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EVALUATION OF SURFACE AND INTERFACIAL ROUGHNESS OF NANO RESIN COMPOSITES USING DIFFERENT POLISHING SYSTEMS

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ABSTRACT

Objectives: This research evaluated the surface and interfacial roughness of three nano resin composites with different polishing techniques after thermocycling.

Materials and Method: Class-V cavities of dimension (4mm mesiodistally, 2mm occluso-gingivally and 2mm cavity depth) were prepared on buccal surfaces of 45 human premolars either restored utilizing Omnichroma (Tokuyama, Japan), Harmonize Universal (Kerr, USA) or Filtek Z350XT (3M Oral Care, USA) then either be left unpolished or polished using PoGo disc micro-polishers (Dentsply, USA) or Sof-Lex spiral wheels (3M ESPE, USA). A profilometer was utilized to measure the surface roughness (Ra) after thermocycling. Repeated measures ANOVA and Bonferroni's post-hoc tests were utilized for statistical analysis. The significant level was set at ($P \leq 0.05$).

Results: Harmonize Universal showed the statistically significantly highest mean Ra (0.645 µm) followed by Filtek Z350XT (0.594 µm). Omnichroma showed the statistically significantly lowest mean Ra (0.539 µm). Polyester strip showed the statistically significantly highest mean Ra (0.73 µm) followed by Sof-Lex spiral wheels (0.627 µm). PoGo disc micro-polishers showed the statistically significantly lowest mean Ra (0.422 µm). Composite surface showed statistically significantly lower mean Ra (0.222 µm) than interface (0.556 µm).

Conclusions: Omnichroma is a good choice material for the clinical use because it has better surface polishability after thermocycling compared to Harmonize Universal and Filtek Z350XT.

KEYWORDS: Nano Composites; Polishing systems; Roughness; Thermocycling

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INTRODUCTION

Since the introduction of nanotechnology, nanofilled and nanohybrid composites have become some of the most commonly used resin composites in dental practice (**Perdigão et al. 2021**). Single shade supra-nanofilled composites use only one shade that can be blended with every shade of VITA-classical, whereas group-shaded nanohybrid composites utilize less shades for a specific group of VITA-classical shades. On the other hand, multi-shade nanofilled composites, have been developed in multiple enamel, dentin, and body shades to mimic the visual characteristics of both enamel and dentin (**Al-Saudi et al. 2022**).

Surface roughness of contemporary composites remains an issue despite novel development in materials that improves their esthetic qualities. It is responsible for food retention, plaque accumulation, gingival inflammation, and color staining that result in decreasing the esthetic value of the dental restoration (**Yahya et al. 2020**).

Thus, composite finishing and polishing are important procedures in restorative dentistry. Finishing is the process of shaping a filling to achieve the appropriate tooth anatomy. However, polishing describes smoothness in addition to a reduction in scratches caused by finishing tools (**Abdurazaq and Al-Khafaji 2014**).

PoGo micro-polisher discs are newly introduced finishing and polishing system that allow finishing and polishing to be accomplished with a one tool in a short period (**Jaramillo-Cartagena et al. 2021).** Another polishing system is Sof-Lex spiral wheels, which are designed universally to enable finishing and polishing in any part of the tooth. They are made up of elastomeric wheels, which have been infused with powdered aluminum oxide that enable finishing and polishing in two steps (**Patel et al. 2016**).

Thermocycling testers can cause surface roughness by imitate temperature fluctuations inside the mouth cavity by transferring clinical settings through in-vitro investigations that mimic the oral environment, which provide useful information to manufacturers and researchers in the selection of restorative materials prior to their clinical use (**Fidan and Dereli 2022**).

Therefore, it‘s worthwhile to assess the surface and interfacial roughness of three nano resin composites using different polishing techniques after thermocycling.

MATERIALS AND METHODS

Three various kinds of nano resin composites were utilized in the current study (**Table 1**). Shade A2 was utilized if the resin composite was made in a several of shades (**Lemon et al. 2020**).

