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Research Article

Evaluation of the Effect of 40% HydrogenPeroxide Bleaching Agent on the Abrasion Resistance of Composites

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ABSTRACT

Introduction: Tooth whitening products may affect the various properties of restorative materials, including their abrasion resistance. The purpose of this study was to investigate the effect of 40% hydrogen peroxide bleaching agent on the abrasion resistance of composites.

Materials and methods: In this experimental study, 20 disc shaped samples (10 mm in diameter and 2 mm in thickness) from each of Z250, Z350 and Heliomolar composites were used. The samples of each composite were randomly divided into two subgroups of 10, based on being bleached or not. eventually, 6 groups were obtained:

1. Z250 samples taken under abrasion after exposure to 40% hydrogen peroxide
2. Z250 samples taken under abrasion after exposure to distilled water
3. Z350 samples taken under abrasion after exposure to 40% hydrogen peroxide
4. Z350 samples taken under abrasion after exposure to distilled water
5. Heliomolar samples taken under abrasion after exposure to 40% hydrogen peroxide
6. Heliomolar samples taken under abrasion after exposure to distilled water

Office bleaching process (ExtraBoostOpalesence, Ultra Dent, USA) was performed on the samples, according to manufacturer's instructions. In the next step, the toothbrush abrasion test (20,000 cycles) was performed again. Weight loss was calculated for each sample. Data were analyzed by SPSS ver.20.0 software and using statistical tests of ANOVA and T-test. P value less than 0.05 was considered significant.

Findings: The 40% hydrogen peroxide bleaching agent had no impact on the abrasions of Z250 (P value = 0.18), Z350 (P value = 0.89), and Heliomolar (P value = 0.19) composites. The abrasions of three types of composite did not show any significant differences (P value = 0.15).

Conclusion: The 40% hydrogen peroxide bleaching agent had no impact on the depth of abrasion of different composites, and it can be stated that all three types of composites had similar amounts of abrasion.

Keywords: Bleaching - Composite - Abrasion resistance

INTRODUCTION:

Despite many advances that have been made in tooth whitening in recent years, there are still a lot of obscure points about tooth whitening that have remained unanswered (1). In addition, dental materials manufacturers have introduced new and diverse products due to the huge revenues generated by increased demand, which has led to the dentist's confusion in choosing the most suitable one. In the past, teeth with unpleasant appearance experienced more aggressive

therapies, such as prosthetic treatments, but today, simpler, cheaper and more efficient techniques, such as bleaching, that are also widely accepted, are proposed and have made bleaching a popular treatment in dentistry in recent decades. (2)

In tooth bleaching technique, various concentrations of substances such as hydrogen peroxide, carbamide peroxide, and sodium perborate are used for bleaching of vital and non-vital teeth. The bleaching of vital teeth is performed by two techniques of home (using bleaching tray at home) and office (using bleaching materials at the office) (3). Whitening in the office is usually done using concentrations above 35% of hydrogen peroxide. These materials are available in various forms in the market, such as gel, powder and liquid, which are placed on the proximal and facial surfaces of the teeth in accordance with the manufacturer's instructions, and Within a certain time specified by the manufacturer, they remain on the surface of the tooth. Whitening at the office requires an average of 3 to 4 sessions and at least one session of treatment (4). Tooth bleaching can increase the surface roughness of composites (5 and 6), but the effect of bleaching on the abrasion of the composites is still unclear. Bleaching agents may increase the staining of composites by increasing the surface roughness, but all studies do not agree with this finding (7). Few studies have investigated the effect of tooth whitening on the abrasion of composites (8, 9). Hasani et al. (2015) investigated the effect of carbamide peroxide on the abrasion resistance of silorane and methacrylate-based composites, and finally concluded that using 45% carbamide peroxide for 3 to 8 hours did not had any destructive effect on the abrasion resistance of the composites (10). Faraoni et al. Studied the effect of resin-based office bleaching on the abrasion. They selected 5 different types of composites and performed experiments on them, and eventually concluded that bleaching did not have any effect on the depth of abrasion, but there were significant differences between different restorative materials (5).

