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RESEARCH ARTICLE

EFFECT OF TWO POLISHING SYSTEMS ON THE SURFACE ROUGHNESS OF DIFFERENT COMPOSITE RESTORATIVE MATERIALS

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ABSTRACT

This study was performed to determine the effect of two polishing system ,Aluminum oxide disk (opti-4dental AZ) and Silicon rubber bur (SJK dent) on the surface roughness of two color restorative materials (Microhybrid composite (Filtex Z 250 USA) & Nanofilled composite (Supereme XT). Sixty samples were prepared (A,B,C, Microhybrid) & (D,E,F, Nanofilled). Groups (A, D) with no surface treatment as a control groups, while (B,E) were polished by SJK dent system and(C, F) polished by Opti4 dental AZ system. Surface roughness of each samples were investigated by Digital Portable Tester (RP-100Instrutherm, pocket).Then the result were analysis by Mean value of each group, bar chart, and comparison between groups by using student t test. In relation to the tooth color materials used the result showed less surface roughness for nanofilled composite than that of Microhybrid composite in all groups, while it were less in roughness for both controlled groups than other treated groups, and although the comparison were non-significant in differences between Silicon rubber system and aluminum oxide system but it were less in surface roughness for Aluminum oxide than that of Silicon rubber. The result of this study give information that the Nanofilled composite is better than the Microhybrid composite in relation to the surface roughness, also the aluminum oxide polishing system give more acceptable smoothness than the Silicon rubber system.

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INTRODUCTION

Tooth-colored restorations using resin composites have been widely used in comparison with metallic restorations even for posterior teeth with relative success. Patients and dentists have consider resin composites as the choice material for aesthetic restorations because of their adequate strength, excellent initial aesthetics, moderate cost compared to ceramics, and adhesion to tooth structure. However, due to intrinsic properties of this type of material, they are prone to staining and wear (Rashel and solloe, 2003) (Tamayo *et al*., 2005) (Benicia *et al*., 2012). The final aesthetic appearance of any tooth colour restoration is dependent upon theabilities of the clinician in choosing the correct shades of composite resin to mimic the colour and appearance of the teeth, and shaping and contouring of the restoration (Nadeem *et al*., 2003) (Glazar,2009) (John *et al*., 2011). The similarity of resin restoration in appearance to the tooth and/or adjacent teeth also depends upon the proper finish and polish of the restorative to its highest lustre (Aline *et al*., 2014).

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Numbers of research have shown that the technique for polishing composite resins to their optimal smoothness and gloss is specific to the type of composite resin and the product (Nadeem *et al*., 2003) (Vera *et al*., 2011) (Aline *et al*., 2014).

A new generation of hybrid composite resin has been introduced. These materials have been categorized as Nanofilled, with filler particles with a diameter in the 0.005- to 0.1-µm range (Barbara *et al*., 2013) (Marina *et al*., 2014), The Nanofilled composites have physical properties equivalent to the original hybrid composite resins, good handling characteristics, but with greater polishability. These Nanofilled composites provide an excellent alternative to Microfilled composites because they can be polished to a toothlike translucency. For anterior restorations, both Microfilled and Nanofilled hybrid resins can be expected to provide good colour stability, resistance to stain, low wear, and good polishability (Vera *et al*., 2011) (Aline *et al*., 2014) (Marina *et al*., 2014).

The polishing procedure of the tooth colored restoration consist of making the surface glassy without changing its contour, To develop a high glass surface of composite, all scratches and rough area must be remove.

A series of progressive finer abrasive is used to produce a lustrous surface (Marina *et al*., 2014).

Final polish of the composite resin surface to its most lustrous finish can be accomplished using disks with the finest aluminium oxide abrasive. Using a disk will not only smooth the resin surface, but will also heat the surface, creating a highl lustre. This heating is sufficient to allow the polymer matrix to reach its glass transition temperature. This phenomenon gives the composite resin a glassy appearance (Laurie, 2011). Also, a composite resin can be polished with specialized composite resin polishing pastes that contain either very fine aluminium oxide abrasive particles or diamond particles. This is best accomplished with foam cups, felt-mounted disks, or fine goat-hair brushes. If the surface of the restoration is generally smooth, disks work well (Mariana *et al*., 2015).

This study used 2 different types of polishing systems to reach the lustrous surface of Microhybrid and Nanofilled composite restoration and the tested idea of this study is that composite resin with different filler types submitted to different types of polishing procedures produces different results of surface roughness.

MATERIALS AND METHODS

Samples Preparation

Sixty cylindrical specimens size (15 *3 mm) were prepared by using a plastic mold the internal mold filled with the composite in one increment. A mylar strip was placed on top of the uncured composite. A glass slide (1.1 mm thick) was applied on top of the Mylar stripand pressure applied to remove excess resin. The composite was light-cured according to the manufacturer's instructions, using an LED light-curingunit (Translux Blue - Heraeus Kulzer, South Bend) with a light intensity of 674mW/cm. The specimens were stored in distilled water at 37°C for 24 (Claudio *et al*., 2006).