Three distinct techniques were used to polish three kinds of nano resin composites in the current research (**Table 2**).

Ethical Regulation:

The Research Ethics Committee (REC) of Faculty of Oral and Dental Medicine at Al-Minia University granted ethical approval for this study.

Sample Size Calculation:

Data from previous researches (**Babina et al. 2020**, **Babina et al. 2021**) were collected to determine the total number of specimens, which was 45 specimens utilizing an effect size (f) of 0.5 with a probability of (α-error = 0.05 and β-error = 0.8).

Teeth Collection:

From the oral surgery clinic, Faculty of Oral and Dental Medicine, Al-Minia University, 45 human premolars were extracted for orthodontic purposes. A written informed agreement was provided to each patient to utilize his/her removed teeth for scientific study.

TABLE (1) Brand names, filler loading, constitutions, and manufacturers of utilized nano resin composites employed in this research

Brand name/ Kind	Filler Loading	Constitution	Manufacturer (Batch No.)
Omnichroma (OC) Supra-nanofilled	79% by wt (68% by vol)	Filler type: Spherical supra-nano SiO_2-ZrO_2 (260 nm), composite fillers. Matrix: UDMA, TEGDMA	Tokuyama Dental, Tokyo, Japan (030E81)
Harmonize Universal (HU) Nanohybrid	81% by wt (64.5% by vol)	Filler type: Barium glass (0.4 μm), aggregated zirconia/silica cluster filler (2-3 μm) comprised of 20 nm spherical silica, and 5nm zirconia. Matrix: Bis-GMA, Bis-EMA, TEGDMA.	Kerr, MFG, Orange, CA, USA (9060553)
Filtek™ Z350XT Universal Restorative (FZ) Nanofilled	78.55% by wt (63.3% by vol)	Filler: Combination of a non- agglomerated/non-aggregated 20 nm silica filler, a non- agglomerated/non-aggregated 4-11 nm zirconia filler, and an aggregated zirconia/silica cluster filler (compromised of 20 nm silica and 4-11 nm zirconia particles. Matrix: Bis-GMA, UDMA, TEGDMA, PEGDMA, and Bis-EMA.	3M Oral Care, St. Paul, MN, USA (NEB2990)

UDMA: *Urethane-dimethacrylate,* ***TEGDMA:*** *Tri-ethylene-glycol-dimethacrylate,* ***Bis-GMA:*** *Bisphenol-A-glycol-dimethacrylate,* ***Bis-EMA:*** *Bisphenol-A-polyethylene-glycol-diether-dimethacrylate,* ***PEGDMA:*** *Polyethylene glycol dimethacrylate*

TABLE (2) Polishing systems, specifications, compositions, and manufacturers of utilized polishing systems employed in this research

Polishing system		Product Specifications	Composition	Manufacturer (Batch No.)
PoGo®	**Enhance® finishers**	Pre-mounted, disc finishers.	Polymerized urethane dimethacrylate resin, aluminum oxide, silicon dioxide (40 μm).	Dentsply Caulk, Milford, Delaware, USA (00098515)
	PoGo® micro-polishers	Pre-mounted, disc polishers.	Polymerized urethane dimethacrylate resin, fine diamond powder, silicon oxide (10-15 μm).	Dentsply Caulk, Milford, Delaware, USA (062023Y)
Sof-Lex™	**Sof-Lex™ extra-thin discs**	Medium-grit discs (dark orange) for contouring.	Aluminum oxide (diameter: 12.7 mm, grit: 40 μm).	3M ESPE, St. Paul, MN, USA (N906475)
	Sof-Lex™ spiral wheels	Fine grit (beige) pre-polishing spiral wheel.	Thermoplastic elastomer impregnated with aluminum oxide (diameter: 12.7 mm, grit: 24 μm).	3M ESPE, St. Paul, MN, USA (N514708)
		Superfine grit (white) for final polishing spiral wheel.	Thermoplastic elastomer impregnated with aluminum oxide (diameter: 12.7 mm, grit: 8 μm).	3M ESPE, St. Paul, MN, USA (N508796)

