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COMPARATIVE EVALUATION OF EFFECT OF FLUORIDATED AND NON-FLUORIDATED BLEACHING AGENTS ON MICROHARDNESS OF 3 COMPOSITE RESINS: AN IN VITRO STUDY

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ABSTRACT

The aim of the study was to compare the effect of fluoridated and non-fluoridated carbamide peroxide on microhardness of nanofilled, nanohybrid and microfilled composite. 20 samples of each composite (Nanofilled, Nanohybrid, Microfilled) were prepared in prefabricated silicon moulds and mounted on acrylic blocks. Microhardness testing was done prior to initiation of bleaching. The samples were then divided into two subgroups and the bleaching process was done with fluoridated and non-fluoridated carbamide peroxide. The gel was applied for 4 hours daily for 21 days. Microhardness testing was done post bleaching. The pre and post bleaching values were compared using student t test and one way ANOVA with the level of significance p=0.05. The results showed a statistically significant decrease in the microhardness of nanohybrid, nanofilled and microfilled composite after application of both fluoridated and non-fluoridated bleaching agents. The least reduction was seen in case of nanofilled composite

KEYWORDS: Fluoridated Bleaching, Non-Fluoridated Bleaching, Microfilled Composite, Nanofilled Composite, Nanohybrid Composite

Everyone wants to have whiter teeth [Okte et. al., 2006]. One of the most frequent reasons warranting dental care is discoloured anterior teeth. The esthetic appearance of a person's smile is influenced largely by the color, shape, and position of the teeth [Bailey and Swift, 1992]. Esthetics is the science of beauty. The perception and description of colour in a given object, coupled with the need and desire of people forms the basis of esthetics [Mahantesh et. al., 2010].

The different treatment modalities available for correction of discoloured teeth are: Bleaching, Veenering, Jacket crowns, Micro abrasion. Out of all these, bleaching is the most commonly used technique, least expensive with maximum conservation of tooth structure. American dental association defined bleaching as 'the treatment, usually involving an oxidative chemical that alters the light absorbing and/or light reflecting nature of the material structure, thereby increasing its value (whiteness) [Mahantesh et. al., 2010].

Over the years, various materials and techniques have been tried to aid in bleaching. In early nineteenth century, hydrogen peroxide alone and in combination with other materials, was used as bleaching agent. Products to "whiten" teeth are ample in the market place. Contemporary bleaching agents are typically either hydrogen peroxide (HP) or carbamide peroxide (CP). In-office bleaching generally uses relatively high levels of bleaching agents (25–35% HP or 35% CP) for shorter time periods while home-bleaching products typically contain low levels of whitening agent (3-6% HP or 10-16% CP). Ten percent CP has been used extensively within the dental profession for the purpose of home-bleaching teeth [Mohammed Q.A., 2014]. Carbamide peroxide (CP) agent was introduced as an alternative to traditional hydrogen peroxide (H_2O_2), and its use has become widespread.

The use of dental bleaching agents may increase the incidence of side effects, such as tooth sensitivity, soft tissue irritation, and alteration of the structural integrity and microhardness of dental and restorative surfaces [Cooley and Burger, 1991]. The effect of bleaching agents on the properties of the restorative materials is also important. Several studies have evaluated its effect both on the mechanical and physical properties of restoratives. However, investigations on surface microhardness of restoratives after bleaching treatment have shown contradictory results. [García-Godoy et. al., 2002] Studies reported an increase, decrease or no change in composite surface hardness after application of carbamide peroxide gels.

Topical application of fluoride (TAF) has been used as an agent for preventing caries, and its effectiveness is widely recognized and studied [Sharafeddin and Jamalipour, 2009]. Effects of fluoride on enamel are known to all, but the effect of fluoride agents on restorative materials is still under research. Malkondu et. al., 2011 observed a reduction in the surface microhardness due to the inorganic filler loss on the surface of composite after using Opalescence PF and in 2011, Hao Yu et al., 2008 assessed the effect of Opalescence PF 15% on the hardness of three composite resins and a conventional glass ionomer in an in-situ

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environment, and reported that the hardness of the conventional glass ionomer increased while the hardness of the composites did not change significantly. Hence this study was done with an aim to compare microhardness of nanofilled, nanohybrid and microfilled composites after bleaching with fluoridated and non-fluoridated carbamide peroxide gel using VHN.

