table 1: Mean surface roughness and standard deviation of finished and polished composite resins.

COMPOSITE RESINS	NO. OF SPECIMENS	MEAN	STANDARD DEVIATION
FILTEK Z 350	40	4.145	0.523
CERAM X MONO	40	3.952	0.391
TETRIC N CERAM	40	3.180	0.324

Table 1 shows the comparison of Mean surface roughness and standard deviation of composite specimens i.e, Filtek z 350, Ceram X mono, Tetric N Ceram when subjected to Mylar strip and three different finishing and polishing systems i.e, Astropol, Enhance, Supersnap. It was found that the mean surface roughness was least among Tetric N Ceram, Ceram X Mono, and Filtek Z 350 respectively.

Graph 1: Average of three different composite resins when finished and polished with three different finishing and polishing systems.



Graph 1 shows the highest polishability among Tetric N Ceram followed by Ceram X Mono and Filtek Z 350 Respectively.

Table 2: Mean surface roughness and standard deviation of Filtek Z 350 Composite specimens when subjected to different finishing and polishing systems.

FINISHING AND POLISHING SYSTEMS	NO. OF SPECIMENS	MEAN	SD
ASTROPOL	10	4.087	0.395
ENHANCE	10	4.742	0.518
SUPERSNAP	10	3.655	0.127
MYLAR STRIP	10	4.095	0.281

Table 2 shows the comparison of mean surface roughness and standard deviation when Filtek Z 350 composite specimens were subjected to Mylar strip, Astropol, Enhance, Supersnap finishing and polishing systems. Supersnap finishing and polishing system showed the least mean surface roughness followed by Astropol, mylar strip and Enhance respectively.

Table 3: Mean surface roughness and standard deviation of Ceram X Mono Composite specimens when subjected to different finishing and polishing systems.

FINISHING AND POLISHING SYSTEMS	NO. OF SPECIMENS	MEAN	SD
ASTROPOL	10	4.036	0.305
ENHANCE	10	4.189	0.202
SUPERSNAP	10	4.024	0.384
MYLAR STRIP	10	3.561	0.367

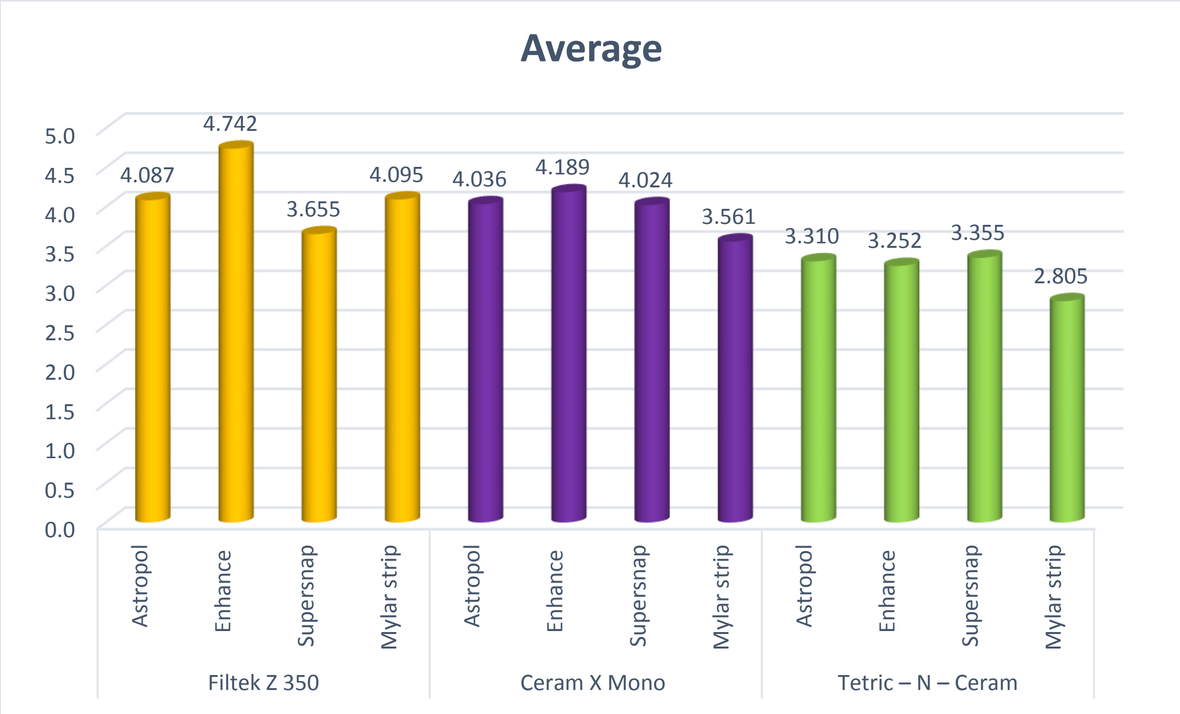
Table 3 shows the comparison of mean surface roughness and standard deviation when Ceram X Mono composite specimens were subjected to Mylar strip, Astropol, Enhance, Supersnap finishing and polishing systems. Mylar strip showed the least mean surface roughness followed by Supersnap, Astropol and Enhance respectively.