Teeth Selection:

The following were among the inclusion criteria: Age 18-26 years old who needed orthodontic treatment involving extraction of premolars with normal morphology while the following were among the exclusion criteria: Fluorosis, dental filling, fracture, crack-line, carious or non-carious lesions in the premolars (**Sugsompian et al. 2020**). Every tooth was scrutinized utilizing a stereomicroscope (Olympus, Tokyo, Japan) at (10x magnification). To exclude the possibility of any flaws (**ElTanany et al. 2022**).

The teeth were cleansed under running water immediately after atraumatic extraction to eliminate blood and mucus. After that, they were cleansed using an ultrasonic scaler to get rid of any remaining calculus and soft tissue. Before being used in the study, the extracted teeth were kept in a 0.5% Chloramine-T trihydrate solution for a week at room temperature to prevent bacterial overgrowth then stored in distilled water at 4°C in a refrigerator for two months, with weekly water changes to prevent dehydration (**Pisal et al. 2022**).

Specimens Grouping:

Forty-five prepared specimens were split into three major groups (C_1, C_2, and C_3) based on the kind of resin composite utilized in this research (n=15). (C_1: Omnichroma, C_2: Harmonize, and C_3: Filtek Z350XT). Every group was separated into three subgroups (P_0, P_1, and P_2) based on the type of polishing system used (n=5). Polishing was done using a polyester strip in group P_0 (control group). The PoGo discs were used to polish the composite surfaces in group P_1. Polishing was done in group P_2 utilizing the Sof-Lex spiral wheels.

Cavity Preparation:

To standardize the prepared Class-V cavities, a modified stainless steel metal band Tofflemire with a central window was employed (**Fig. 1-a**) (**Al-Saudi et al. 2021**), to be 4 mm ±0.5 mesiodistally and 2 mm occluso-gingivally ±0.5, while the cavity depth was 2 mm ±0.5 (**Fig. 1-b, 1-c & 1-d**) (**Babina et al. 2020**).

With a high-speed handpiece and a lot of coolant spray, Class-V cavities were created on the buccal aspects of extracted human premolars using a No. 330 carbide bur (Hager and Meisinger GmbH, Neuss, Germany) (**Ebaya et al. 2022**). No bevels were formed at any of the prepared cavity enamel edges (**Bajabaa et al. 2021**).

Cuts were made 0.5-1 mm coronal to the free gingiva, parallel to the cemento-enamel junction (CEJ) (**Dabhi et al. 2016**). The cavity dimensions were measured by a graded periodontal probe (Hu-friedy, Chicago, USA) (**Asafarlal 2017**) (**Fig. 1-b, 1-c & 1-d**). A new bur was utilized for every cavity to avoid dullness (**Bajabaa et al. 2021**).

Application of Adhesive Materials:

The enamel surfaces of the prepared cavities were selectively etched with 37% phosphoric acid gel for 15 sec, washed for 30 sec then lightly dried. The adhesive systems were then inserted into the created cavities following the directions provided by the manufacturer. With the exception of Tokuyama Universal Bond (Tokuyama Dental, Tokyo, Japan), which is chemically cured utilized in group C_1, all other universal adhesives (OptiBond Universal; Kerr, USA and Single Bond Universal; 3M Oral Care, MN, USA) were photopolymerized for 10 sec utilizing Elipar curing unit (3M ESPE, MN, USA) of wavelength (430-480nm) and light intensity (1200 mW/cm^2) that utilized in groups C_2 and C_3, respectively.

