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Influence of Dentifrices on Teeth Restored with Esthetic Restorative Materials

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Authors' contributions

This work was carried out in collaboration between all authors. Author EIE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HMM and KAA managed the analyses of the study. Author KAA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Rough surface can lead to the decreased gloss of the material surface with subsequent plaque accumulation, which affects the esthetic quality of a restoration and initiate periodontal diseases.
Aim: The aim of this study was to evaluate the effect of toothbrushing with two types of dentifrices (with or without whitening agents) on the surface roughness of both nanohybrid filling resin and compomer.
Materials and Methods: Thirty specimens were prepared and divided to two main groups (n = 15) according to the restorative material, each main group randomly divided into three groups (n = 5) according to the surface treatment (Control, Colgate and Colgate whitening) for a period of 6 months. The surface roughness of the specimens was measured before and after the surface treatment.

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Statistical Analysis: Results are presented as mean S.D. values. One-way ANOVA was used for multiple group comparison followed by Post-Hoc Tukey's test. The paired t-test was used for intragroup comparison and unpaired t-test for comparing independent sample groups.
Results: The composite group recorded the lowest mean values of the surface roughness in comparison with compomer. However, whitening toothpaste and conventional toothpaste had a significant change in surface roughness compared with control group. The control group recorded the lowest value while the whitening group recorded the highest value.
Conclusions: These results suggest that when using whitening dentifrices, it is advisable a whitening agent with minimal grain particles size to reduce the roughness of the restoration.

Keywords: Composite; dentifrices; esthetics.

1. INTRODUCTION

The smoothness of restoration provides both good esthetics and minimum plaque accumulation resulting in healthy gingival [1]. Rough surface can lead to the decreased gloss of the material surface with subsequent plaque accumulation, which affects the esthetic quality of a restoration and initiate periodontal diseases [2,3]. Successful esthetic restorative materials are largely dependent on their resistance to solubility in the oral environment [4,5]. The masticatory forces and oral hygiene measures can lead to attrition, erosion [4], which in turn affects the gingival health. Thus it is very important to know the effect of a dentifrice abrasion on the loss of restorative materials [6]. Maintenance of an effective plaque control is the cornerstone in preventing and controlling gingival and periodontal diseases. The most commonly employed plaque control at home is by tooth brushing [7]. Improper tooth brushing can increase the surface roughness of restorative materials [8]. The cleaning action is mainly provided by the abrasive particles, which designed to disorganize the bacterial biofilm, removing microorganisms and stains, giving a whitened effect [9-11]. The tooth brushing also causing resin composites abrasion, surface roughness and loss of gloss occur [12-17] with subsequent accumulation of plaque in this area is facilitated, leading to periodontal diseases development and discoloration of the restoration [18,19]. The majority of studies have provided that, the effect of whitening dentifrices on the surface roughness of composites occur after a long period of use, ranging from 6 months to 1 year, [8,10,20]. In fact, the effect of whitening can be reached after 2 weeks of dentifrice use, remaining stable for up to 3 months [21,22]. Some studies have proved that continues use of whitening dentifrices results in severe tooth wear, and the dentin is eroded [23,24]. In fact, many whitening dentifrices do not contain bleaching agents, their action includes an extrinsic stain removal [25]. Surface roughness means irregularities of the surface that may result from the production process or the material's characteristics [26]. A previous study reported that a mean roughness of 0.2 mm is the critical threshold value for plaque accumulation [27], but the effect of the abrasiveness of dentifrices on the surface roughness and gloss of resin composites is still unknown.

This study aimed to evaluate the effect of toothbrushing with two types of dentifrices (with or without whitening agents) on the surface roughness of both nanohybrid filling resin and compomer after being submitted to tooth brushing for six months.

2. MATERIALS AND METHODS

Thirty disk-shaped specimens were used in this study classified into two main groups (n=15) according to the restorative materials used Compomer (Compo glass) and nanohybrid composite [Table 1]. Samples were prepared by placing the materials into Teflon disk molds (5x2 mm) using incremental technique between two clear strips and two glass plates to obtain smooth surfaces, and light cured perpendicularly according to the manufacturer instructions through the clear strips and glass plates with Light cure unit (Bee Cool plus top light LED Curing. To control the brushing force, it is done by one operator and performing the brushing for each main group in different time and there is (one-hour gap) between the two main group to avoid fatigue of the operator. The brusher head was replaced monthly to avoid wearing their bristles. Brushing the samples was done in the vertical direction to simulate most commonly used brushing technique.

Samples were subjected to brushing simulation equivalent to the period of 6 months. Each main

group were randomly subdivided into three groups (n=5). As follows:

Saline Group: were subjected to brushing with saline, *Colgate Group*: were subjected to brushing with *Colgate dentifrice* and *whitening Group* were subjected to brushing with *Colgate whitening* toothpaste [Table 2].