Table 4: Mean surface roughness and standard deviation of Tetric N Ceram Composite specimens when subjected to different finishing and polishing systems.

FINISHING AND POLISHING SYSTEMS	NO. OF SPECIMENS	MEAN	SD
ASTROPOL	10	3.310	0.280
ENHANCE	10	3.252	0.224
SUPERSNAP	10	3.355	0.245
MYLAR STRIP	10	2.805	0.225

Table 4 shows the comparison of mean surface roughness and standard deviation when Tetric N Ceram composite specimens were subjected to Mylar strip, Astropol, Enhance, Supersnap finishing and polishing systems. Mylar strip showed the least mean surface roughness followed by Enhance, Astropol and Supersnap respectively.

Graph 2: Comparative assessment of mean value of different composite resins when finished and polished with different finishing and polishing systems.



Graph 2 shows the highest polishability for Tetric N Ceram followed by Ceram X Mono and Filtek Z 350 respectively when subjected to different finishing and polishing systems i.e Astropol, Enhance, Supersnap and Mylar strip.

Table 5: One way Analysis of Variance (ANOVA) for significance between groups and within groups for different composite resins.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20.848	2	10.424	58.856	0.000
Within Groups	20.722	117	0.177		
Total	41.570	119			

Table 5 shows relation between three different composite resin groups (One way ANOVA) when subjected to different finishing and polishing systems. It was found that there was highly significant difference in the mean surface roughness among the composite resins. (p= 0.000).
The significance limit was set at ***P* value less than 0.05** for all tests.

Table 6: Comparative assessment between the groups (Tukey HSD)

Groups			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
	Filtek Z 350 (Group I)	Ceram X Mono	0.192	0.094	0.000	-0.031	0.416
		Tetric – N – Ceram	.96450*	0.094	0.000	0.741	1.188
	Ceram X Mono (Group II)	Filtek Z 350	-0.192	0.094	0.000	-0.416	0.031
		Tetric – N – Ceram	.77227*	0.094	0.000	0.549	0.996

Tetric – N – Ceram (Group III)	Filtek Z 350	-.96450*	0.094	0.000	-1.188	-0.741
	Ceram X Mono	-.77227*	0.094	0.000	-0.996	-0.549

The significance limit was set at ***P* value less than 0.05** for all tests.
Table 6 shows Tukey HSD tests indicates that there was highly significant difference in the surface roughness when

- Group I was compared with Group II and Group III.
- Group II was compared with Group I and Group III.
- Group III was compared with Group I and Group II.

Table 7: One-way Analysis of Variance (ANOVA) for significance between groups and within groups for different finishing and polishing systems.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	**5.225**	**3**	**1.742**	**5.558**	**0.001**
Within Groups	**36.346**	**116**	**0.313**		
Total	**41.570**	**119**			

Table 7 shows relation between different finishing and polishing systems in three different composite resin groups (One way ANOVA). It was found that there was highly significant difference in the mean surface roughness among all groups of the composite resins, when they were subjected to Astropol, Enhance, Supersnap and Mylar strip (p= 0.001)

- The significance limit was set at ***P* value less than 0.05** for all tests.

