Original Article

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Comparison of the Effect of Different Bleaching Régimes of Carbamide Peroxide on Wear of Z250 Composite

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ABSTRACT

BACKGROUND AND OBJECTIVE: wear is the one of factors which can influence on the clinical performance of composites. Tooth bleaching agents can effect on these materials. The aim of this study was the comparison of the effect of different bleaching regimes of carbamide peroxide on wear of Z250 composite

METHODS: in this in vitro study, 40 disk shape sample of Z250 were made with 7mm in diameter and 2mm in thickness by plastic molds. Samples divided in 4 groups randomly (n=10): In first group (control group), samples were toothbrusted (for 20000 cycles) with no carbamide peroxide (were kept in 37 °C distilled water for two weeks), in second group, samples that were tooth brusted with 10% carbamide peroxide (4 hours daily for 2 weeks). In third group samples were toothbrusted with 16% carbamide peroxide (3 hours daily for 2 weeks). Fourth group were toothbrusted with 22% carbamide peroxide (1 hour daily for 2 weeks) Weight of samples were recorded before and after wear test.

FINDINGS: The mean of weight loss (gr) of samples in control group was 0.001±0.0016, for second group was 0.0048±0.0089, for third group was 0.0013±0.0025 and for fourth group was 0.0005±0.0002. There were decrease in samples wear with increasing of peroxide concentration but this difference was not statistically significant.

CONCLUSION: Based on the findings of this study, carbamide peroxide 10%,16% and % had no effect on tooth brush wear rate of Z250 composite.

KEY WORDS: *Bleaching Agents, Composite Resins, Tooth Brushing.*

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Introduction

Recent studies have suggested that teeth bleaching has high success (1,2). For whitening the color of the tooth change the peroxide releasing agents, such as hydrogen peroxide and carbamide peroxide are used. Studies have shown that these materials do not have a detrimental effect on the structure of the teeth. (3) By release of free radicals, they resulted in breakdown of colored materials inside the teeth, thereby brightening the tooth (4). Resistance to wear is one of the most challenging factors in dental materials (5,6).

Abrasion is a mechanism that occurs whenever surface is exposed to the surface or material with chemical activity (7). Abrasion is one of the factors affecting the clinical function of various types of restorative materials. Usually, there is little relation between abrasion and other mechanical properties of materials. The increase in wear is due to a complex process involving mechanical, thermal and chemical agents (8). Wear mechanisms are classified clinically as wearing, crocheted, fatigued and supplemented (Two or three physical body).

Abrasive wear is the most common type of abrasion that occurs more than other types in the oral environment. Two-body wear occurs due to the contact between the dental surfaces or the composite of the forehead or other restorative materials. Three-body wear occurs when two surfaces move in the presence of a layer of their abrasive particles (11-9). Resistance to wear of the material can be measured by the amount of mass loss (12). Abrasive wear on the composite can be due to contact with the food mass or toothbrush (13). Despite the great benefits of brushing teeth, toothbrushes can cause surface damage to restorative materials (such as increased surface irritation and abrasion), which increases the potential for plaque accumulation and soft tissue inflammation (14).

The severity of this damage depends on the type of composite, the type of toothpaste and some other factors interfering with it. Composite properties such as the size of the particles, the shape and type of filler, the composition of the resin matrix can be effective on wear resistance (13). In the past, enamelled teeth experienced more aggressive therapies, such as prosthetic treatments, but today, easier, cheaper and more efficient techniques such as bleaching, which are also widely accepted, have been introduced and have made bleaching one of the most popular treatments in dentistry in recent decades (15-18). In the teeth whitening technique, various concentrations of materials such as hydrogen peroxide, carbamide peroxide and sodium perborate are used to bleach live and non-living teeth (19). It has been shown that dental bleaching agents can change some of the properties of the composites. Tooth whitening can increase surface irritation, porosity of microfiltrate and microhybrid composites, and makeup of the composites (20-23). Mair and his colleagues also examined the effect of 6% hydrogen peroxide on three types of ionomer glass and showed that the material did not affect the abrasion of ionomer glass materials (24). Hasani Tabatabaei et al. stated that the use of 3 to 8 hours of carbamide peroxide had a 45% detrimental effect on the abrasion resistance of Z250 and P90 (25). Faraoni et al. also showed that 10% carbamide peroxide does not affect the abrasion depth of their composites, but there is a significant difference between different restorations materials (26). Hajizadeh and colleagues also showed that carbamide peroxide 15% increases the compaction rate (27). Due to very limited studies in this field, there is not enough information on the effect of dental bleaching on the degree of composites wear. Therefore, the aim of this study was to investigate the effect of 10%, 16% and 22% carbamide peroxide on the rate of microfibrillation z250 composite wear.

