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Evaluation of the Effect Of Toothbrushing with a New Charcoal Containing Dentrifice on Surface Roughness of Two Direct Esthetic Restorative Materials: An In vitro Study

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The aim of the present study was to evaluate the effect of brushing with a charcoal containing dentrifice on the roughness of a Nanohybrid and a Giomer using a profilometric analysis.20-disc shaped samples each of the Nanohybrid resin composite and Giomer were prepared as per standard protocol. Specimens of each material were further randomly divided into 2 groups of 10 specimens each. Group A for Nanohybrid composite that were further divided into AC (control) and AE (experimental) group. Group B for Giomer that were further divided into BC (control) and BE (experimental) groups. The initial roughness value was as initial roughness value (Rai). The control groups (AC and BC) were brushed using a powered toothbrush along with deionized water. For the experimental groups, brushing was done using a charcoal dentrifice. After a period of 28 days, final surface roughness values were measured as final roughness value Raf. Statistical analysis was done with paired T and Independent T tests using SPSS version 18 software. Both the Composite and Giomer groups show increased in roughness before and after tooth brushing when comparing the control and experimental groups after brushing, there was an increased surface roughness seen on the experimental groups for both the materials. However, this difference was not statistically significant. When comparing the composite group to Giomer group, Giomer shows a higher surface roughness in both the control and experimental groups. Surface roughness of both Nanohybrid composite and Giomer increased after tooth brushing with the charcoal containing dentrifice.

Keywords: Charcoal containing dentrifice, Composite, Surface roughness, Giomer, Profilometer.

1. Introduction

The increased demands for esthetic restorations have led to the development of tooth colored restorative materials. In the past years, improvements on the mechanical properties of resin-based materials along with increased esthetic demands have resulted on the enlarged use of direct composite resin restorations in anterior and posterior teeth [1]. Composite resins are most commonly used materials for esthetic restorations of teeth. The latest generation of Nanohybrid composites combines the wear properties of hybrid composites with the esthetics of nanofilled composites to give durable, highly esthetic restorations [2]. Filtek Z250 XT is one such Nanohybrid composite with surface-modified zirconia/silica with a median particle size of approximately 3 microns or less and filler loading of 82%. Manufactures claim that it retains polish even after brushing.

Giomers are a new type of restorative material that demonstrates many of the same characteristics as glass ionomers but with clinically demonstrated esthetics and durability. They contain surface pre-reacted glass ionomer particles in a resin matrix which combine the fluoride release and recharge similar to glass ionomers with the strength and esthetics of composites [3]. Beautiful II is one such Giomer with universal application and is useful in patients with a high caries index.

Dentrifices have been a source of concern for many professionals, since it is used in daily oral care by the population. The components in toothpastes are strong abrasives that remove salivary pellicle along with dental stains. Studies have shown that the movements of abrasive agents with the aid of toothbrush bristles will alter the roughness and mechanical properties of restorative materials [4].

Colgate total charcoal deep clean is new fluoridated toothpaste containing hydrated silica and charcoal powder. It contains micro particles of charcoal which are claimed to have superior cleaning and remove stains. Activated charcoal is a known antibacterial and absorbs impurities. It is used in home teeth whitening regimes and is a known abrasive agent [5]. However, the effect of charcoal as an abrasive on restoration surface has not yet been evaluated.

Therefore, the aim of the present study was to evaluate the effect of tooth brushing with a charcoal containing dentrifice on the surface roughness of a Nanohybrid composite (Filtek Z250XT) and a Giomer (Beautifil II) using a profilometric analysis. Initial surface roughness values were measured using a contact profilometer. Brushing of the samples was carried out for 2 mins a day twice a day for a period of 28 days using a soft toothbrush head.

2. Materials and method

Specimen preparation

20-disc shaped samples each of the Nanohybrid resin composite (Filtek Z250XT, 3M ESPE shadeA2) and Giomer (BeautifulII, Shofu, shadeA2) were prepared. There in samples were prepared using a bi-parted matrix (4mm x 6mm) placed on a glass plate. 3 increments of material were inserted using a composite spatula. The first 2 increments of 2 mm each were placed and cured for 2 cycles of 20 seconds with a curing light at 1000 mW/cm2 (Elipar™

Deep Cure-S LED Curing Light, 3M ESPE). For the 3rd increment, a strip polyester matrix was placed and covered by a glass plate 20 mm thick with a 500 g load for 10 seconds. Photopolymerization was then done for two 20-second periods with a curing light at 1mm distance.