MATERIAL AND METHODS

Samples of the composite were prepared in stock Silicon moulds which were customised to gain samples of thickness of 4 mm, and then the samples were mounted onto acrylic blocks. Finishing and polishing of the sample was done with Super Snap Kit Discs. Total of 60 samples (20 of each composite) were made in similar manner.

Samples were divided according to the filler content of composite. Three different composites were used.

Sr. no	Group	Type of composite	Number of samples
1.	Group A	Nanofilled composite	20
2.	Group B	Nanohybrid composite	20
3.	Group C	Microfilled composite	20

Specimens in each group were further divided into 2 subgroups of 10 each according to the bleaching agent used

Sr. no	Sub-group	Procedure
1.	GROUP A1	Nanofilled composite bleached with 16 % carbamide peroxide
2.	GROUP A2	Nanofilled composite bleached with fluoridated carbamide peroxide
3	GROUP B1	Nanohybrid composite bleached with 16% carbamide peroxide
4	GROUP B2	Nanohybrid composite bleached with fluoridated carbamide peroxide
5	GROUP C1	Microfilled composite bleached with 16% carbamide peroxide
6	GROUP C2	Microfilled composites bleached with fluoridated carbamide peroxide

The samples in each subgroup were treated with respective bleaching agents. To simulate the bleaching process, bleaching agent was applied on the top surface of specimens using an applicator tip. The bleaching agent was kept in place for 8 hours per day at room temperature. After 8 hours the bleaching agent was removed by rinsing the specimens under tap water for 1 min and blot dried retained in distilled water at 37°C. The process was repeated for 21 consecutive days.

Microhardness testing was done in two stages- before bleaching and after bleaching.

Vickers microhardness technique uses a square pyramid indentor for measurement. The load is divided by the area of indentation. In order to measure microhardness a 100-g force was applied for 10 seconds on the specimens by Vickers microhardness tester (DHV 3000).

First microhardness testing was done after the preparation of samples. Microhardness of each specimen was recorded at three separate locations randomly from each other and a mean was noted for each specimen. Second testing was done after the bleaching procedures were complete, in similar fashion, and were compared with the initial values.

STATISTICAL ANALYSIS

Statistical analysis of the comparison of microhardness of composites by two different bleaching agents was carried out to find the significant difference between those values. The statistical tests used for the analysis of the result were: One way ANOVA, Student's paired t test, Student's unpaired t test.

Comparison of post scores of all composites after bleaching with non-fluoridated agent by one way ANOVA

	N	Mean	Std. Deviation	p-value
A1	10	56.00	3.30	0.001*
B1	10	29.76	2.98	
C1	10	36.69	1.68	
A1		B1		0.001*
		C1		0.001*
B1		C1		0.001*

