

The effect of 35% H₂O₂ and 22% carbamide peroxide on compressive strength of composite resin

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ABSTRACT

Back ground: The compressive strength of composite resin may be affected by bleaching agent. This study was conducted to evaluate the effect of two different bleaching agents; at home (22% carbamide peroxide) and in office; light activated (35% hydrogen peroxide) bleaching agent on the compressive strength of light cured composite resin; spectrum (submicron hybrid composite).

Material and methods: A total number of 20 samples were prepared, 10 samples for each type of bleaching agent which were divided in to 2 groups; first group was subjected to at-home bleaching for one day. The second group was subjected to at-home bleaching for one week, The third group was subjected to the in-office (35% H₂O₂) for one day. The fourth group was subjected to in-office bleaching for three days.

Results: There were statistically significant differences between the tested groups (p=0.048). Highly significant reduction of the compressive strength of composite was observed subsequent to treatment with H₂O₂ for three times.

Conclusion: Reduced compressive strength was detected in composite when it was subjected to bleaching process with H₂O₂ carbamide peroxide.

Key words: Bleaching, hydrogen peroxide, carbamide peroxide, compressive strength. (J Bagh Coll Dentistry 2011;23(4):16-19).

INTRODUCTION

Currently, the general population relates modern dentistry to improve facial aesthetics, health, and social success.⁽¹⁾

Bleaching when combined with advanced restorative techniques & materials can optimize esthetic results.⁽²⁾

In office bleaching utilizes a gel or liquid of high concentrations of hydrogen peroxide applied to the tooth surface and allow the bleaching agent to remain on teeth for 8 minutes. A heat source, usually a visible light curing lamp is used to enhance the bleaching process.⁽³⁾

Another technique available is at-home bleaching, it is called night guard vital Bleaching. It was first described by *Hay wood* and *Heymann* in 1989. Night guard vital bleaching is an esthetic procedure where the patient, at home, uses custom-fitted prostheses to apply a carbamide peroxide containing gel to lighten the vital vary from 10% to 22%.

Several studies have established the safety and efficacy of the Bleaching agents. However there are concerns about the effects of these agents on the chemical teeth.⁽⁴⁾ The carbamide peroxide concentration may composition, surface texture, microhardness and toughness of enamel, dentine and cementum.

Compressive strength is important in many restorative dental materials. This property is particularly important in the process of mastication because most of the forces of mastication are compressive. Compressive strength is the most useful for comparing materials that are brittle and generally weak in tension therefore; a useful property for comparison of dental amalgam, resin composites, and cements and for determining the qualities of other materials.⁽⁶⁾

Some controversy has arisen regarding the effects of Bleaching agent on the restorative materials. Although several studies have not reported significant changes, other indicated that the physical properties of certain restorative material may be affected.⁽⁵⁾

MATERIAL & METHOD

Twenty samples were prepared for spectrum (submicron hybrid composite) by utilizing cylindrical Teflon molds (6mm in height and 4mm in diameter). The molds were placed on transparent celluloid strip that fixed on a glass cement slab. The material inserted and pressed into the mold until it was intentionally over filled, then the material was covered with another matrix strip and a glass microscopic slide. Thousand gm pressure was applied to expel excess material from the mold.

The specimens were polymerized in the compressive strength molds with the conventional visible light for 40 seconds for each of 3mm increment, the specimens then were

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cured for 40 additional seconds on two sides, for a total exposure time 160 seconds.

After specimens were light-cured through the application of the tip of light cure directly on the top glass slide, the specimen was removed from the Teflon mold and all samples were rinsed very well with deionized distilled water and then stored in plastic containers that contained deionized distilled water and put in an incubator that set on temperature (37c) for 24hrs.

The bleaching procedure was performed at the surface of each sample. A timer was used to determine the treatment period for each group. Before application of the bleaching agent each composite sample was wiped with a piece of sterile cotton.

The bleaching agents were applied using a disposable brush to paint the surface of the composite and totally covered the top-surface of every sample, this method according to *Nadia* in

2005 would more closely resemble the in vivo conditions as opposed to immersing the specimens in a container of gel. At the end of the respective bleaching procedure, the treated specimens were cleaned with a piece of cotton and rinsed under running distilled water for 2 minutes to remove any remnants of the bleaching agent and placed in a fresh distilled water until the next application or until the end of the time period and returned to incubator in(37c).

For treatment with 22% carbamide peroxide, composite samples were subjected to 22% cp gel for 40 min/day as recommended by the manufacturer and during this time, samples were stored in a light proof container and then they were stored at incubator temperature (37c), this is for more closely resemble the in vivo conditions. These bleaching steps repeated daily and for one week. For treatment with 35% H₂O₂, composite samples were subjected to 35% Hp gel, the time of application is 8 minutes and during this time each sample was exposed to a conventional halogen curing light machine for 30 sec and the tip of curing light put as near as possible from the bleached surface as recommended by the manufacturer. This step was repeated for three times for each sample, so the total exposure time to pol office bleaching agent for each sample was 24min/week.

Compression test Instrument

The specimens were all subjected to compressive strength test using a hydraulic press type ley bold harris NO.36110. The procedure of testing was performed as following: The composite resin specimen was placed on a mobile base of the machine, then left up this base until the specimen surface contacted with the

upper surface of the machine. Then the mechanical force was applied on the specimen until fracture was occurred. The compressive strength of the specimen calculated by the application of following formula:

$$\text{Compressive strength} = \frac{\text{Force}}{\text{Area}}$$

RESULTS

The results of this study were collected and analyzed statistically. The mean Compressive Strength, Standard Deviations, Standard Error, Minimum and Maximum of the experimental groups are shown in Table 1.