Table 8: Comparative assessment between the Sub-groups (Tukey HSD)

Sub Group		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	**Upper Bound**
Astropol	Enhance	-0.250	0.145	**0.314**	-0.627	0.127
	Supersnap	0.133	0.145	**0.795**	-0.244	0.510
	Mylar strip	0.324	0.145	**0.119**	-0.053	0.700
Enhance	Astropol	0.250	0.145	**0.314**	-0.127	0.627
	Supersnap	.38263*	0.145	**0.045**	0.006	0.759
	Mylar strip	.57353*	0.145	**0.001**	0.197	0.950
Supersnap	Astropol	-0.133	0.145	**0.795**	-0.510	0.244
	Enhance	-.38263*	0.145	**0.045**	-0.759	-0.006
	Mylar strip	0.191	0.145	**0.552**	-0.186	0.568

- The significance limit was set at ***P* value less than 0.05** for all tests.

Table 8 shows:

- When Astropol was compared with Enhance, Supersnap and Mylar strip no statistically significant difference was found.
- When Enhance was compared with Astropol, Supersnap and Mylar strip statistically significant difference was found with SuperSnap, highly significant difference was found with Mylar strip. No statistically significant difference was found with Astropol.
- When Supersnap was compared with Astropol, Enhance and Mylar strip statistically significant difference was found Enhance. No statistically significant difference was found with Astropol and Mylar strip.

IV. Discussion

To attain optimum aesthetics, it is imperative that restorative materials should duplicate the appearance of a natural tooth. The appearance of the restoration is majorly governed by the degree of surface gloss, which in turn is based on the amount of light reflected from the restoration. There is a direct relation between the surface roughness, the degree of light reflected, and the final gloss of the restoration. The more the surface roughness, the more the amount of light reflected, thus resulting in a decreased gloss[9].

Resin composites have become a choice of restorative material because of their unique combination of aesthetics, bondability, availability of versatile materials, and conservation of tooth structure. The resin matrix and filler particles of resin composites have different levels of hardness that cause variations in polishing efficiency. This variability can lead to differences in surface roughness[10].

The application of nanotechnology to resin composites has been one of the most significant advances in recent years. Nanotechnology is based on the production of functional materials and structures in the range of 1 to 100 nanometers using various physical and chemical methods. Nanocomposites have superior finishing and polishing ability, shade matching, flexural strength, and hardness than conventional composites[8].

The finishing procedure plays a vital role in long-term oral hygiene performance. The effectiveness of finishing/polishing procedures on the composite surface is an important goal to be achieved in the restorative process. Aesthetic restoration can be imperceptible only if its surface closely resembles the enamel surface[9].

Various finishing and polishing techniques have been proposed and analyzed over time; many studies have shown that the smoothest surface is obtained by directly contacting the material with a polyester matrix during the curing phase. However, due to the anatomical complexity of the tooth, this method is not always feasible. Other finishing and polishing methods include the use of aluminium oxide finishing discs, fine diamond finishing burs, carbide finishing burs, resin polishing points, and polishing pastes[11].

In literature, many studies have been conducted to evaluate the effect of different finishing and polishing systems on microfilled and hybrid composite resins. However, there is limited information about the polishability obtained when nanofilled composite resins were used.

The composite resins tested in this study consist of features of nanotechnology with high filler load. Ceram X Mono is an advanced Nano-ceramic composite resin with organically modified ceramic nano-particles and nanofillers combined with conventional glass fillers of particle size ~1 μm. It is based on the novel "SphereTec Filler Technology". Filtek Z 350 is a nanocomposite containing zirconia-silica particles with 5 - 20 nm fillers and 0.6-1.4 μm nanoclusters. Tetric N Ceram composite is referred to as nanohybrids with nano-optimized filler technology.