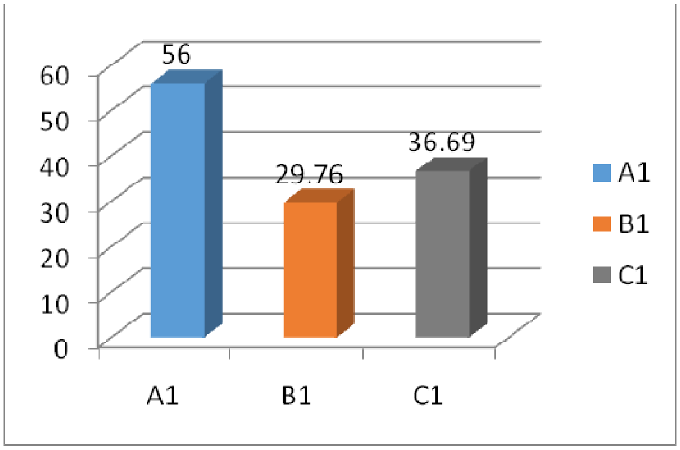
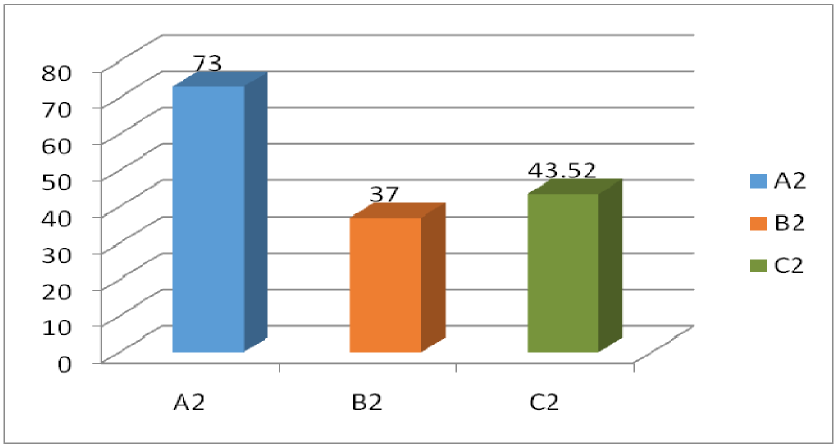


Table and graph shows that in A1 the scores after treatment were 56 which higher when compared with B1 (29.76) and C1 (36.69) and all these differences were found significant on comparison by one way ANOVA. Further on pair-wise comparison the difference was found significant with-in all the groups.

Comparison of post scores of all composites after bleaching with fluoridated bleaching agents by one way ANOVA

	N	Mean	Std. Deviation	p-value
A2	10	73.00	1.71	0.001*
B2	10	37.00	1.43	
C2	10	43.52	2.65	
A2		B2		0.001*
		C2		0.001*
B2		C2		0.001*

Table and graph shows that in A2 the scores after treatment were 73 which higher when compared with B2 (37) and C2 (43.52) and all these differences were found significant on comparison by one way ANOVA. Further on pair-wise comparison the difference was found significant with-in all the groups.



RESULTS

When Group A1, B1 and C1 were compared microhardness reduction was seen in all the groups after application of bleaching agents. The least reduction in microhardness was seen with nanohybrid composite (A1) followed by microfilled (C1) and nanofilled (B1). Also when groups A2, B2 and C2 were compared, it was observed that the microhardness reduction was least with nanohybrid (A2), followed by microfilled (C2) and nanofilled (B2).

DISCUSSION

Group A consisted of Nanohybrid composite. The mean microhardness of composite at pre-test was 67.62 VHN. After bleaching with non-fluoridated bleaching agent (A1) hardness reduced to 56 and the difference was statistically significant. After application of fluoridated bleaching agent the mean was 68.77 which was more than pre-test values but the difference was not statistically significant. This observation of present study is in accordance with Hao Yu et al (2008). Hao Yu, Qing Li, Manal Hussain, Yining Wang (2008), assessed the effect of Opalescence PF 15% on the hardness of three composite resins and a conventional glass ionomer in an in-situ environment, and reported that the hardness of the conventional glass ionomer increased while the hardness of the composites did not change significantly. Carbamide peroxide is very unstable and will immediately degrade into around one-third hydrogen peroxide (HP) and two-third urea on contact with tissue and saliva. Following the initial degradation, HP then breaks down into free radicals which may induce oxidative cleavage of polymer-chains. While the results were contradictory to the findings of Mortezavi *et al.* 2008. They showed that Opalescence PF (20% carbamide peroxide) and Opalescence Quick (35% carbamide peroxide) did not have any significant effects on the surface roughness and thereby microhardness of microhybrid (Point 4) and nanofilled (Filtek Supreme and Premise) composites owing to the size of fillers.