Samples Grouping

Samples were divided into 6 groups

1-Group A: 10 samples of Microhybrid composite (Filtex Z 250 USA) consider as a control group without polishing just cover by Mayler strip during curing.

2- Group B : 10 samples of Microhybrid composite (Filtex Z-250 USA) polished by a new Aluminum oxide disk(opt-4dental AZ) for each sample.

3- Group C : 10 samples of Microhybrid composite (Filtex Z-250 USA) polished by a new Silicon rubber bur (SJK dent) for each sample.

4- Group D : 10 sample of Nanofilled composite (Supereme XT) consider as a control group without polishing just cover by Mayler strip during curing.

5-Group E : 10 samples of Nanofilled composite (Supereme XT) polished by a new Aluminum oxide disk(opt-4dental AZ) for each sample.

6- Group F: 10 samples of Nanofilled composite (Supereme XT) polished by a new Silicon rubber bur (SJK dent) for each sample.

Polishing Procedure

1- Groups (A&D), no polishing procedure will be done, just covered by mylar strip during curing, these 2 groups consider as control one (Mopper, 2011).

2- Groups (B &E), polished by using silicon burs(SJK dent) according to manufacture instruction using three steps technique:

*First step: Using white large coarse finishing bur to remove irregularities, recommended speed (15000 rpm,10 second) with contra angle hand piece. *Second step: Using pink mid-coarse polishing bur to get polished surface, recommended speed (15000 rpm, 10 second) with contra angle hand piece.

*Third step: Using blue fine bur to make surface gloss, Recommended speed (15000 rpm, 10 second), with contra angle hand piece.

3- Groups (C&F), polished by using aluminum oxide disk (opti4) according to manufacturing instruction using four steps technique:

4-

*First step: Using the coarse blue disk for finishing and removing irregularities, slow speed(1500rpm,10 seconds) with contra angle hand piece.
*Second step: Using the medium green disk for contouring, with slow speed(1500rpm,10 seconds) with contra angle hand piece.
*Third step: Using the fine yellow disk for smoothening surface, with slow speed (1500rpm,10 second) with contra angle hand piece.
*Fourth step: Using the very fine white disk for polishing and lustering the surface, with slow speed(1500rpm,10 seconds) with contra angle hand piece.

-The load applied on the sample was (400g) adjusted and standardize by using spring measuring balance fixed to the hand piece.
-New bur was used for each sample, with intermittent water wash between these three steps.
-After polishing of all samples rinsed with water and allowed to dry 24hr. before measurement (Claudio *et al*., 2006).

Surface Roughness

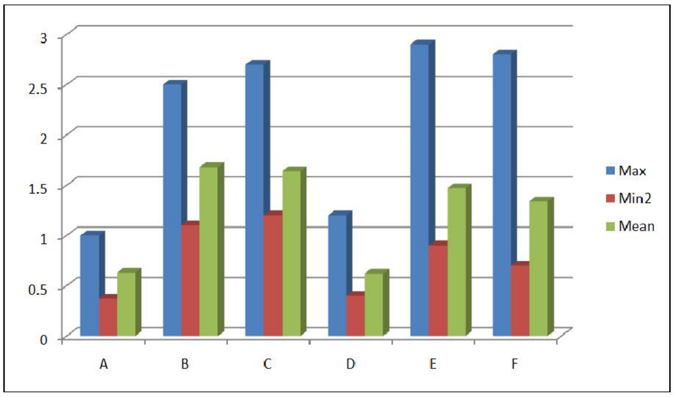
In order to determine the efficiency of each of these systems to act as a polishing instrument for composite restorations using a Surface Roughness Digital Portable Tester (RP-100 Instrutherm, pocket). The Surface Roughness Tester was operated with cut-off of 0.8 mm, a reading speed of 0.1 mm/seach sample positioned on the probe that had the ability to detect the amount of surface roughness for each sample. In this study, the Ra parameter obtained with packet is used to describe the surface texture of the samples in µm. This parameter describes the overall roughness of a surface and can be defined as the arithmetical average value of all absolute distances of the roughness profile from the center line within the measuring length (Vanessa *et al*., 2014).

RESULTS

Table (1) representing the Descriptive Statistic showing (Maximum value, Minimum value, Mean, Standard Deviation) of all groups.

