IN-HOME BLEACHING EFFECT ON COMPRESSIVE STRENGTH VALUES OF SOME DIRECT RESTORATIVE MATERIALS

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Abstract

Patients commonly have restorations in posterior teeth, made of resin-based composite, amalgam or glass ionomer or another material. Questions remain concerning the need for replacement of posterior restorations after bleaching. It's not clear if the bleaching agents exert some effect on the restorative materials that could harm the quality and longevity of these restorations. The aim of this study is to evaluate the effect of in home bleaching material on the compressive strength of different direct restorative materials.

Three types of direct restorative materials: (two types of light activated composites, TG fine glass (Technical & General Ltd, Germany); Cavex (Quadrant Universal LC, CE 0197; Germany)) and one type of amalgam restorative material; World-Cap (Ivoclar vivadent FL-9494 schaan/Liechtenstein, Sweden) were used in this study. Forty resin composite specimens and 20 amalgam specimens were prepared using a circular nickel-chromium split mold with 3 mm in inner diameter and 6 mm in height. The twenty samples of each restorative material being selected were divided into 2 groups: ten tested before treatment with home bleaching tooth whitening system and the other ten, tested after treatment with home bleaching system (WHITE smile HOME BLEACHING, 35% carbamide peroxide, Germany) for 8 hours: (4X2 hours). Specimens were placed into a dark bottle containing distilled water at 37°C for 7 days before testing procedure. Compressive testing was performed in a Universal Testing Machine at a crosshead speed of 0.5 mm/min. The data was calculated in MPa and data were analyzed by one way ANOVA at 0.05 level of significance.

All direct restorative materials being tested, exhibited statistically insignificant differences ($P \geq 0.05$) in compressive strength values between the two groups (before and after bleaching) except for TG direct restorative composite, which exhibited statistically significant differences ($P < 0.05$) in compressive strength values between the two groups (before and after bleaching).

All the restorative materials being tested exhibited lower compressive strength values after bleaching in comparison with their values before bleaching. In-Home bleaching material should not be used when TG light activated composite restorations.

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Introduction

Esthetic dentistry, particularly tooth whitening, is one of the most rapidly growing areas in dentistry, and vital tooth bleaching is a popular treatment modality[1, 2].

Many techniques for vital tooth bleaching are available: in-office and at home bleaching systems. The latest one is called also night guard vital Bleaching or NGVB. NGVB is an esthetic procedure where the patient, at-home, uses

custom-fitted prostheses to apply a solution to lighten vital teeth. The American Dental Association's (ADA) accepted standard for the procedure recognizes the use of a 10% carbamide peroxide or CP material. The CP concentration, however, may vary from 10-35%.

Restorative filling materials used in dentistry require long-term durability in the oral cavity[3]. In order to find out the performance of restorative materials against masticatory forces, it is required to determine the compressive strength values of the restorative materials. Several investigators have studied the effects of home bleaching on oral tissues and restorative materials[4, 5].

At-home as well as in-office bleaching agents have a softening effect on some tooth colored restorative material, and the patient must be aware before using them[6].

Material and Methods

Three types of direct restorative materials (two types of light activated composites, TG fine glass (Technical & General Ltd, Germany) and Cavex (Quadrant Universal LC, CE 0197; Germany) and one type of amalgam, World-Cap) were used in this study.

Forty resin composite specimens were prepared (20 for each type of composites being tested) by incremental (three increments) insertion of composite into a circular nickel-chromium split mold with 3 mm in inner diameter and 6 mm in height and cured using Blue phase C5 (Ivoclar, Vivadent) LCU for 40 seconds for each 2 mm increment of composite thickness. For the preparation of the 20 amalgam specimens, the freshly triturated World-Cap amalgam (Non-gamma-2, spherical 40% silver alloy amalgam in self-activating capsule, Ivoclar vivadent FL-9494 schaan/Liechtenstein, Sweden) was introduced into the mold and condensed incrementally into the mold until it became over filled then by simple movement of a glass slide over the excess amalgam, the top surface of the specimen became flat. After 24 hours, the two halves of the mold were separated and the amalgam cylindrical specimen was removed.

Twenty samples were prepared for each restorative material being tested, ten tested before treatment with home bleaching tooth whitening system and the other ten tested after treatment with home bleaching system (WHITE smile HOME BLEACHING, 35% carbamide peroxide, Weinheimer strabe 6. 69488 birkenau. Germany) for 8 hours: (4X2 hors).

Specimens were placed into a dark bottle containing distilled water at 37°C for 7 days before testing procedure. Specimens were positioned vertically on the testing machine base and subjected to compressive load until failure. Compressive testing was performed in a Universal Testing Machine at a crosshead speed of 0.5 mm/min.

The compressive strength (CS) was calculated by dividing the failure load (F) by the cross-sectional area, i.e.: CS = F/πR2, where R is the radius of the cross-section of the specimen.

Mean compressive strength values were expressed in MPa and data were analyzed by one way ANOVA at the 0.05 level of significance.

Results

Mean compressive strength values, standard deviations of amalgam, Cavex and TG composites in MPa before and after bleaching are presented in table 1.

	Amalgam		Cavex		TG	
	before	after	before	after	before	after
Mean	159.2	138.5	204.8	201.8	241.4	182.2
SD	20.92	44.13	65.18	37.79	44.39	57.21

Table 1. Mean compressive strength values and standard deviations of tested restorative materials before and after bleaching in MPa.