Restorative Procedures:

Following the etching and bonding procedures, the uncured resin composites were immediately put inside the created cavities in two increments to avoid composite sticking to the instrument (**Bajabaa et al.**

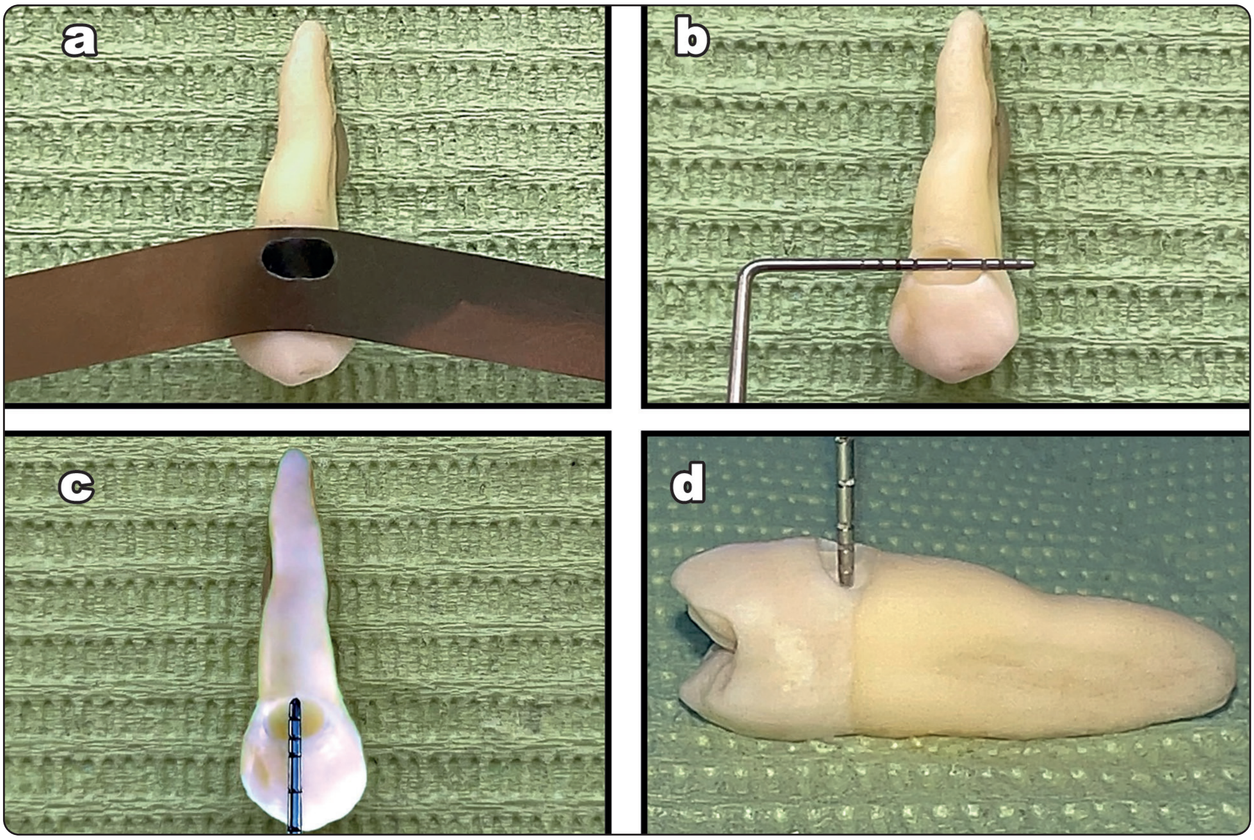

Fig. (1) Photograph showing procedures of cavity preparation; (a) Modified metal band (Tofflemire) with a central window, (b) width, (c) height, and (d) depth dimensions of Class-V cavity preparation

2021); the first increment was applied with a sterile gold-plated composite spatula, covering the entire incisal wall down to the gingivo-axial line angle then photo-cured for 10 sec. The second increment filled the remaining space in the created cavity. It was adapted using a modeling tool CompoRoller (Kerr, Orange, CA, USA) to enhance smoothness, eliminate voids, and extrude any extra material, coated with a clear polyester strip then photo-cured for 10 sec as per the manufacturer's directions. A digitally calibrated radiometer was used to measure the curing unit's light output every five exposures (**Gönülol et al. 2019**). The cured specimens were either be left unpolished or polished using either PoGo micro-polisher discs or Sof-Lex spiral polishing systems depending on their subgrouping.