Table 1. Descriptive statistic of all groups

Group	Max	Min	Mean	S.D.
A	1.0	0.37	0.63	± 1.14
B	2.5	1.1	1.68	± 2.20
C	2.7	1.2	1.64	± 1.94
D	1.2	0.4	0.62	±2.10
E	2.9	0.9	1.47	± 1.30
F	2.8	0.7	1.34	± 2.40



Bar chart representing the mean, maximum value, minimum values of all groups

The maximum value was shown in group (E), while the minimum value was found in group (A), the least degree of standard deviation found in group (A), while the highest one occurred in group (F).

Table 2. Student t-test between different materials treated by similar polishing system

Group	t-test	P-value	Sig.
A	0.06	0.82	N.S
D			
B	0.21	0.024	S
E			
C	0.18	0.04	S
F			

Table (2) representing the student t-test between groups in relation to the difference in the materials (Microhybrid & Nanofilled composite) but treated with similar polishing system, the results was Non-Significant in differences between groups (A&D), while it were Significant in differences between groups (B&E) (C&F).

Table (3) representing the Inferential Statistic through Student t-test between groups of Microhybrid composite (Filtex Z 250 USA), The results were Highly Significant in differences between groups (A&B) (A&C), while it was Non-Significant in differences between groups (B&C).

Table 3. Student t-test between groups of Microhybrid composite

Group	t-test	P- value	Sig.
A			
B	7.2	0.0001	H.S
A			
C	3.16	0.0052	H.S
B			
C	0.14	0.81	N.S

Table (4) representing the Inferential Statistic through Student t-test between groups of Nanofilled composite (Supereme XT), The results were Highly Significant in differences between groups(D&E) (D&F), while it was Non- Significant in differences between groups (E&F).

Table 4. Student t-test between groups of Nanofilled composite

Group	t-test	P- value	Sig.
D			
E	5.45	0.00018	H.S
D			
F	3.12	0.0021	H.S
E			
F	0.34	0.53	N.S

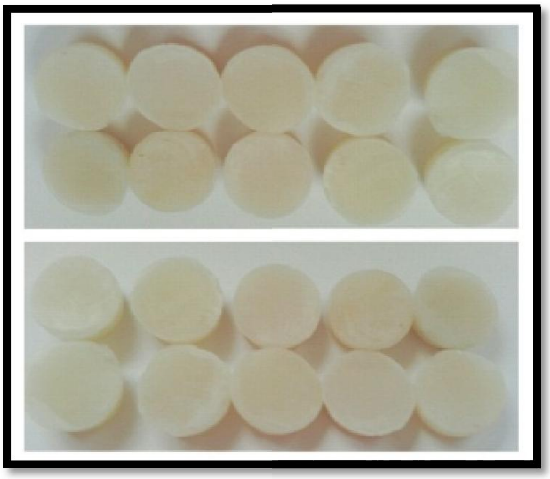


Fig.1. Groups A, D

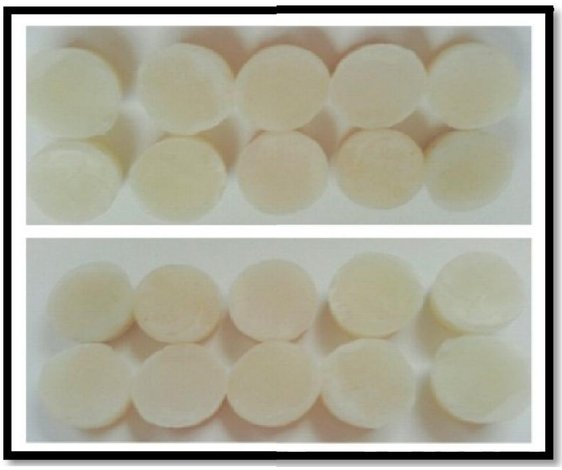


Fig.2. Groups B, E

Fig.3. Groups C, F

Fig.4. Opti4 Aluminum oxide disk

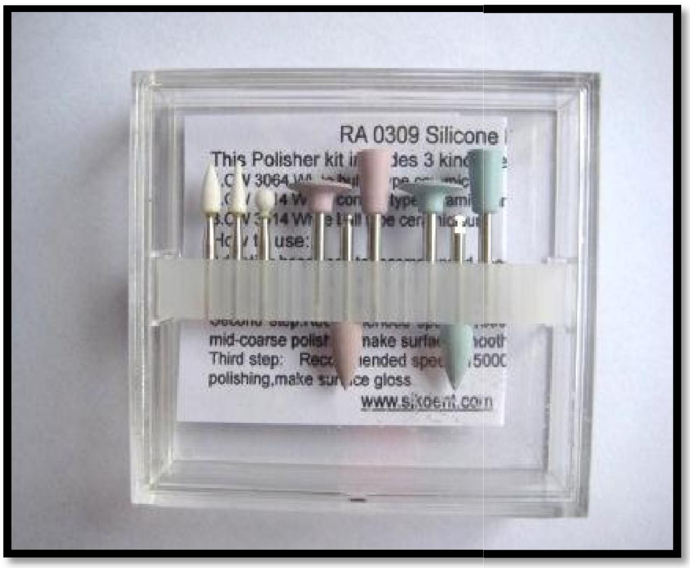


Fig.5. SJK Rubber plastic point bur used for polishing groups C, Fused for polishing groups B, E

