ORIGINAL ARTICLE

EFFECTS OF DIFFERENT BLEACHING AGENTS ON MICROHARDNESS OF COMPOSITE RESINS

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ABSTRACT

The objective of the study was to evaluate the effect of bleaching agents on micro hardness of composite resins. 15 specimens were fabricated, 10 of 3M Filtek Z350 (nano-filled composite) & 105 of Dentsply Esthet-X (hybrid composite) with 10mm diameter & 2mm thickness. Each composite group of 15 specimens was divided further into 3 groups of 5 specimens each. All four groups were tested for baseline Vickers hardness reading. One of each composite group was treated with home bleach (Beaming White home bleaching kit) & the other was treated with in-office bleach (Beaming White office bleach system) while controls were not treated with any bleaching system. The bleaching procedure was carried out according to the manufacturer instructions for each system respectively. Final Vickers hardness value were recorded after the respective bleaching procedures were completed .

Between-materials one-way ANOVA was used for comparison of groups at 5% level of significance & post Hoc Grames-Howell test was utilized for multiple comparisons.

Both bleaching systems significantly reduced microhardness of both composite groups. Furthermore, although both bleaching agents reduced microhardness but there was no significant difference between them.

Both home & office bleaching agents reduce microhardness of hybrid & nano-filled composite resins. Therefore, it may be necessary to replace composite restorations after bleaching procedure.

INTRODUCTION

In recent decades, esthetic dentistry has experienced many advances. Most of the patients demand whiter teeth due to increased media awareness for beauty and health.[1] Esthetics can be defined as the science of beauty, that particular detail of an object that makes it appealing to the eye. Although, discolored teeth may not be related to disease, they nonetheless may compromise the esthetics of a smile.[2,3] In order to improve the appearance of smile by lightening of teeth bleaching is the best conservative treatment.[4]

Many restorative treatment options are available for discolored teeth, such as bleaching, veneers, and crowns. Tooth bleaching has been introduced in aesthetic dentistry since late 1870s. There are different approaches to perform bleaching for vital or non-vital teeth.

Bleaching can be done in-office or at home, different kits are available commercially for this purpose. In bleaching at home for vital teeth, the patients need to apply bleaching solutions (greater part of it contains 10-15% carbamide peroxide) to their teeth in customized splints for couple of hours each day. Due to its easy application, low cost and easy accessibility this technique is popular among all socioeconomic patients. Home bleaching has proved to be a safe and successful treatment over the last few years.

In-office bleaching systems are under the dentist control and procedure is carefully performed with the protection of soft tissues. Strong oxidizing agents are used for this procedure which gives quick and effective results which are pleasant for the patient.[5,6]

It has been documented in literature that bleaching has a significant effect on surface micro hardness of composite.[12,13] The resistance of a material to penetration or indentation shows hardness of the material.[7] Hardness is related to material strength, proportional limit, ability of resistance to abrasion by opposing dental

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prosthesis/teeth/restorations. Softening resulting from bleaching may affect the durability of restoration. As hardness is related to strength of material, proportional limit and its ability to abrade or to be abraded by opposing structures/materials, any chemical softening as a result of bleaching might have consequences on the clinical durability of restorations. Composite resin materials contain organic matrix which is the main cause of chemical alteration as compared to inert metal or ceramic restorations.[8-10] Recently introduced composite restorative materials are now more esthetically acceptable in the field of dentistry but availability of literature data is inadequate.

This In vitro study has been carried out to evaluate the effect of the home office and in-office bleaching technique on the micro hardness of different composite restorative materials.

METHODOLOGY

Sample Preparation

Two different composite materials were used in the study. These were: nano-filled Filtek Z350(3M) and hybrid composite Esthet-X (Dentsply). The specimens were fabricated using an acrylic mold with holes of 10mm diameter and 2mm thickness. The mold was kept on a glass slab, composite resin was packed within the holes and a second glass slab was placed on the mold to create a smooth surface and remove the excess material. The resin was then cured by LED curing light (Mectron, Starlight Pro, 440-480nm) for 40 seconds. After curing they were finished with sof-lex (3M ESPE) discs of coarse grit, followed by medium and fine grit mounted on a slow speed handpiece until a smooth surface was obtained.

The specimens were stored in distilled water for a day after finishing and polishing. Specimens were then tested for baseline readings. Once the baseline readings were obtained, the composite specimens were subjected to their respective bleaching procedure.

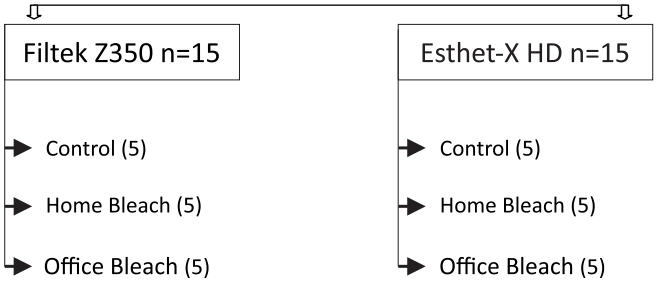
Application of Bleaching Process

Specimens were removed from the distilled water only when bleaching has to be done. Procedure of bleaching techniques was followed according to mentioned manufacturers' instructions. After each single application remnants of bleaching gel were washed off with running distilled water. The bleaching agents used were home bleaching (Beaming White Home Whitening System) consisted of 36% Carbamide Peroxide. Specimens were then immersed in bleaching gel for 1 hour. After 1 hour the specimens were washed with distilled water and again stored in distilled water. This procedure was followed for 14 days for one hour according to the manufacturer instructions.