Mair et al. (2004) investigated the effect of bleaching by 6% hydrogen peroxide on the degradation and wear by toothbrush of three glass ionomers (ChemFlex, Fuji II and Ketac-Fil). Their study showed that hydrogen peroxide had no effect on the abrasion rate of glass ionomers (11).

Therefore, due to limited studies carried out in this field, the purpose of this study was to investigate the effect of 40% hydrogen peroxide bleaching agent on the abrasion resistance of composites.

MATERIALS AND METHODS:

In this experimental study, the effect of 40% hydrogen peroxide on abrasion caused by tooth brushing of three types of composite, including microhybrid (Z350, 3M, USA), nanohybrid (Z250, 3M, USA), and microfil (Evliar, Evidence Vivalent Germany) was investigated. All three composites were selected in 2 A color. (Table 1)

Table 1. The combination of materials used in the study

Manufacturer	The combination	Explanation	Product Name
3M ESPE, St. Paul, MN, USA	Organic matrix: Bis-GMA; UDMA; BisEMA Filler: Zirconia/silica(0.6-0.8$_{\mu}$m),(82 wt%)	Microhybrid	Filtek Z250
3M ESPE, St. Paul, MN, USA	Organic matrix: Bis-EMA, UDMA, Bis-GMA, TEGDMA Filler: ZrO2($_{0.6\text{-}1.4\mu}$m)/SiO2(20 nm) (78.5% wt)	Nanofill	Filtek Z350
Ivoclar, Vivadent, Germany	Organic matrix: Bis-GMA, UDMA, decandiol Filler: Silica, ytterbium-Trifluoride (0.04-0.2 $_{\mu}$m) (77.8 wt%)	Microfill	Heliomolar
Ultra Dent,USA	Hydrogen Peroxide(40%), Pottasium nitrate, flouride	Whitening agent	ExtraBoost Opalesence

From each composite, 20 samples were made in the form of discs of 10 mm in diameter and 2 mm in thickness by using plastic generators. After insertion of the composite into the generator, a transparent strip and a glass slab were laid on it, and according to the manufacturer's instructions, it was light cured for 20 seconds using the ivoclarvivadentliechtenstion (Germany) (7Asrtralis) cure machine. Following the removal of the samples from the inside of the generator, exposure was performed on each side for 20 seconds. The surface of the samples was sanded using sandpaper 400 to 1200 grits, respectively. The samples were then stored in distilled water at 37 ° C for 24 hours.

Bleaching process:

40% Hydrogen Peroxide (Extra BoostOpalescence, Ultra Dent, USA) bleaching agent was used for bleaching. In accordance with the manufacturer's instructions, the composites are exposed to the bleaching agent two times and each time for 20 minutes (for a total of 40 minutes), and then each time, they are washed with flowing water for 1 minute.

Samples are randomly divided into 6 groups of 10:

1. Z250 samples taken under abrasion after exposure to 40% hydrogen peroxide
2. Z250 samples taken under abrasion after exposure to distilled water
3. Z350 samples taken under abrasion after exposure to 40% hydrogen peroxide
4. Z350 samples taken under abrasion after exposure to distilled water
5. Heliomolar samples taken under abrasion after exposure to 40% hydrogen peroxide
6. Heliomolar samples taken under abrasion after exposure to distilled water

Control group samples during the bleaching process were kept in distilled water at 37 ° C. The upper surface of the samples was covered with bleaching material with thickness of 1 mm at room temperature. During the intervals of the bleaching sessions, the samples were stored in distilled water.