Fig.6. Pocket Surf –Digital portable tester, With sensitive probe positioned on the sample

DISCUSSION

Surface of restoration finishing is a critical step to reach an esthetically acceptable restoration, and different materials and polishing systems may be used. It is clinically important to determine the finishing technique that will result in the smoothest surface using minimum time and instruments. Composite surface roughness is basically affected by the size, hardness and amount of filler, all of which influence the mechanical properties of the resin composites, and by the flexibility of the finishing material, hardness of the abrasive and grit size (Andrefigueiredoreis *et al*., 2002) (Smita and Rahul, 2012).

It is known that surface roughness will enhance morebacteria leading to problems like excessive plaqueaccumulation, gingival irritation, increased surface staining, and poor or less than optimal esthetics of the restored teeth (Zahraa, 2009).

Generally in relation to the results of this study and according to (Smita and Rahul, 2012) who indicated that roughness values less than 10 µm are clinically Undetectable, So that any system that produces a surface roughness less than 10 µm is acceptable. With roughness values closer to 1 µm than to 10 µm, the polished specimens in this study showed acceptable surface finish.

According to Table (1), In all groups (D,E,F) of Nanocomposite showed smoother surface than groups (A,B,C) of Microhybrid composite with Mean of surface roughness value, And also from Table (2) the results were significant in differences during comparison between groups (B&E) (C&F) which were polished by the same type of polishing system but differ in materials, This is may be contributed to the fact that In addition to fact of the smaller size of Nanocomposite fillerparticles, nanotechnology is contribute to have abeneficial effect on the stable chemical integration of such particles within the composite matrix. This is thought to leads to the low wear rates of Nanoparticle composites (Claudio *et al*., 2006) (Smita and Rahul, 2012) (Vanessa *et al*., 2014) (Luca *et al*., 2014).

Also in the case of surface alteration caused by contact with abrasive polishing instruments, a surface that is composed of nanoparticles is less likely to suffer particle loss. This might explain the low surface roughness found in groups (D,E,F) of Nanocomposite Compared to groups (A,B,C) of Microhybrid composite (Jozo *et al*., 1988) (Halim *et al*., 2003), In addition to that the Nanocomposite had higher filler content by volume. Thus, it can be expected that, in Nanocomposites, a greater number of particles will be present on the surface, establishing a larger contact area with rotating instruments. Moreover, the strong integration of Nano particles within the composite material might further explain the results of this study (Jozo *et al*., 1988) (Esra *et al*., 2014).

Also from Table (2), the result was Non significant in difference between groups (A& D) which were consider as control subgroups before polishing, this result come with agreement with (Zahraa, 2009) who stated that surface roughness of composite resin is directly influenced by finishing / polishing technique used.

According to Tables (3& 4) they were reported that lowest roughness values were obtained with the specimens polymerized against the mylar strip alone (control groups, A&D) this agree with (Claudio *et al*., 2006) who stated that although the Mylar strip is a versatile instrument, it does not me*et al*l the criteria with respect to contour and form, also after placing of the composite restorations, removal of excess material or re – contouring of the restoration is often necessary. Furthermore, the Mylar exposed surface is a resin fill surface layer that is easily wears in the oral environment. If it's not polished, rough, inorganic filler material will be exposed (Andrefigueiredoreis *et al*., 2002) (Smita and Rahul, 2012) (Vanessa *et al*., 2014).

Also from these two Tables (3 & 4) the results of comparison between groups of same material but polished by different polishing system (B&C) (E&F) were Non-Significant in differences but with smoother surface with the aluminum oxide disk than the plastic point bur and this result may be due that aluminum abrasive disk has the ability to flatten the filler particles and abrade the softer resin matrix at an equalrate, Also may be attributed to the filler particles present in a polishing instrument must have higher hardness than the filler particles of the composite resin so that the resin matrix and the particles are both reduced to a higher surface smoothness (Zahraa, 2009), Such result agrees with (Halim *et al*., 2003) who stated that the disks having the ability to remove the surface scratches created by carbide or finishing burs and agree with (Esra *et al*., 2014) who stated that the aluminum oxide discs having their own malleability that promotes a homogenous abrasion of the filler and the resin matrix.

In this Invitro study, the two polishing systems were found to be effective in polishing the resin composite tested. However Since there are several physiological and biological processes that may be related to the increase in the surface roughness, further studies are needed to determine which finishing techniques are best suited to clinical situations.

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