Methods

In this experimental study, after approval by the Ethics Committee of the Babol University of Medical Sciences, MUBABOL.REC.1396.10, the composite (3M: ESPE, USA) z250 was used in the color of A2 and carbamide peroxide 10%, 16% and 22% (Table 1). Fourteen composite samples (28) were made in the form of discs of 7 mm in diameter and 2 mm in thickness using plastic molds. After placing the composite into the productive, a transparent strip and a glass slab were placed on it. The upper surface of specimens was exposed to the Astralis 7 light cure device (Ivoclar vivadent, liechtenstein), 2 cm/750 mAh for 20 seconds (according to the manufacturer's instructions). After extracting the specimens from the mold, other sides were exposed to light for 20 seconds. The samples were filled with 400 to 1200 grit silicon carbide paper. The specimens were then stored in distilled water (37 ºC) for 24 hours.

Methods of carbamide peroxide application: The samples were randomly divided into 4 groups of 10: In group 1(control group), Z250 composite samples without toothbrushing were treated with carbamide peroxide (stored in distilled water at 37 degrees for two weeks). In the second group, Z250 composite specimens were applied tooth brushing after bleaching (Whiteness perfect, FGM, Brazil), 10% carbamide peroxide (4 hours daily for 2 weeks). In the third group, Z250 composite samples were applied tooth brushing after application of bleaching agent (Whiteness perfect, FGM, Brazil), 16% carbamide peroxide (3 hours a day for 2 weeks). In fourth group, samples of Z250 composite were applied tooth brushing after application of bleaching agent (Whiteness perfect, FGM, Brazil), 22% carbamide peroxide (1 hour for 2 weeks). The upper surface of the specimens was covered with a 1 mm thick blacktop material at room temperature. After use of the bleaching agent, the specimens were washed under running water for 1 minute and at intervals of bleaching sessions, samples were distilled in 37 °C.

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Toothbrush abrasion test: Before each type of abrasion, each specimen was packed with a drying paper inside a special plate for 10 minutes at 37 degrees to be uniformly de-watered and then electrically (starting orius, germany) with an accuracy of 0.1 milligrams was weighed and recorded in the relevant table. Abrasion test of samples were performed according to ISO-14569-1 (29). Abrasion test was carried out in a mechanical toothbrush wearing machine. (V8 CROSS BRUSHING MACHINE model, Spasan Peak Design, Iran), this machine has 8 stainless steel holders and 8 acrylic-resin bases to maintain the sample in each base.

The heads of the Trisa pro interdental (Trisa, Switzerland) toothbrushes were used with medium type nylon brushes with a force of 400 gr perpendicular to the slider surface, and a total of 20,000 hits (equivalent to 2 years of brushing) (30, 31) were applied. The toothbrush was set to 100 beats per minute in full motion. Aqueous mixture was prepared by mixing 20 g of toothpaste crest complete 7 (crest, USA) and 20 ml of distilled water with the same concentration for all specimens, so that the surface of all specimens was covered, immediately before the start of the test. This watery mixture was constantly stirred to prevent the abrasive particles from depositing into the toothpaste. The abrasion was carried out at room temperature of 23 degrees.

Toothbrushes have been replaced by 20,000 new ones. After the end of the experiment, the samples were removed from the mold and washed in plain water and placed in ultrasonic apparatus (star sonic 25, Argofil, Japan) for 10 minutes. Then each sample after drying with a drying paper was placed inside a special plate for 10 minutes in oven to be uniformly de-watered. The weight of each sample was measured two times, and the weight loss was calculated for each sample based on gram. The results were analyzed using one-way ANOVA and SPSS statistical software 22. P value less than 0.05 was considered significant.

Table 1. Name, type and chemical composition of the materials used in the study

Name (Manufacture company)	Type	Comosition
Filtek Z250 (3M ESPE)	Microhibrid company	Bis-GMA, Bis-EMA, UDMA Fillers: zirconia, silica (content: 78% by wt and 60% by vol; particle size: 0.01-3.5 μm)
Whiteness Perfect (FGM Produtos Odontológicos)	Carbamide peroxide (10%, 16%, 22%)	Carbamide peroxide, Carbopol, humectants, potassium nitrate, and sodium fluoride

Results

In this study, the effect of Carbamide Peroxide 10, 16 and 22% on wear resistance with Z250 micro-hybrid composite toothbrushes was investigated. The mean and standard deviation of sample weight loss are given in Table 2. One-way ANOVA showed that the mean weight loss of the control group (0.0009±0.0001) was more than the 10% carbamide peroxide group (0.0008), the carbamide peroxide 16% (0.002±0.0013), and the carbamide peroxide 22% (0.0005±0.0002), but this difference was not statistically significant ($p>0.05$). Statistical analysis showed that different concentrations of carbamide peroxide had no effect on the wear degree of composite z250. Power analysis was performed using SPSS 11 software. (Table 3).

The extent of study ability in the discovery of 2 mg was the difference between the groups with a mean standard deviation of 5.1 mg compared to 0.84.