Pogo Polishing System:

Prior to polishing with PoGo discs, the composite surfaces were gently dried finished with Enhance finishing discs for 15-20 sec utilizing a slow-speed micro-motor handpiece (Strong, South Korea) at 10,000-15,000 rpm to shape the composite surfaces in accordance with manufacturer instructions (**Jang et al. 2017**).

The composite surfaces were then polished with the one-step PoGo polishing system. Each composite specimen was therefore made using a single disc. For each specimen, the speed was set at 10,000–15,000 rpm for 30 sec while applying gentle intermittent pressure with a light buffing motion (**Ergücü and Türkün 2007**).

Sof-Lex Polishing System:

First, the specimens were shaped using a medium grit single use Sof-Lex extra thin disc, which was connected to an autoclavable Sof-Lex metal mandrel by a metal hub and rotated at 10,000–20,000 rpm for 15 sec without applying any water spray. The specimens were washed for 10 sec to eliminate any powdery materials, and then dried for 5 sec using water-air syringe (**Farzaneh et al. 2021**).

The beige Sof-Lex spiral wheel was utilized to remove scratches in the composite restorations developed during contouring. Then, the white Sof-Lex spiral wheel was used to final polish the composite restorations (**Kritzinger et al. 2017**). Both spiral wheels were applied to the surfaces of composite restoration under dry conditions at 10,000-20,000 rpm for 15 sec by using forward linear movements with no reverse direction (**Ibrahem et al. 2023**). All polished specimens were kept in distilled water at 37 °C for 24 h (**Lopes et al. 2018**).

Thermocycling Aging:

The thermocycling technique consisted of 10,000 cycles. Dwell times in each water bath were 30 sec, with a lag period of 15 sec. The lowest temperature was 5°C, while the highest was 55°C (**Bajabaa et al. 2021**).

Surface Roughness Measurements:

A profilometer (Mitutoyo, Japan, Surftest SJ-410) was utilized to measure the average surface roughness (Ra) with a cut-off value of 0.8 mm and a stylus speed of 0.1 mm/sec. Ten tracings were carried out in two sites: the surface of resin composite and the composite/enamel interface. Ra (μm) arithmetic mean values were calculated (**Babina et al. 2020**).

Statistical Analysis:

Repeated measures ANOVA test was utilized to examine the impact of the composite type, polishing system, site, and their interactions on the Ra of composite surface and composite/enamel interface. When the ANOVA test is significant, pair-wise comparisons were performed utilizing Bonferroni's post-hoc test. A significance level of $P < 0.05$ was established.

RESULTS

Effect of composite type regardless of polishing system and site:

Regardless of polishing system and site, Harmonize Universal composite displayed the statistically significantly greatest mean Ra (0.645 µm) followed by Filtek Z350 XT composite (0.594 µm) while Omnichroma composite displayed the statistically significantly least mean Ra (0.539 µm).

Effect of polishing system regardless of composite type and site:

Regardless of composite type and site, polyester strip displayed the statistically significantly greatest mean Ra (0.73 µm) followed by Sof-Lex spiral wheels (0.627 µm) while PoGo discs displayed the statistically significantly least mean Ra (0.422 µm).

Effect of site regardless of composite type and polishing system:

Regardless of composite type and polishing system, composite surface displayed statistically significantly lower mean Ra (0.222 µm) than composite/enamel interface (0.556 µm).

Effect of different interactions of variables on Ra:

Omnichroma composite showed the statistically significantly the least mean Ra among all tested composites whether using polyester strips, PoGo or Sof-Lex after aging at composite or interface sites.

Polyester strip displayed the statistically significantly the greatest mean Ra among all tested polishing systems whether using on Omnichroma, Harmonize Universal or Filtek Z350 XT after aging at composite or interface sites.

