

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

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Abstract

Amalgam and composite resin materials are considered the main durable direct restorative materials. Diametral tensile strength (DTS) of any restorative material is an essential test that could reflect the tensile behavior of the restorative material during function in the oral cavity. This strength could be affected by the use of bleaching agents used nowadays for the purpose of tooth whitening and consequently might interfere with their longevity. The aim of this study was to evaluate the effect of in-home bleaching material on the DTS of an amalgam and two composite resins.

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; 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 6 mm in inner diameter and 3 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. DTS 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 t-test at 0.05 level of significance.

World-Cap amalgam restorative material being tested, exhibited statistically insignificant differences ($P \geq 0.05$) in diametral tensile strength values between the groups before and after bleaching while TG and Cavex restorative composites, exhibited significantly lower DTS values after bleaching compared to the values before bleaching.

DTS values of the two composite restorative materials being tested is significantly influenced by the bleaching agent.

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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 diametral tensile

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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

Although there have been few reports of bleaching effects on amalgam restorations, studies^{7,8} suggest that there may be significantly more mercury released from amalgam restorations during the bleaching procedure. It appears that prolonged treatment with bleaching agents may cause micro-structural changes in amalgam surfaces and this may possibly reduce its general strength and increase exposure of patients to toxic by-products.⁸

Existing amalgams may change color from black to silver.⁸

The objective of this study was to evaluate the effect of in-home bleaching agent on the DTS of an amalgam and two different composite resins.

Materials and Method

Three types of direct restorative materials (two types of light activated composites, TG fine glass (Technical & General Ltd, Germany) and Cavex (Quadrant Universal LC,; Germany, batch no. CE 0197) 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 (two increments) insertion of composite into a circular nickel-chromium split mold with 6 mm in inner diameter and 3 mm in height and cured using Blue phase C5 (IvoclarVivadent, Liechtenstein) LCU for 40 seconds for each 1,5 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, Schaan Liechtenstein, batch no. FL-9494) 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.

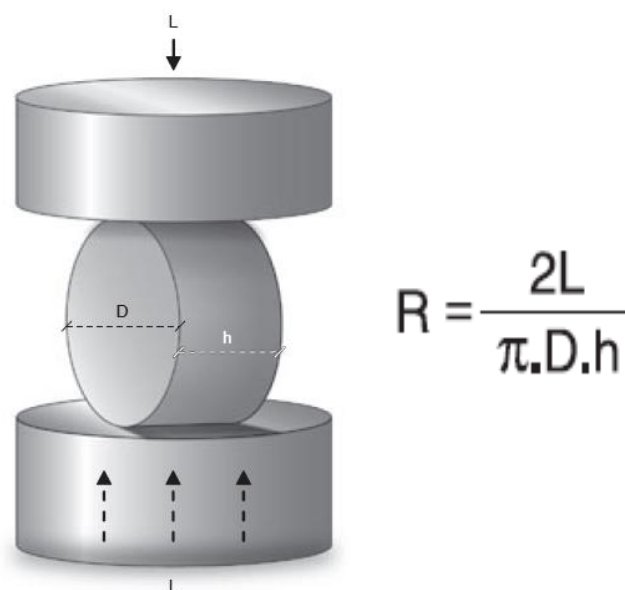
After 24 hours, the two halves of the mold

were separated and the amalgam disk 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 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 horizontally on the testing machine base and subjected to compressive load until failure (Figure 1).

The DTS was calculated using the equation: $DTS = \frac{2L}{\pi Dh}$, where L is the failure load, D the diameter, and h the height of the specimen.

Mean DTS values were expressed in MPa and data were analyzed by t- test at the 0.05 level of significance.



$R = DTS$, L: load, D: diameter, h: height.

Figure 1. Diagram of diametral tensile strength test.

Results

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

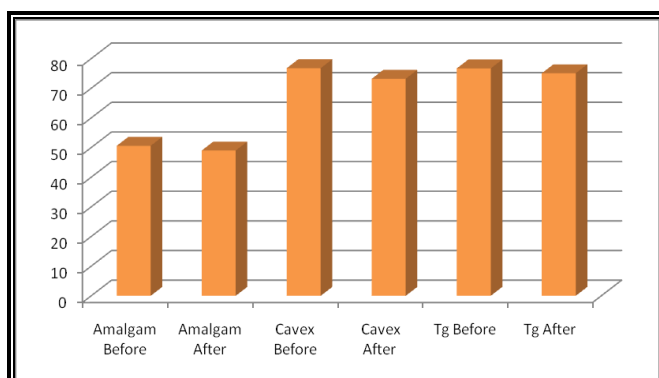


Figure 2. Mean DTS values for restorative materials before and after bleaching.