Table 2. Comparison of mean and standard deviation of weight before and after wear and wear rate (g) of studied groups

Group	Before wearing	After wearing	Wear rate
Control	0.1761±0.0097	0.1752±0.0096	0.0009±0.0016
Cp*10%	0.1747±0.0093	0.1739±0.0136	0.0008±0.0007
Cp16%	0.1732±0.0091	0.1719±0.009	0.0013±0.002
Cp22%	0.1658±0.0171	0.1653±0.017	0.0005±0.0002

***Cp: Carbamide peroxide, P=0.74**

Table 3. The power level of the ANOVA analysis

n	K	N	Mean±SD	Effect size	Power
10	4	40	0.00±0.00	0.577	0.838

Discussion

The present study showed that exposure to different concentrations of carbamide peroxide bleaching agent does not affect the amount of composite abrasion. Natural and restored teeth are constantly exposed to occlusive and chewing forces. During these continuous contacts and stresses, injuries to the teeth are caused by deformed teeth and cracks formed on or below the surface of the teeth. With the accumulation of these fine cracks on the surface, gradual perforation (Pit) occurs (32). In addition, these fine cracks can penetrate the inside of the repair and produce a large failure (33). There has been a study of the effect of bleaching on restorative materials, but its effect is not clear. A group of studies have argued that carbamide peroxide can cause soft tissue complications (34,35).

Bleaching group is considered as a factor in increasing the surface hardness (34) and its group reduces surface hardening and softens the composite and increases its wear in areas of stress (36, 35). Bleaching agents in the office (35% carbamide peroxide, 35% hydrogen peroxide) did not significantly affect the surface hardness and tensile strength of composite materials (37,38). Adding hydrogen peroxide 10% can change the clinical color change of the

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composite (39), but carbamide peroxide 10% does not cause a change in clinical color change in the composite (40). Hasani Tabatabaei and colleagues showed that 45% carbamide peroxide had no harmful effect on abrasion resistance of z250 and P90 composites (25). Faraoni-Romano et al. also stated that the effect of 10% carbamide peroxide does not have a significant effect on the abrasion depth of composites (26). Similar findings were obtained in the present study and 10%, 16% and 22% Carbamide Peroxide had no effect on the amount of Z250 composite wear. But Hajizadeh et al. evaluated the effect of 15% carbamide peroxide on the wear of three different composite materials (Z100, Z250, Supreme), which showed that there was a significant difference between the weight loss of all samples before and after bleaching, and the amount of wear was reduced by using carbamide peroxide (27).

The reason for this difference could be the time difference between the storage time of samples in water. In the study of Hajizadeh et al., samples were exposed to aging for 2 weeks, whereas in the present study samples were exposed to carbamide peroxide after 24 hours. Different studies have examined the effect of aging in water on the properties of composites. Egilmez and colleagues showed that three-week maintenance in water reduces the flexural strength of CAD/CAM composites (41). Hahnel et al. stated that the maintenance of composites for 7, 90 and 365 days in water reduced the flexural strength, the hardness of the wicks and increase the surface violence (42). The maintenance of composite in aqueous solutions results in the leakage of composite ions, degradation of resin cross linking of the resin and filler (43-45). Hence, preservation in water can affect the effect of carbamide peroxide on the abrasion of composites. Although there was no significant difference in the concentration increase of carbamide peroxide in composite wear. After use in the mouth, carbamide peroxide was converted to 3.3% hydrogen peroxide. It has been shown that hydrogen peroxide has a high potential for oxidation and radical regeneration and production. It also has a high penetration power (46). Peroxide can break the polymeric chain. Unreactive monomers are the most susceptible component of peroxide. Peroxide results in microscopic cracking (35), which affects the binding surface of the resin and the filler. For this reason, it seems that increasing the percentage of peroxide leads to increased compaction wear. However, because of the fact that the percentage of peroxide produced by 10%, 16% and 22% carbamide peroxide, which was studied in this study, is very low, this may not have a significant effect on the amount of abrasion. In this study, the increase in the concentration of carbamide peroxide resulted in a slight reduction in the wear in the studied groups, which was not statistically significant. Low levels of hydrogen peroxide appear to increase surface hardness, but if this amount increases to a certain extent, these free radicals can break the polymeric chain and ultimately reduce the surface tension (27).

The presence of saliva creates a protective layer on the surface of restorative materials that affects the effect of bleaching agents. Camila and colleagues argued that maintaining composite in artificial saliva reduces the amount of composite wear. (47) On the other hand, in some studies, saliva has been shown to act as an accelerator on carbamide peroxide, so the effect of saliva cannot be ignored. In addition to the damp conditions inside the mouth, there are other conditions within the mouth that affect the physical properties of the composite, such as the low pH caused by bacterial plaque and acidic foods, and the enzymatic attacks of the oral medium (48). Therefore, it is suggested that other studies be conducted for considering 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 will undoubtedly affect the results of the study. According to the findings of this study, the concentrations of carbamide peroxide (10%, 16% and 22%) used in this study have no effect on the degree of wearing with the zinc-hybrid microbial composite toothbrushes.

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