TABLE (3): The mean, standard deviation (SD) values and results of repeated measures ANOVA test for comparison between Ra (μm) of composite types with different interactions of variables

Polishing system	Site	Omnichroma		Harmonize Universal		Filtek Z350 XT		*P*-value	Effect size *(Partial eta squared)*
		Mean	SD	Mean	SD	Mean	SD		
Polyester strips	Composite	0.328^{C}	0.014	0.369^{A}	0.02	0.343^{B}	0.017	<0.001*	0.306
	Interface	1.275^{C}	0.016	1.374^{A}	0.021	1.333^{B}	0.012	<0.001*	0.442
PoGo	Composite	0.152^{C}	0.015	0.178^{A}	0.011	0.169^{B}	0.015	0.001*	0.151
	Interface	0.703^{C}	0.037	0.898^{A}	0.029	0.806^{B}	0.0278	<0.001*	0.753
Sof-Lex	Composite	0.266^{B}	0.017	0.287^{A}	0.011	0.277^{A}	0.017	0.013*	0.102
	Interface	1^{C}	0.037	1.207^{A}	0.028	1.11^{B}	0.032	<0.001*	0.773

TABLE (4): The mean, standard deviation (SD) values and results of repeated measures ANOVA test for comparison between Ra (μm) of polishing systems with different interactions of variables

Composite type	Site	Polyester strips		PoGo		Sof-Lex		*P*-value	Effect size *(Partial eta squared)*
		Mean	SD	Mean	SD	Mean	SD		
Omnichroma	Composite	0.328^{A}	0.014	0.152^{C}	0.015	0.266^{B}	0.017	<0.001*	0.890
	Interface	1.275^{A}	0.016	0.703^{C}	0.037	1^{B}	0.037	<0.001*	0.963
Harmonize Universal	Composite	0.369^{A}	0.02	0.178^{C}	0.011	0.287^{B}	0.011	<0.001*	0.903
	Interface	1.374^{A}	0.021	0.898^{C}	0.029	1.207^{B}	0.028	<0.001*	0.949
Filtek Z350 XT	Composite	0.343^{A}	0.017	0.169^{C}	0.015	0.277^{B}	0.017	<0.001*	0.887
	Interface	1.333^{A}	0.012	0.806^{C}	0.0278	1.11^{B}	0.032	<0.001*	0.957

TABLE (5): The mean, standard deviation (SD) values and results of repeated measures ANOVA test for comparison between Ra (μm) at composite surface and composite/enamel interface with different interactions of variables

Composite type	Polishing system	Composite		Interface		*P*-value	Effect size *(Partial eta squared)*
		Mean	SD	Mean	SD		
Omnichroma	Polyester strips	0.328	0.014	1.275	0.016	<0.001*	0.991
	PoGo	0.152	0.015	0.703	0.037	<0.001*	0.974
	Sof-Lex	0.266	0.017	1	0.037	<0.001*	0.985
Harmonize Universal	Polyester strips	0.369	0.02	1.374	0.021	<0.001*	0.992
	PoGo	0.178	0.011	0.898	0.029	<0.001*	0.985
	Sof-Lex	0.287	0.011	1.207	0.028	<0.001*	0.991
Filtek ZX350 XT	Polyester strips	0.343	0.017	1.333	0.012	<0.001*	0.992
	PoGo	0.169	0.015	0.806	0.0278	<0.001*	0.981
	Sof-Lex	0.277	0.017	1.11	0.032	<0.001*	0.989

DISCUSSION

Polishability is an essential characteristic of composites and surface parameters such as roughness is important in determining the clinical success of the restorations (**Paolone et al. 2020**).

In this in-vitro study, supra-nano composite (Omnichroma), nanohybrid composite (Harmonize Universal), and nanofilled composite (Filtek Z350 XT) were evaluated for composite surface and composite/enamel interface roughness using different polishing techniques (PoGo single step and Sof-Lex multiple steps) after thermocycling aging (10,000 cycles).