In the present study the nano-filled, Tetric N Ceram, showed superior polishability than the other nanocomposite resins with all three finishing and polishing systems. This may be due to the fact that it contains both nanofillers and nanohybrids and is considered to be a true "Nanofill" composite. During finishing and polishing, the nano-sized filler particles are worn away whereas nanoclusters are not plucked out from the resin matrix. Subsequently, the surface will have fewer flaws and better polish retention[9].

In the current study, Ceram X mono showed a significantly smoother surface than Filtek Z 350 with all three finishing and polishing systems. This is contributed to the fact that in addition to the synthesis of nanosized filler particles, nanotechnology is believed to have a beneficial effect on the stable chemical integration of such particles within the composite matrix. This is believed to have contributed to the low wear rates of nanoparticle composites[12]. A surface composed of nanoparticles is less likely to undergo particle loss when subjected to surface alteration caused by contact with abrasive polishing instruments. Another point that might be attributed to good surface quality is the fact that nanotechnology enables obtaining high filler loading[13].

In the present study, Filtek Z 350 composite showed the roughest surface when subjected to Supersnap followed by Astropol, and Enhance finishing and polishing systems. This may be due to the presence of spherical silica and zirconia particles with Adaptive Response Technology (ART) – elements of the filler system that actually have two components. First, the zirconia and silica nanoparticles are in an arrangement that imparts special optical properties as claimed by the manufacturer. The second component of the ART filler system is a rheological modifier, which, if left undisturbed, acts as a stabilizing network, increasing the apparent viscosity of the material and preventing material creep, also known as "slump" [14].

The efficiency of surface finishing and polishing procedures is critical for any restoration. These procedures are frequently performed following the placement of direct composite resin restorations because they reduce the retention of plaque and stains, as well as other issues caused by the exposure of rough surfaces to the oral environment, and are necessary to improve the mechanical properties of composite resin surfaces[15].

To minimize the clinical time, the technology for two-step and single-step finishing and polishing systems has developed over the past few years and these systems seem to be as effective as multistep systems for finishing and polishing composite resins. Multiple steps finishing and polishing systems use small and finer particles in each step to get rid of scratches from the previous polishing step until a highly polished and lustrous surface is obtained. Grit size plays an important role in single-step finishing and polishing systems as it may leave scratches on the surface of composite resin[16].

In clinical practice, it is preferred to polymerize composite resins against Mylar strips to produce the smoothest composite surfaces with the highest gloss. Composite resins that have been polymerized with a clear matrix on the surface, on the other hand, will leave a resin-rich surface layer that is easily abraded in the oral environment, revealing the unpolished, rough, and inorganic filler material. Polishing is thus necessary to prevent wear and discoloration on the resin-rich surface[17].

In the present study, Astropol, Enhance, and Supersnap finishing and polishing systems were selected for evaluation of the surface roughness of different types of nanofilled composite resins.

The results obtained by Fruits and others[18] comparing different polishing motions on restorative materials showed that for all possible combinations of materials and abrasive grits, the planar motion achieved the lowest average roughness values. On the basis of this information, in the present study, the finishing and polishing systems were tested using a planar motion.

A rotary motion (circular), a planar motion and a reciprocating motion can be employed to polish the surface of resin composite. In rotary (diamonds and cylindrical stones); the axis of rotation of the abrasive device is parallel to the surface being smoothened. The planar motion is a rotational movement with axis of rotation of the abrasive device perpendicular to the surface being smoothened (abrasive discs)[18]. When a finishing strip is pulled back and forth across the surface, the reciprocating motion is used.

The specimens were finished after 24 hours in this present study. This is in accordance with the study done by Yalcin et al. and Lopes et al., who suggested that final finishing should always be delayed for at least 24 hours when composites are used. If finishing is conducted immediately after composite placement, the material might be more readily subject to plastic deformation due to the heat generated during the finishing and polishing procedure[16].