	Amalgam		Cavex		TG	
	before	after	before	after	before	after
Mean	47.41	45.28	72.89	68.99	72.182	69.70
SD	9.01	8.79	9.89	9.616	11.09	11.56

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

T-test indicated that, there was statistically insignificant difference in DTS values ($p > 0.05$) before and after bleaching for World-Cap amalgam restoration being tested while there were statistically significant differences in DTS values ($p < 0.05$) before and after bleaching for Cavex and TG composites as shown in Table (2).

Discussion

In the last few years, industry worked in order to improve the physical and mechanical properties of composite. A concern exists about the effect of bleaching on the physical properties of restorative materials.⁹ Bleaching is widely applied in approaches to improve dental esthetics. Due to the chemical nature of this reaction, it is expected that different substrates in the oral environment, such as dental substrates and restorative materials, will respond differently.^{6, 10, 11}

Different bleaching systems are indicated for at-home or in-office treatments; the active ingredients of these two methods are typically carbamide peroxide and hydrogen peroxide, respectively.¹¹⁻¹³ Due to these differences and the differences in concentration and frequency of use, these two methods can lead to distinct

reactions with different restorative materials.^{6, 14, 15}

35% carbamide peroxide is the most commonly used solution in dental bleaching procedures. When such a solution is activated, it decomposes into perhydroxyl ions and active oxygen, which break the double bond of the chromophore structure of the organic molecules into simpler and lighter colored molecules.^{16, 17}

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.¹⁸

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, 19} Two studies^{20, 21} indicated that, carbamide peroxide statistically reduce the microhardness of some composites being tested in that study. Another study²² indicated that, 35% H₂O₂ has no significant effect on the microhardness of Tetric ceram composite resins while can reduce the microhardness of 3M composite resins and these findings coincide with the results of Petros Mourouzis et al²³ who found that, bleaching procedure did not alter the microhardness and the surface roughness of all composite resins tested in their study. In this study, TG and Cavex composites showed a significant difference reduction in DTS values (Table 2) after the exposure to at home bleaching process compared to World-Cap amalgam restorative material being tested which was insignificantly affected by bleaching material.

Paired samples Test	
Pairs	Sig. (2-tailed)
Amalgam before X Amalgam after	0.141
Cavex before X Cavex after	0.003
TG before X TG after	0.025

Table 2. t-test of the restorative materials before and after bleaching.

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.²⁴ 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.¹⁹

Since both Cavex and TG composites used in this study had an approximately the same filler percentage by weight (72% and 74% respectively) (Table 3), their physical properties were approximately the same regarding DTS values before bleaching and affected to approximately the same degree after bleaching (Figure 2) due to their approximately similar resin matrix composition and filler percentage by weight loading.

Restorative material	Classification	Composition
World- Cap amalgam	Non-gamma-2, spherical 40% silver alloy amalgam in self-activating capsule.	One size 1 capsule contains: Powder Silver 183 mg Tin 142 mg Copper 133 mg Liquid Mercury 400 mg
Cavex composite	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 composite	Fine glass hybrid light-activated composite	Barium glass) 74% pyrogenic silica 3% in a matrix of Bis-GMA, TEGDMA and UDMA

Table 3. Composition of the materials being tested (manufacturer's data).

In this study, The DTS of dental amalgam showed insignificant differences before and after bleaching (Table 2) and this could be related to the metallic nature of dental amalgam as a direct restorative material and dental bleaching could produce minor structural changes limited only to the surface or to the color of dental amalgam.^{7, 8}

The severity of the effect of bleaching gel depend on it is ability to diffuse or penetrate through the composite resins surfaces, especially through it is organic matrix.²² This can also

explain to us why amalgam was not affected by the bleaching gel in this study, which might be attributed to the inability of the bleaching gel to penetrate through the amalgam material while the decrease in DTS of Cavex and TG composites might be attributed to the ability of the bleaching gel to penetrate and diffuse through these materials.

Conclusion

DTS values of the two composite restorative materials being tested is significantly influenced by the bleaching agent.

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