In the current investigation, undamaged non-carious Class-V cavities were created to reduce technique sensitivity, as they are suited for surface roughness evaluation due to their ease of preparation and restoration (**Bajabaa et al. 2021**). To prevent investigator variability, all fabrication, finishing, and polishing processes of specimens were completed by the same investigator (**Tavangar et al. 2018**).

In the present research, every specimen was exposed to 10,000 cycles between 5°C and 55°C with a dwell time of 30 sec, which is regarded as a suitable artificial aging test as it is similar to a year of clinical service (**Bajabaa et al. 2021, El-Rashidy et al. 2022**).

Although there is a lack of agreement in the dental literature on a threshold for unsatisfactory surface roughness, **Patel et al. (2016)** observed no variation in plaque buildup across the roughness average of 0.7-1.4 μm. Thus, in the current investigation, 1.4 μm was set as the clinically appropriate threshold level for surface roughness.

Harmonize composite displayed the significantly greatest mean Ra (0.645 μm) followed by Filtek Z350XT composite (0.594 μm) while Omnichroma composite displayed the significantly least mean Ra (0.539 μm) (**Table 3**). Their roughness values did not exceed the clinically acceptable 1.4 μm threshold. Thus, the first null hypothesis that, there would be no variation in surface roughness scores among supra-nanofilled, nanohybrid, and nanofilled resin composites was rejected. These findings could be allocated to variations in filler composition, size, and loading across all resin composites examined (**Madhyastha et al. 2017**, **Babina et al. 2020**).

These outcomes were in line with those of previous researches **Say et al. (2014)** and **Abo-Eldahab et al. (2022)** who demonstrated superior surface morphology of supra-nanofilled resin composites and correlated the surface roughness mean values after polishing with the mean filler size and amount of filler load of resin composites.

According to **Maesako et al. (2021)**, Omnichroma composite has a precise construction of homogeneous widely scattered spherical organic and inorganic fillers with the diameter of 260 nm. Its supra-nano fillers are consistently dispersed in a uniform density throughout the surrounding resin basis with the coupling process that closely joined them all that resulted in the lowest surface roughness.

Say et al. (2014) investigated the surface roughness and morphology of two supra-nanofilled, two micro-hybrid, and three nano-hybrid composites polished with Enhance/PoGo and Venus Supra, and discovered that, supra-nanofilled composites produced smoother surfaces than nano-hybrids. The presence of bigger, heterogeneous, and irregularly shaped glass filler in these materials leads fillers to either protrude from the surface layer during polishing or to get dislodged from the surface layer, leaving persistent surface imperfections and flaws.

However, **Patel et al. (2016)** reported contradictory outcomes, the Tetric N-Ceram, which is classed as a nanohybrid composite like Harmonize composite utilized in this study, has reduced surface roughness compared to Filtek Z350. The authors attribute the superior surface polish of Tetric N-Ceram to its lower filler hardness, which includes barium glass (1.25 Moh's) and ytterbium fluoride

(206 KHN) than Filtek Z350, which contains zirconia (1600 KHN) and silica (820 KHN).

This difference can be allocated to differences in the chemical structure of the resin composites employed; Harmonize Universal nanohybrid composite, which used in the current investigation, was constituted not only of barium glass like Tetric N-Ceram, but also zirconia and silica, which were not found in Tetric N-Ceram.

Polyester strip displayed the significantly greatest mean Ra (0.73 μm) followed by Sof-Lex spiral wheels (0.627 μm) while PoGo discs displayed the significantly least mean Ra (0.422 μm) (**Table 4**). Thus, the second null hypothesis that, there would be no difference in surface roughness between the one-step and multi-step polishing systems was rejected.

The PoGo exceptional polishing capabilities could be ascribed to its tougher diamond particles (7000 KHN) in comparison to aluminum oxide (2100 KHN) in the Sof-Lex polishing system **(Patel et al. 2016)**. The abrasive particles in polishing system required to be comparatively tougher than the fillers in resin composites to be efficient; otherwise, the polishing substance will just take away the resin matrix, keeping the filler particles sticking out of the surface (**Ergücü and Türkün 2007**).