The mean reading of surface roughness for each specimen was recorded from both the initial readings as baseline data and the final reading which was measured after the six months of surface treatment [Table 3]. Brushing was performed with a powered toothbrush (Oral B® professional care Braun Germany) [Fig. 1]. Each time toothbrush head was loaded with toothpaste of 0.25 mg weight and travelled vertically for 30 sec. The toothpaste slurry was prepared by mixing one of the dentifrices with water at a ratio of 1:3 by weight. Three erosive/abrasive cycles were carried out three times per day. During this period the specimens were stored in 100% humidity.

Fig. 1. Electrical toothbrush used in the study

Table 1. Restorative materials description used in the study

Name of material	Organic phase	Inorganic matrix	Manufacturer	Patch number
Nanohybrid composite	UDMA Bis-Gama Bis-Ema TEGDMA	Silica (20nm nonagglomerated/ aggregated), Zirconia(4-11 nm nonagglomerated/ aggregated and agglomerated), clusters, zirconia/silica aggregated particles (20 nm silica particles combined with 4-11 nm zirconia 3)	3M ESPE St. paul, Minn., USA	6018A3-S
Compomer	Like that of a dental composite	Fluoride-releasing silicate glasses.	KGC, Corp, Tokyo, Japan	130432

Table 2. Dentifrice composition used in the study

Dentifrices	Chemical composition	Manufacture	Batch number
Colgate	NaFl 0.32% (1450 ppm), H_2O, glycerin, sorbitol, copolymer, PVM, sod.lauryl sulfate, cellulose gum, NaOH, propylene glycol, carrageenan, triclosan, sod. Saccharin,	Colgate-Palmolive Company New York, NY, USA	8268MX1139
Colgate Baking Soda Whitening	Sodium monofluorophosphate 0.76% (0.14% w/v fluoride ion). Inactive ingredients: glycerin, hydrated silica, water, sodium bicarbonate, PEG-12, sodium lauryl sulfate, flavor, sodium hydroxide, cellulose gum, carrageenan, sodium saccharin, calcium peroxide, titanium dioxide.	Colgate-Palmolive Company New York, NY, USA	9116MX1113

Table 3. The mean and standard deviation for surface roughness of two dental esthetic materials under various surface treatments

Surface treatment aesthetic material		Saline		Conventional dentifrice		Whitening dentifrice	
		Before	After	Before	After	Before	After
Nanofilled composite	M	1.4	1.5	1,5	1.8	1.2	1.5
	SD	0.4	0.3	0.5	0.4	0.5	0.6
Compomer	M	1.6	2	1.9	2.3	1.7	2.1
	SD	0.6	0.7	0.4	0.6	0.4	0.4

SD: Standard Deviation; M: Mean

2.1 Surface Roughness Measurement

The average surface roughness of the specimens was measured with a surface profilometer (MarSurf PS1; Mahr, GmbH, Göttingen, Germany) [Figs. 2, 3]. To measure the roughness profile value, the diamond stylus (5 μm tip radius) was moved across the surface under a constant load of 3.9 mN. The instruments were calibrated by using a standard reference specimen and then set to travel at a speed of 0.100 mm/s with a range of 600 μm during testing. Surface roughness was measured 5 times for each specimen in the central part; the average value was obtained and defined as the Ra. The surface roughness of a nanohybrid resin composite and a compomer were evaluated. The power of the study is about 80%.

Fig. 2. Profilometer (MarSurf PS1; Mahr and Surface roughness measurement of the specimen

2.2 Statistical Analysis

Results are presented as mean values and standard deviation (S.D) values. One-way ANOVA was used for multiple group comparison followed by Post-Hoc Tukey's test. The paired t-test was used for intragroup comparison and unpaired t-test for comparing independent sample groups.

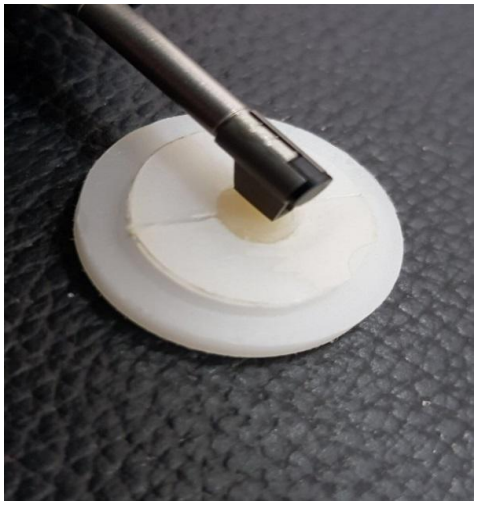

Fig. 3. Surface roughness measurement of the specimen

3. RESULTS

There was surface roughness in all the samples. The composite group recorded the lowest value in comparison with compomer one. Regarding the whitening group there was a significant difference between composite specimens and compomer ones. Although there were significant differences between the conventional and whitening toothpaste on compomer, there were no significant differences in both conventional and whitening toothpaste on composite specimens, However, whitening toothpaste and conventional toothpaste had a significant change in surface roughness when compared with Saline group. The whitening group recorded the highest value while the saline group recorded the lowest value for all groups. Although these results are expected, our study was aimed to evaluate the effect of different dentifrices with or without whitening agents [Table 3/Fig. 4].