Toothbrush wear test:

Prior to the abrasion process, each samples were placed with dryer paper in a special plate for 10 minutes at 37 ° C oven, so they would be equally dewatered, then they were weighted by an electronic scale (start orius, Germany) with accuracy of 0.1 mg and they were recorded in the related table. The abrasion test was performed on a mechanical toothbrush wearing machine (PEDEB, made by Dr. HomayounAlaghemand). This device has a sample holder. Medium toothbrush heads, which have 20 tufts and 50 bristols in each tuft, are used with a force of 400 g in perpendicular to the slider surface, and a total of 20,000 strokes equal to 2 years brushing is applied. The toothbrush wearing device is set to 100 bpm rotation of complete back and forth movements. Watery mix was prepared immediately before the test starts by mixing 20 g of toothpaste (Crest complete 7) (crest, USA) and 20 ml of distilled water with same concentration for all samples, so that the surface of all samples is covered. This watery mixture was constantly stirred to prevent the abrasive particles of toothpaste from settling down. The wear action was carried out at room temperature of 23 ° C. Toothbrushes were replaced for each new cycle of 20,000. After the end of the test, the samples were removed from the mold and placed in an ultrasonic device (star sonic25) for 10 minutes. Then, each samples after drying with drying paper were placed inside of special plates for 10 minutes in 37° C oven, so they would be equally dewatered. The weight of each sample was re-measured and the weight loss was calculated for each sample. The results were analyzed by SPSS ver.20.0 software and by using statistical tests of ANOVA and T-test. P value less than 0.05 was considered significant.

FINDINGS:

In this study, which was performed on three types of composites (Z250, Z350, Heliomolar) exposed and not exposed to bleaching agent, the results are expressed as follows:

One-way ANOVA test showed that there was no significant difference in the abrasion of the three groups of samples not exposed to the bleaching agent (p> 0.05) (Table 2).

Table 2. Comparison of weight loss of the three groups of samples not exposed to bleaching agent

Group	The mean ± SD	The result of the statistical test
Heliomolar	0.00038±0.003	P=0.15
Z250	0.00041±0.0002	
Z350	0.00051±0.0003	

One-way ANOVA test showed that there was no significant difference in the abrasion of the three groups of samples exposed to the bleaching agent (p=0.06).

Table 3. Comparison of weight loss of the three groups of samples subjected to bleaching agent

Group	The mean ± SD	The result of the statistical test
Heliomolar	0.00039±0.002	P=0.06
Z250	0.00041±0.0001	
Z350	0.00053±0.0001	

The independent t test showed that there was no significant difference in the abrasion of samples exposed and not exposed to the bleaching agent in groups of Heliomolar (P value=0.19), Z250 (P value=0.18), and Z350 (P value=0.89), which means that being exposed or not exposed to the bleaching agent does not affect the abrasion (Table 4).

Table 4. Comparison of weight loss of samples exposed and not exposed to bleaching agent in composite samples

The result of the statistical test	Mean and standard deviation	group	Composite type
P=0.19	0.00039±0/002	Located under the bleaching agent	Heliomolar
	0.00038± 0/003	Not subjected to bleach	
P=0.18	0/0001 0.00041±	Located under the bleaching agent	Z250
	0/0002 0.00041±	Not subjected to bleach	
P=0.89	0/0001 0.00053±	Located under the bleaching agent	Z350
	0.0051±0/0003	Not subjected to bleach	

DISCUSSION AND CONCLUSION:

The present study showed that exposure to bleaching agent does not affect the amount of abrasion of any of the composites studied. Studies have been done on the effects of bleaching on restorative materials, but its effect is not exactly clear. A group of studies introduce bleaching as a factor for increasing surface hardness (14), and some studies introduce it as a factor for reducing the surface hardness and softening of composite and increasing its abrasion in stress and non-stress areas (15, 16).