Accordingly, it is thought that, the diamond used in PoGo is harder than the most of the filler particles in the restorative materials examined, promoting a smooth surface by evenly abrading both the filler particles and the matrix (**Patel et al. 2016**, **Daud et al. 2018**).

Conversely, **Nithya et al. (2020)** found that, Sof-Lex spiral wheels produced smoother surfaces than PoGo micro-polisher after polishing one nanofilled packable, one nanohybrid packable, one micro-hybrid packable, and two nanohybrid flowable resin composites. The discrepancy can be clarified by grinding the composite top surfaces utilizing 600-grit silicon carbide paper for 20 sec. Furthermore, specimens were created on a cylindrical mold (8 mm in diameter and 2 mm in height) rather than on extracted teeth in the current investigation.

Composite surface showed statistically significantly lower mean Ra (0.222 μm) than composite/enamel interface (0.556 μm) (**Table 5**). Hence, the third null hypothesis that, there would be no variation in surface roughness of the investigated surfaces: composite surface and composite/enamel interface was rejected.

This observation can be justified by the relative softness of enamel, which makes it more prone to abrasion from polishing techniques and uneven wear than the composite material. Also, thermal cycling may hasten hydrolysis and produce recurrent contraction-expansion stress, which have a major detrimental impact at the tooth/restoration interface (**Zanatta et al. 2017**).

Omnichroma composite showed the statistically significantly the least mean Ra among all tested resin composites whether using polyester strips, PoGo or Sof-Lex after aging at composite or interface sites (**Tables 3, 4 & 5**).

This observation generally accounts for filler technology in Omnichroma, in which structural coloring technology is added, which has similar primary constitution like traditional resin composites. However, there is a notable improvement in the siloxane bonding technique at the filler-base resin interface. It was stated that, the bonding among the organic filler and basic resin was particularly crucial. Stronger filler-base resin junctions prevent filler peeling caused by siloxane bond hydrolysis or dye penetration into filler drop-out areas. This reduces surface roughness after thermocycling by strengthening and shortening the distance between neighboring particles (**Maesako et al. 2021**).

Additionally, Omnichroma with more filler content absorbs less water (**Sensi et al. 2021**).

The resin matrix of the Omnichroma composites examined in the current study is predominantly composed of UDMA, which has increased flexibility and polymerization degree to create superior cross links than the Bis-GMA and TEGDMA monomers existing in the resin matrix of the Filtek Z350 XT and Harmonize Universal composites (**Arai et al. 2021**, **Sensi et al. 2021**).

Polyester strip displayed the statistically significantly the greatest mean Ra among all tested polishing systems whether using on Omnichroma, Harmonize Universal or Filtek Z350 XT after aging at composite or interface sites (**Tables 3, 4 & 5**).

These findings are consistent with those demonstrated by **Aytac et al. (2016)** and **El-Rashidy et al. (2023)** who discovered that, polyester strip has poor physical, mechanical, and biological properties, as well as leaving a resin-rich surface layer of lower hardness that is simply eroded inside the oral cavity, exposing inorganic filler materials and accelerating wear and staining. Therefore, polishing is necessary to eradicate the outermost resin creating more clinical reality in order to avoid wear and staining on the resin-rich surface.

CONCLUSIONS

Within the limitations of this investigation, the subsequent conclusions could be made:

The supra-nanofilled Omnichroma resin composite is an excellent material option for clinical application because it has better surface polishability after thermocycling than nanohybrid (Harmonize) and nanofilled (Filtek Z350 XT).

Regarding surface and interfacial roughness, the one-step PoGo micro-polisher yielded superior surface quality than the multiple steps Sof-Lex polishing system and polyester strip. The composite-enamel interface presented the higher surface roughness than composite surface.

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Conflict of interest

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