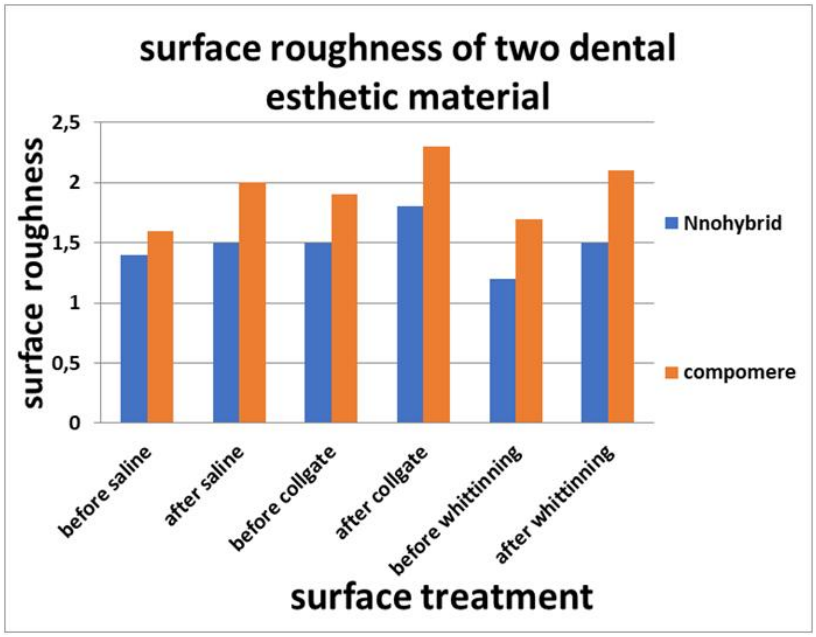

Fig. 4. Illustrate surface roughness

4. DISCUSSION

Aesthetic quality of restoration depends on surface texture if it is rough leads to decreased gloss and discoloration. Rougher surface also gives rise to staining, accumulation of plaque which may lead to secondary caries and periodontal diseases development [28]. The main abrasive particles present in dentifrices are softened silica (hydrated silica), chalk (calcium carbonate), and baking soda (sodium bicarbonate). Other abrasives particles include sodium metaphosphate, hydrated alumina, tricalcium phosphate, and calcium sulfate. Any dentifrice has a relative dentin abrasivity (RDA), which influence the degree of surface roughness and wear of tooth substances [11,18]. Composite materials have been used for many years and manufacturers are trying to improve the handling property, strength and polishability to make a universal material for restoration [28]. One of the major disadvantages of resin-based material is its wear resistance.

Tooth whitening can be done with bleaching agents like hydrogen peroxide carbamide, peroxides and also which the abrasives present in dentifrices [29].

Our study revealed that compomer and composite, when brushed with whitening dentifrice, showed highly significant changes in surface roughness. These results were in accordance with a previous study[30]. It was verified that the dentifrice containing carbamide or hydrogen peroxide along with alumina + silica and calcium carbonate produced changes in roughness [29]. It has been proved that mechanical tooth brushing results in abrasion of the surface of the restorative materials. Tooth brushing can erode the softer polymer matrix, leaving the harder reinforcing particles standing higher in relief [29]. Dentifrice normally contains an abrasive [31]. The increased surface roughness with whitening dentifrice could be due to both the brushing which can abrade the surface and the abrasives of the dentifrices. The difference in surface roughness of compomer and composite may be attributed to the high wear resistance of composite when compared with compomer [32].

5. CONCLUSION

It is concluded that when using whitening dentifrices, it is better to use whitening agent with minimal grain particles size to reduce the roughness of the restoration and it is advisable to restore teeth with composite restoration when using whitening dentifrices. The results obtained, and the conclusions drawn are based on in-vitro studies, correlation to clinical practice requires further invivo research to evaluate long-term effects of whitening toothpaste on

aesthetic restorative materials with larger sample size.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Al-Farabi College ethical committee has reviewed this project in the meeting held on 17th May 2017 and gives approval (Reference NO: AEC 4-017).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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