Dr. HassaniTabatabaei et al. (2015) examined the effect of office bleaching system by 45% carbamide peroxide at the office on the abrasion resistance of Z250 and P90 composites, and they concluded that office bleaching has no harmful effect on the abrasion resistance of Z250 and P90 composites (10). Faraoni et al. Also studied the effect of bleaching materials on the abrasion of resin-based restorations and showed that bleaching does not have a significant effect on the depth of abrasion of composites (5). In the present study, similar findings were obtained and 40%

hydrogen peroxide, like 10% and 45% carbamide peroxide, which was investigated in the studies by Tabatabaei and Faraoni, had no effect on the amount of abrasion of various composites.

However, Hajizadeh et al. evaluated the effect of bleaching (15% carbamide peroxide) on the abrasion of 3 different composites (Z100, Z250, Supreme), and showed that there was a significant difference between the weight loss of all samples before and after bleaching (17). Several factors can be effective on the result of the studies. Factors such as pH of the bleaching agent, temperature, exposure time, substance concentration, and the frequency of use of bleaching agent (18). Dogan showed that home bleaching materials make more changes to hardness and surface roughness compared to office bleaching (19). The reason for this is the longer exposure time of the composite surface to home bleaching agent. In the present study, unlike the Hajizadeh study, bleaching agent used was office bleaching, which was used in a shorter time period, which could be the reason for possible differences in our results with the results of Hajizadeh study.

Natural and restored teeth are constantly exposed to occlusal and chewing forces. During these constant contacts and stresses to the teeth, restoration is deformed and small cracks begin to from on or below the surface of the teeth. With the accumulation of these fine cracks on the restoration surface, gradual perforation (Pit) occurs (20). In addition, these fine cracks can penetrate inside of the restoration and lead to a big failure (21). Theoretical and practical studies of abrasion and mechanical properties of nanocomposites compared to micron sizes showed that nanocomposites have better performance (21, 22, 23). But the findings reported in present study do not support this theory. Not surprisingly, because Microfill and Nano fill composites actually contain fillers of the same size. With this in mind, increased abrasion depth and weight loss of some Nano fill composites can be due the fact that these filler particles are so small that they cannot easily tolerate the occlusal forces (24), on the other hand, smaller particles can easily be washed off by surface roughness of their opposite surfaces. Another reason for the increase in the abrasion depth, especially in Nanohybrides, is the presence of large glass particles in their composition. In general, it can be said that similar abrasion of all these composites (Z250, Z350, Heliomolar) is due to the small overall size of the particles of these composites, since none of these composites have filler particles larger than 1 µm (25).

In the study by Juliana da Costa et al., it was shown that Micro fill composites have a similar surface roughness and shine after brushing. due to the size similarity of their particles with Nano fill composite (both composites have particle sizes smaller than 100 nm) (26).

Yesil et al. compared the abrasive properties of two Nano fill composite samples (Supreme and Premise) with micro fill (Heliomolar RO) and Microhybrid (Point 4) composites. The results of their study, similar to the present study, showed that the type of composite has no effect on the amount of abrasion, which can be due to the similar weight percentage of fillers in these composites, all of which are between 75-80% (27). In the present study, composites had similar weight percentages too. Therefore, the use of nanofillers in composites does not affect their abrasion resistance.

The presence of saliva creates a protective layer on the surface of restorative materials. Which can affect the effect of bleaching agents. On the other hand, it was mentioned in some studies that saliva affects the carbamide peroxide as an accelerator factor, so the effect of saliva cannot be ignored. Therefore, it is recommended that further studies should be conducted by considering the in vivo conditions. Meanwhile, it should be kept in mind that keeping samples in water can cause changes in the filler and matrix contact surfaces, which undoubtedly affect the results of the study.

CONCLUSION

In the study, it was concluded that bleaching with 40% hydrogen peroxide had no effect on the

amount of abrasion of the composites studied (Z250, Z350, Heliomoar), the type of composite does not affect the amount of their abrasion, and the merging of nanoparticles in composites does not improve their abrasion properties.

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