For amalgam restoration, statistical analysis of data by using one-way analysis of variance (ANOVA) revealed that, there was statistically insignificant difference (P≥0.05) in compressive strength values between the two groups before and after bleaching as shown in Table (2).

Source	DF	SS	MS	F	P
Factor	1	2142	2142	1.80	0.197
Error	18	21464	1192		
Total	19	23607			

Table 2. ANOVA for amalgam before and after bleaching.

For Cavex composite restoration, statistical analysis of data by using one-way analysis of variance (ANOVA) revealed that,

there was statistically insignificant difference (P≥0.05) in compressive strength values between the two groups before and after bleaching as shown in Table (3).

Source	DF	SS	MS	F	P
Factor	1	45	45	0.02	0.901
Error	18	51091	2838		
Total	19	51136			

Table 3. ANOVA for Cavex composite before and after bleaching.

For TG composite restoration, statistical analysis of data by using one-way analysis of variance (ANOVA) revealed that, there was statistically significant difference (P<0.05) in compressive strength values between the two groups before and after bleaching as shown in Table (4).

Source	DF	SS	MS	F	P
Factor	1	17523	17523	6.68	0.019
Error	18	47192	2622		
Total	19	64715			

Table 4. ANOVA for TG composite before and after bleaching.

Discussion

In order to find out the performance of restorative materials against masticatory forces, it is required to determine the compressive strength values of the restorative materials.

Bleaching agents affect lightening of discolored tooth structure through decomposition of peroxide into free radicals. The free radicals break down large pigmented molecules included in reflecting a specific wavelength of light and are responsible for the color stain in enamel, into smaller less pigmented molecules through oxidation and reduction[7, 8].

In addition to the oxidizing agent used in the at-home bleaching procedure an additive called carbopol (carboxy polymethelene) may be added to thicken the gel that improves adherence to the tooth surface and prolongs the release of oxygen. This additive keeps the gel contained within the tray better and slows the chemical reaction[9].

The effect of the active agents of bleaching solutions has not been adequately investigated since there have been a limited number of studies done on their effects on restorative materials[1, 10]. TG composite is the only direct restorative showed a significant difference reduction in compressive strength values (Table 4) after the exposure to the at home bleaching process compared to other direct restorative materials being tested in this study (World-Cap amalgam and Cavex composite were insignificantly affected by bleaching material (Tables 2&3).

This could be contributed to the type, size, and volume fraction of the filler particles and the degree to which the filler is bonded to the resin matrix. Filler-matrix interactions appear to have a great effect on increasing the resistance of composite resin[11].

Restorative material	Classification	Composition
World- Cap amalgam	Non-gamma-2, spherical 40% silver alloy amalgamin self-activating capsule.	One size 1 capsule contains: Powder Silver: 183 mg Tin: 142 mg Copper: 133 mg Liquid Mercury: 400 mg
Cavex	Fluoride releasing radiopaque microglass composite for universal application.	Bis-GMA matrix and contains 60% filler by volume (72% by weight) which is: • Ba-Al-F-silicate glass (0.02-2 µm) • Highly dispersed silicon dioxide (0.02-0.07 µm)
TG	Fine glass hybrid light-activated composite	Barium glass (silan) 74% pyrogenic silica (silan) 3% in a matrix of Bis-GMA, TEGDMA and UDMA

Table 5. Composition of the materials being tested (manufacturer's data).

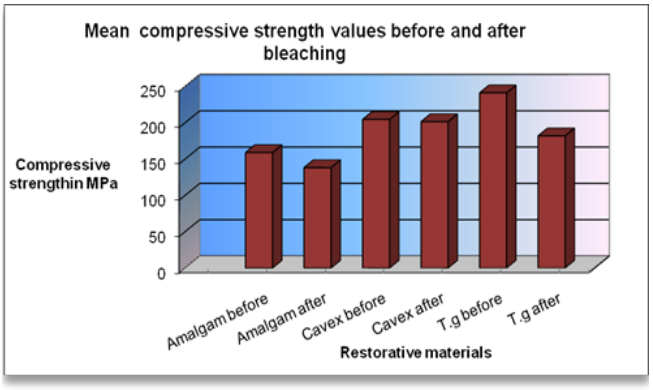

Figure 1. Mean compressive strength values for restorative materials before and after bleaching.

Carbamide peroxide (at-home bleaching) breaks into urea and hydrogen peroxide. Hydrogen peroxide in turn breaks down into free radicals, which eventually combine to form molecular oxygen and water. Some aspect of this chemical process may accelerate the hydrolytic degradation of tooth colored restorative materials[12].

Since both Cavex and TG composites used in this study had an approximately the same filler percentage by weight (72% and 74% respectively) (Table 5) , the main cause behind this difference in compressive strength values before and after bleaching is in the resin matrix. Cavex composite contained only one type of resin matrix (Bis-GMA without diluents monomers) (Table 5) while TG composite contained three types of resin matrixes (Bis-GMA, TEGDMA and UDMA with diluents monomers) and the incorporation of TEGDMA diluents monomer in TG composite showed less resistance to the bleaching material than the principal monomers (Bis-GMA and UDMA) in spite of its high mean compressive strength value before bleaching in comparison with Cavex composite (Figure 1).

Conclusions

1. All the restorative materials being tested exhibited lower compressive strength values after bleaching in comparison with their values before bleaching.
2. All the materials being tested showed insignificant differences in compressive strength values before and after bleaching except for TG composite which showed significant differences in compressive strength values before and after bleaching.

Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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