The prepared samples were stored in artificial saliva [Table 1] for 24 hours. Following this polishing with a low speed contra-angled handpiece was carried out using medium, fine and super fine polishing discs (Super snap, Shofu) in a sequential manner with 5 strokes from each disk. The samples were cleaned in distilled water for 2 minutes to remove any surface contaminants. The specimens were then fixed in custom made cylindrical acrylic molds.

Specimens of each material randomly divided into 2 groups of 10 specimen's each. Group A comprised of the Nanohybrid composite divided into AC (control) and AE (experimental) group. Group B comprised of the Giomer samples divided into BC (control) and BE (experimental) groups.

Table1: Samples stored in artificial saliva for 24 hours

Artificial saliva composition	Niacin, carboxymethyl, KCl, NaCl, MgCl, CaCl ,cellulose, sorbitol and deionized water	pH6.8	MCODS , Manipal

Initial surface roughness measurement

Initial surface roughness values were measured using a contact profilometer (SurftestSJ-310, Mitutoyo America Corporation, NITK, Suratkal).Three readings of surface roughness were taken for each sample. The mean of these three values calculated and taken as initial roughness value (Rai).

Toothbrushing protocol

A power toothbrush (Oral B Professional care PRO 3000) was mounted on a customized holder to standardize the force application [Figure1].Brushing of the samples was carried out for 2 mins a day twice a day for a period of 28 days using a soft toothbrush head.

The control groups (AC and BC) were brushed using tooth brush along with deionized water. For the experimental groups, brushing was done using toothbrush along with a pea sized amount of dentrifice. After each tooth brushing cycle, the samples were cleaned with distilled water. The specimens were stored in artificial saliva at 37 degrees Celsius for the entire study period.

Final surface roughness measurement

After a period of 28 days, final surface roughness values were measured (NITK, Suratkal). 3 values were taken per specimen, mean of the 3 (Raf) used for statistical analysis.

Figure1: Mounted powered toothbrush

Statistical analysis

Statistical analysis was done with paired T and Independent T tests using SPSS version 18software.A p-value of <0.05 was considered statistically significant.

3. Results

Mean surface roughness measurements (µm)

Table2: Comparison of difference of roughness (before –after brushing) between experimental and control groups in composite

GroupA (COMPOSITE)		
	Rai	Raf
Control(AC)	0.46	0.55
Experimental(AF)	0.41	0.59

Table 3: Comparison of difference of roughness (before –after brushing) between experimental and control groups in Giomers

GroupB(GIOMER)		
	Rai	Raf
Control(BC)	0.54	0.64
Experimental(BE)	0.53	0.75

Table 4: Experimental groups showed increased roughness after brushing comparison

GROUP	MATERIAL				p-value
	Composite		Giomer		
	Mean	SD	Mean	SD	
Control	-.09	.13	-.10	.13	0.973; NS
Experimental	-.18	.07	-.21	.13	0.462; NS