The most commonly used parameter to describe surface roughness is Ra. Surface roughness measurements in dentistry are usually carried out with the aid of a profilometer. The surface roughness of the restoration will appear optically smooth when the surface Ra value is smaller than 0.1 µ[15].

The results of the present study showed that Supersnap finishing and polishing system produced smoother surfaces followed by Astropol system. This result is supported by Barbosa *et al*.[19], who observed smoother surfaces by Super-Snap system, suggesting a better ability of Super-Snap discs to remove the scratches left by diamond burs.

Furthermore, the smoother surface obtained through the Supersnap finishing and polishing system may be due to the aluminium oxide discs, which provide adequate surface smoothness as these discs do not displace the composite fillers. The fillers in nanocomposite are so small that their stiffness is reduced and oxide discs are best recommended because their malleability promotes a homogenous abrasion of the fillers and the resin matrix[20].

In this study, Astropol finishing and polishing system produced a rougher surface when compared with Supersnap system. This result may be due to the coarser abrasive particles in the Astropol system than in Supersnap system. On the other hand, Sapra et al[21], discovered that the smoothest surface was recorded with the Astropol system for some of the tested groups. This discrepancy can be attributed to differences in the tested materials or sample preparation techniques. Also, the polishing cups in the Astropol system seemed to cause displacement of filler particles and also grind into the surface causing a rougher surface. This result is in accordance with the study done by Setcos et al[22].

In the present study, the highest Ra value was recorded for groups finished and polished with Enhance system. This might be assigned to the increased number of steps used and the time spent during finishing and polishing procedures with multi-step systems which promote an even reduction of filler particles and organic matrix phases of composite resin. In this regard, Sudha et al[23], found that for nanohybrid composite resin (Tetric N-Ceram), diamond (Enhance) abrasives gave a surface finish rougher than that produced by aluminium oxide (Super-snap) discs. In addition, Schmitt et al[24], stated that the multiple-step polishing procedure produced lower surface roughness values than the one-step polishing system (Enhance) for two nanohybrid composite resins.

Most of the previous studies, including the present study, have been performed on flat composite discs. However, in clinical situations, composite is placed in complex morphologies rather than flat surfaces which may greatly influence the result of the finishing and polishing procedure. Other factors like periodontal health, overall health, food and chewing habits, alcohol and acidic solution exposure may also affect polish retention. The surface finish may also be altered by bacterial biodegradation.

The result of the current study should be interpreted with caution and may not entirely apply to finishing and polishing systems and techniques, and composite resins available in the market. In the present study, surface roughness measurements were used for relative comparisons only and it was inferred that undoubtedly multi-step finishing and polishing systems provide the most superior finish but single-step systems, based on the ease of application and well-acceptable values of surface finish can be a preferable method of finishing and polishing composite restorations as well.

V. Conclusion

Although, this study produced mixed results, but the surface roughness values (Ra) were within acceptable ranges for all three systems and both the composite resin. The Mylar strip provides the smoothest surface when compared with all three finishing and polishing systems. After the Mylar strip, the Supersnap system showed better polishing efficiency with the smallest Ra values. This was followed by Astropol finishing and polishing system and lastly by Enhance finishing and polishing system. For composite resins, Tetric n ceram produced a smoother surface than Ceram x mono with all the finishing and polishing systems.

References

[1]. Yap AU, Yap SH, Teo CK, Ng JJ. Comparison of surface finish of new aesthetic restorative material. Oper Dent 2004 Jan 1;29(1):100-4.

[2]. Uctash MB, Ansu HD, Omurlu H, Eliguzeloglu E, Ozcan S, Ergun G. The Effect of Different Finishing and Polishing Systems on the Surface Roughness of Different Composite Restorative Materials. Jour Contemp Dent Prac 2007; (8)2:089-09.

[3]. Watanabe T, Miyazaki M, Takamizawa T, Kurokawa H, Rikuta A. Influence of polishing duration on surface roughness of resin composites. J. Oral Sci. 2005; 47:21

[4]. Turssi PC, Ferracane LJ, Serra MC. Abrasive wear of resin composites as related to finishing and polishing procedures. Dent Mater 2005; 21:641-648

[5]. Watanabe T, Miyazaki M, Moore BK. Influence of polishing instruments on the surface texture of resin composites. Quintessence Int 2006; 37:61-67.