Group B consisted of Nanofilled composites. The pretest mean hardness values were 44.26 which reduced to 29.76 after bleaching with non-fluoridated bleaching agent (B1) and to 37 after bleaching with fluoridated bleaching agent (B2). The difference for both B1 and B2 was statistically significant. These results were in accordance with Malkondu *et al.* (2011), who studied the effect of a high concentration carbamide peroxide containing home bleaching system (opalescence PF) and hydrogen peroxide on microhardness of nanocomposites and porcelain. They observed a reduction in the surface microhardness due to the inorganic filler loss on the surface of composite after using Opalescence PF. The reduction was seen due to erosion of the organic matrix leading to inorganic filler loss. The results were inconsistent to Mortezavi *et al.* in 2008, who showed that Opalescence PF (20% carbamide peroxide) and Opalescence Quick (35% carbamide peroxide) did not have any significant effects on the nanofilled (Filtek Supreme and Premise) composites due to smaller particle size of the filler and lower pH.

Group C was microfilled composite. The pre-test mean microhardness values were 43.52 which reduced to 36.69 after bleaching with non-fluoridated bleaching agent (C1) which was statistically significant. Whereas the values after bleaching with fluoridated bleaching agent (C2) was 43.25 which was not statistically significant.These results were in accordance with Turker and Biskin 2002. Investigated the effects of three home bleaching agents, on microhardness of restorative materials including microfilled composite. The microhardness of composite decreased after application of bleaching agents. The time of application and pH of gel played an important role. The results are contrary to the study done by F. Sharafeddin et al 2010 studied the effects of 35% Carbamide Peroxide Gel on Surface Roughness and Hardness of Composite Resins (microfilled and hybrid). The surface hardness of hybrid composite significantly increased compared to heliomolar after bleaching. This was attributed to be due to active ingredients of the bleaching agent which can remove the surface layer of hybrid composite specimens, which are rich of filler particles and have a harder surface.

When Group A1, B1 and C1 were compared microhardness reduction was seen in all the groups after application of bleaching agents. The least reduction in microhardness was seen with nanohybrid composite (A1, 10.62) followed by microfilled (C1, 11.17) and nanofilled (B1,13.50). The results are in accordance with Raji Viola Soloman et al (2016), evaluated the microhardness of different direct resin-based restorative materials on using 10% carbamide peroxide gel as a bleaching agent (micro hybrid resin composite (Z250), a nanofilled resin composite (Z350), a hybrid resin composite (Z100)). They concluded that a 10% carbamide peroxide bleaching agent had an adverse effect on the micro hardness of nanofilled and hybrid types of resin-based composite materials compared with the micro hybrid type. The presence of a higher amount of TEGDMA in the nanofilled composite and the absence of TEGDMA in microhybrid explains the low resistance of nanofilled to bleaching agents.

The significant reduction in microhardness in the resin composites tested was expected, since microfilled and nano resin composites contain a high concentration of resinous matrix to be oxidized by hydrogen peroxide.

When Groups A2, B2 and C2 were compared, it was observed that the microhardness reduction was least with A2 (6.62), followed by C2 (7.12) and B2 (8.76). The results are in agreement with Ab Ghani et al (2013) evaluated the effects of 10 and 20% Opalescence PF home bleaching agents on the surface roughness and hardness of universal nanocomposite (Filtek Z350), anterior nanocomposite (KeLFiL), and nanohybrid composite (TPH 3). The surface hardness for KeLFiL and TPH 3 were significantly reduced after bleaching. The observation was explained by theory that after the curing process of a composite resin, a post polymerization process continues to occur up to a certain period of time, which increases the hardness of the composite.

The contradictory findings in various studies might be due to several factors, such as composition of the materials, concentration of bleaching agents and the methodology used in different studies. The unreacted double bonds of composites are anticipated to be the most vulnerable parts of the polymers. The reduced molar mass of the decomposing products lead to a softening and reduction in micro-hardness.

Fluoride ions are capable of causing de-polymerization reactions at the filler–resin matrix interface and hydrolysis of the organosilicon ester group. For the nanohybrid and nanofill composite resins, the inclusion of barium glass particles and nanoclusters are vulnerable to fluoride attack. The concentration and pH of fluorides play an impotant role in the results.

CONCLUSION

There was a statistically significant decrease in the microhardness of nanohybrid, nanofilled and microfilled composite after application of both fluoridated and non-fluoridated bleaching agents.

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