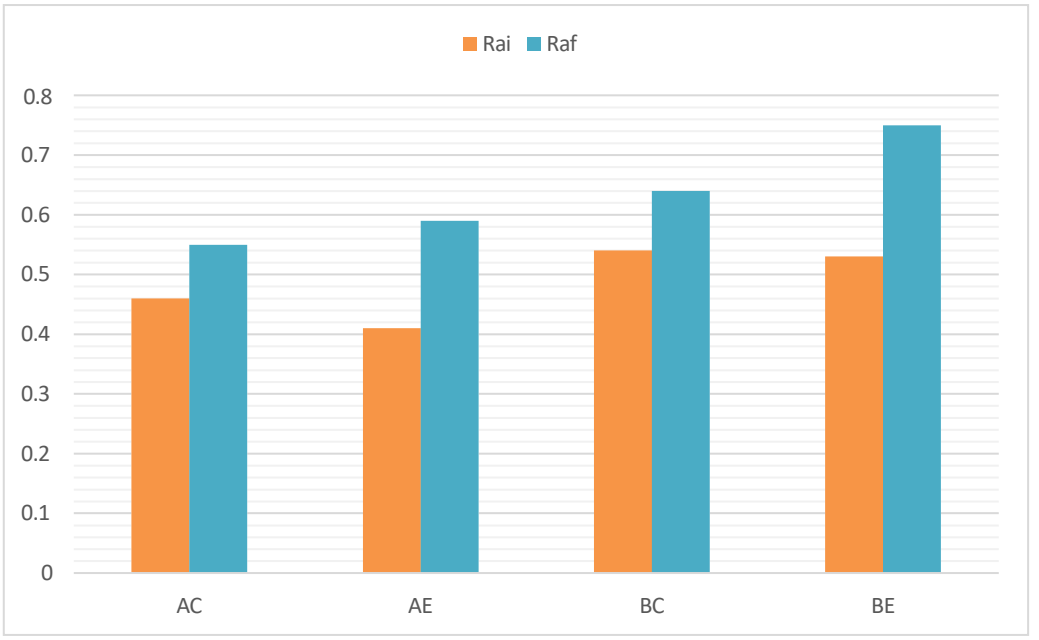

Figure 2: Graphical representation

Both the composite and Giomer groups show increased in roughness before and after tooth brushing in both control and experimental groups and this difference was statistically significant [Table 2, 3, Figure 2].

When comparing the control and experimental groups after brushing, there was an increased surface roughness seen on the experimental groups for both the materials. However, this difference was not statistically significant [Table 4, Figure 2].

When comparing the composite group to Giomer group, Giomer should a higher surface roughness in both the control and experimental groups

4. Discussion

The surfaces of restorative materials in the oral cavity are subjected to a variety of factors that can influence surface quality. Oral hygiene procedures increase the roughness value of restorative materials and promote bacterial growth and staining. These changes have been attributed to the degradation of the polymer matrix, or the resin-filler interface, and loss of inorganic filler particles.

Restorative materials with surface roughness would have a negative effect on the aesthetic appearance of the restorations (that is, staining and tearing) and lead to greater accumulation of biofilm, which could in turn result in cavities and periodontal disease [6]. The abrasives present in the toothpaste used include hydrated silica and charcoal powder. As shown by a number of studies, the abrasives in toothpaste increase the surface roughness of the materials [7, 8, 9].

Tooth brushing in vitro may be a parameter to evaluate the ability of a restorative material to resist deterioration and maintain smoothness. However, the abrasive action of brushing is considered to be acontributingfactortothealterationofsurfacepropertiesofdentalmaterials [6]. Therefore, the control group was subjected to only tooth brushing without the use of toothpaste.

Oral B Professional care toothbrush was used in the study, which works on the rotation-oscillation principle at 8800 oscillations per minute and has a built in timer of 2 mintutes. A power toothbrush was used in the current study to deliver uniform brushing strokes and minimize any operator error in manual brushing techniques [10].It was mounted on a custom made holder for the toothbrush and fastened into place to minimize the changes in force applied during the brushing procedure.

The samples were polished by a single operator to minimize variations, mounted in acrylic blocks to simplify the brushing procedure and stored in artificial saliva to best simulate the oral conditions.

A contact profilometer was used in the present study as it is an established and accepted method to measure surface roughness of dental materials.

The results of the studies indicated a significantly increased Ra value after tooth brushing in both the control and experimental groups for both the restorative materials. This is in accordance with the results obtained from previous studies daCosta et al [7].The experimental groups showed higher surface roughness values as compared to control groups. Similar results have been obtained in previous studies where brushing with water resulted in lower Ra for composite resin compared to brushing with toothpaste [8].

Surface roughness of Giomers was higher than of the Nanohybrid composites before and after tooth brushing. This can be attributed to the fact that Giomer is a biphasic restorative material where the matrix phase which is resin based is preferentially removed during prophylaxis procedures. This leaves the fillers exposed and unsupported, with the displacement of fillers leading to an increased surface roughness [11]. Furthermore, roughness of Nanohybrid composite was less as the mean filler particle size of these is 0.6 microns compared to 0.8 micons for Giomers.

The findings of the current study suggest that charcoal present in dentrifices affect the surface roughness of restorative materials. Further studies are needed to evaluate its effect on the optical and esthetic properties of these materials.

5. Conclusion

Within the limitations of the present study, it could be concluded that:

Surface roughness of both Nanohybrid composite and Giomer increased significantly aftertooth brushing with the new dentrifice.

Giomer showed a rougher surface compared to the Nanohybrid composite both before andafter tooth brushing. However, this was not statistically significant.

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Conflicts of interest: There are no conflicts of interest

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