[6]. Marigo L, Rizzi M, Torre LG. 3-D surface profile Analysis: Different finishing methods for resin composites. Oper Dent 2001; 26:562-568.

[7]. Bollen CML, Lambrechts P, Quirynen M. Comparison of surface roughness of oral hard materials to the threshold surface roughness for bacterial plaque retention: A review of the literature. Dent Mater 1997; 13:258-269.

[8]. Erguci Z, Turkun LS. Surface roughness of novel resin composites polished with One-Step systems. Oper Dent 2007; 32(2): 185-192.

[9]. Hassan AM, Nabih SM, Mossa HM, Baroudi K. The effect of three polishing systems on surface roughness of flowable, microhybrid, and packable resin composites. Journal of International Society of Preventive & Community Dentistry 2015 May;5(3):242.

[10]. 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. International Journal of Applied and Basic Medical Research 2019 Jul;9(3):154.

[11]. Colombo M, Vialba L, Beltrami R, Federico R, Chiesa M, Poggio C. Effect of different finishing/polishing procedures on surface roughness of Ormocer-based and different resin composites. Dental research journal 2018 Nov;15(6):404.

[12]. Atabek D, Sillelioglu H, Ölmez A. The efficiency of a new polishing material: nanotechnology liquid polish. Operative dentistry 2010 May;35(3):362-9.

[13]. Jung M, Eichelberger K, Klimek J. Surface geometry of four nanofiller and one hybrid composite after one-step and multiple-step polishing. Operative Dentistry 2007 Jul;32(4):347-55.

[14]. Kerr Restorative-Harmonize Universal Composite; 2020. Available from: http://www.kerrdental.com.

[15]. Abzal MS, Rathakrishnan M, Prakash V, Vivekanandhan P, Subbiya A, Sukumaran VG. Evaluation of surface roughness of three different composite resins with three different polishing systems. Journal of conservative dentistry: JCD 2016 Mar;19(2):171.

[16]. 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.

[17]. Ece ED, Cogulu D, Attin T. The effect of finishing and polishing systems on surface roughness, microhardness and microleakage of a nanohybrid composite. Journal of International Dental and Medical Research 2012 Dec 1;5(3):155-60.

[18]. Fruits TJ, Miranda FJ, Coury TL. Effects of equivalent abrasive grit sizes utilizing differing polishing motions on selected restorative materials. Quintessence International 1996 Apr 1;27(4).

[19]. Barbosa SH, Zanata RL, Navarro MF, Nunes OB. Effect of different finishing and polishing techniques on the surface roughness of microfilled, hybrid and packable composite resins. Brazilian Dental Journal 2005;16:39-44.

[20]. Rai R, Gupta R. In vitro evaluation of the effect of two finishing and polishing systems on four esthetic restorative materials. J Conserv Dent 2013;16(6):564-567.

[21]. Sapra V, Taneja S, Kumar M. Surface geometry of various nanofiller composites using different polishing systems: A comparative study. J Conserv Dent 2013 Nov 1;16(6):559.

[22]. Setcos C J, Tarim B, Suzuki S. Surface finish produced on resin composite by new polishing system. Quint Int 1999; 30(3):169-173.

[23]. Sudha K, Hanisha RK, Seema RO,Laxmana RC, Leela NPT, Sravana LP. Effect of different polishing systems on the surface roughness of nano-hybrid composites: A profilometric study. Annals and Essences 2017; 9(4):1-4.

[24]. Schmitt VL, Nahsan FPS, Naufel FS Vaez SC, de Andrade CS, Baseggio W, Sinhoreti MAC, Puppin-Rontani RM. Polishing techniques effect on microhybrid, nanohybrid and nanofilled composites color and surface roughness stability. Biosci. J., Uberlândia 2016: 32(1): 262-271

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