Table 1: Descriptive statistics of all groups

	Group1	Group2	Group3	Group4
Mean	374.87	352.2	331.14	315.34
SD	17.542	41.97	37.159	25.144
SE	7.8662	18.821	16.663	11.275
Min	350	278.6	286.6	294.5
Max	398	382	358.2	358.2

Under the experimental conditions of this study, the experimental group 4(subjected to H₂O₂for 3days)scored the lowest mean compressive strength which was 315.34Mpa while the experimental group 1(subjected to carbamide peroxide for one day)had the highest mean compressive strength being 374.87Mpa. The mean compressive strength of all group are show as a bar chart in Figure1.

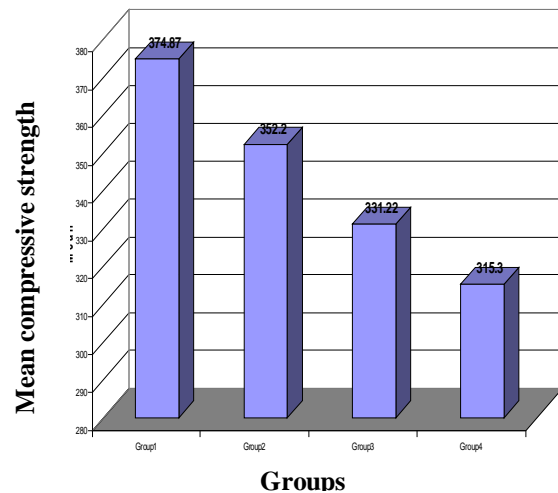


Figure1: Bar chart of the compressive strength of the experimental groups

Analysis Of Variance (ANOVA) test showed that there were significant differences between the tested groups.

Table 2: One-Way Analysis of Variance

Source	DF	SS	MS	F	P
Factor	3	10028	3343	3.28	0.048
Error	16	16329	1021		
Total	19	26357			

In Table 3 the results of the Student's t-test are compiled. From this table; there was a highly significant differences between group1 and group4 ($P < 0.001$). While there were statistically significant differences between group 1 and 3; 2 and 4 ($P < 0.05$). Finally, there were no statistically significant differences between the group 1 and 2; 2 and 3 and 3 and 4 ($P > 0.05$).

Table 3: Student's t-test results

	t-test	P-value	Sig
1&2	1.056	0.350	NS
1&3	2.309	0.048	S
1&4	6.600	0.003	HS
2&3	1.525	0.202	NS
2&4	2.214	0.049	S
3&4	1.249	0.280	NS

* $P < 0.05$ Significant

** $P > 0.05$ Non significant

*** $P < 0.001$ High significant

DISCUSSION

Tooth bleaching has become one of dentistry's most popular esthetic services, as it is the most conservative treatment for discolored teeth⁽⁸⁾. The advantage of in-office whitening procedure is the light sources ability to heat the H₂O₂. There by, increasing the rate of decomposition of oxygen to form oxygen free radicals and enhancing the release of stain containing molecules.⁽⁹⁾ In addition to the oxidizing agent used in the at-home bleaching procedure an additive called Carbopol may be added to thicken the gel that improve adherence to the tooth surface and prolong the release of oxygen. This additive keeps the gel contained within the tray better and slows the chemical reaction.⁽¹⁰⁾

The effect of the active components of bleaching agents has not been adequately investigated since there have been a limited number of studies done on their effects on restorative materials.⁽¹¹⁾ A concern exists about the effect of bleaching on compressive strength of the composite resin. For above reasons, this study was conducted to evaluate the effect of 35% H₂O₂ and 22% carbamide peroxide on compressive strength of composite resins. It appears from the experimental results and analysis of data that the group 1 (CP for 1 day) showed higher mean of the compressive

strength than group 2 (CP for one week) with no significant difference ($P > 0.05$). This reduction in the compressive strength values could be related to oxidation and degradation of the resinous matrix of the composite resin that increase with the number of application times.⁽¹²⁾ It is clearly obvious from Table(1) that group 3 (H₂O₂ for one day) showed higher mean of compressive strength than group 4 (H₂O₂ for 3 times in week) with no significant difference ($p > 0.05$). This reduction is a result of H₂O₂ which could diffuse through the organic matrix of composite and has the ability to produce free radicals, HO₂-and O; oxygen free radicals can break the bond between the polymer chain and the molecule of TEGDMA by combining to form molecular oxygen and water. This chemical process might accelerate the degradation of composite resins.⁽¹³⁾ The results of this study which were obtained from the comparison of group 1 and 2 with group 3 and 4, indicated that the bleaching with H₂O₂ 35% significantly decreased the compressive strength than the bleaching with carbamide peroxide 22%. The difference between in-office and at-home bleaching on tooth colored restorative materials in general could be related to the active bleaching agent.⁽¹⁴⁾ where 35% is aggressive oxidant, capable of degrading the polymer matrix of composite.⁽¹¹⁾ in addition to use the light as heat source to activate the bleaching agent.⁽⁸⁾

Carbamide peroxide (at-home bleaching) breaks into urea and H₂O₂ (conc. of H₂O₂ 3-9%). H₂O₂ in turn breaks down into free radical, which combine to form molecular oxygen and H₂O. Some aspect of this chemical process, may accelerate the hydrolytic degradation of tooth colored restorative material.⁽¹⁵⁾ In addition, the presence of thickening agent, which is said to combine with the free radical intermediates, could alter the process in some way, accounting for the differences between at-home and in-office bleaching. Therefore, composite restorations should be delayed after bleaching procedure. Some authors have suggested delays in restorative procedures in order to avoid reduced compressive strength following bleaching.⁽¹⁶⁾

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