Office bleaching (Beaming White Pro Whitening Kit) contained 38% Hydrogen Peroxide. For this system, the bleaching agent was mixed with activator paste and applied on the finished surface of composite specimens and exposed to LED curing light for 15 minutes. The specimens were then rinsed with distilled water. The same bleaching process was repeated back to back twice making a total of 3, 15 minute bleaching sessions. After the 3 bleaching sessions the composite specimens were rinsed and stored in distilled water.

The total number of testing samples were (n = 30), each experimental group consisted of 5 samples of the respective composite restorative material.

Sample distribution of the fabricated composite specimens



The control group samples were immersed in distilled water for 14 days. Once all samples have subjected to bleaching process, they were again tested for Vickers hardness.

Determination of Vickers microhardness

Vickers-hardness was performed according to standard (ASTM D 1470) analyzed by using INDENTEC ZHV1-M (Zwick/Roell).

Statistical Analysis

Between-Subjects one-way ANOVA was used for comparison of groups and post Hoc Grames-Howell test was utilized for multiple comparisons. Statistics were calculated using the software package SPSS version 16.

RESULTS

Table 3 shows the baseline Vickers hardness values and standard deviations for both composite groups. Tables 4, 5, 6 show Vickers hardness values for both composite groups exposed to control, home and office bleaching procedures. Both composites showed statis-

TABLE 1: COMPOSITE RESINS INVOLVED IN THE STUDY

Composite	Type	Composition	Manufacturer
Filtek Z-350	Nano	Bis-GMA, UDMA	3M ESPE
Esthet-X HD	Hybrid	Bis-GMA, Bis-EMA, TEGDMA	Dentsply

TABLE 2: BLEACHING AGENTS INVOLVED IN THE STUDY

Manufacturer	Type	Composition
Beaming White Home Whitening Kit	Home bleaching	36% Carbamide Peroxide
Beaming White Pro Whitening Kit	In-Office bleaching	38% Hydrogen Peroxide

TABLE 3: MEAN BASELINE VICKERS MICRO HARDNESS READINGS FOR FILTEK Z350 & ESTHET-X HD

Vickers Hardness number for Filtek Z350	Vickers Hardness number for Esthet-X
Mean VHN = 71.466	Mean VHN = 54.866
Standard Deviation = 3.335	Standard Deviation = 2.030

TABLE 4: MEAN VICKERS MICROHARDNESS & STANDARD DEVIATIONS FOR BOTH FILTEK Z350 & ESTHET-X HD EXPOSED TO CONTROL

Specimen Group	Mean VHN	Standard Deviation
Esthet-X HD	55.2	2.3
Filtek Z350	71.4	4.5

TABLE 5: MEAN VICKERS MICROHARDNESS & STANDARD DEVIATIONS FOR BOTH FILTEK Z350 & ESTHET-X HD EXPOSED TO HOME BLEACHING PROTOCOL

Specimen Group	Mean VHN	Standard Deviation
Esthet-X HD	45.6	1.5
Filtek Z350	60.0	2.0

TABLE 6: MEAN VICKERS MICROHARDNESS & STANDARD DEVIATIONS FOR BOTH FILTEK Z350 &ESTHET-X HD EXPOSED TO OFFICE BLEACHING PROTOCOL

Specimen Group	Mean VHN	Standard Deviation
Esthet-X HD	53.2	0.8
Filtek Z350	62.2	1.9

tically significant Vickers hardness after exposure to both home and office bleaching agent. However, there was no statistically significant difference among both bleaching agents.

DISCUSSION

The results of many researches have demonstrated that bleaching has an impact on micro-hardness of composites.[11] The results of this study were in agreement with these studies. Most of the researches carried out to determine the effect of bleaching agents on surface microhardness of esthetic filling materials used home bleaching techniques. Bailey and Swift[12] documented a reduction in Knoop hardness after using home bleaching agents. Turker and Biskin[11] showed that microhardness is dependent on the type of bleaching agent used. Campos et al[13] revealed that home bleaching procedures had no effect on microhardness on the surface of restoration.

Such variation in findings suggested that different bleaching agents have different effect on esthetic restorative materials.[14] One study found out that difference in PH of bleaching agents is the main cause of alteration of surface micro hardness of the restorative material.[15] Fortunately, the pH of most recently used bleaching agents is near to neutral. In the present study bleaching agent used was 38% hydrogen peroxide solution. Hydrogen peroxide performance is dependent on several factors like temperature, PH, presence of transitional metals, light and other conditions and under these different factors it can give different results.[16]

Hydrogen peroxide as an oxidizing agent possessing the ability to produce HO2 and O in the form of free radicals. The most reactive form of free radical is perhydroxyl, HO2. Macro molecular strains can breakup into smaller molecular strain by free radicals. Another thought is that they might attach to the matrix of protein as well as to the molecular staining the inorganic structure.[17] Molecular oxygen and water is formed by the combination of these free radicals. It was suggested that this chemical process might increase the hydrolytic degradation of dental composites concluded by Soderholm.[18] Chemical weakening of composite resins is believed to occur in vivo, contributing to wear of the resin in both stress-bearing and non-stress bearing areas.[19,20] Softening is caused by chemicals with solubility parameters similar to those of the resin matrix. Chemicals can soften the bis-GMA resin polymer with solubility parameters in the range of 18.2-29.7 (MPa)1/2.20 A wide variety of solvents have solubility parameters within this range.[21]

Hydrogen peroxide showed high tendency for oxidation and reduction and the formation of free radicals.[22] It is also documented that other than hydrogen peroxide reactivity, it has an ability to diffuse as well.[2,22,23] Possibly, peroxides disturb polymer chain and induce oxidative cleavage. Most expected weakest part of the polymer is unreacted double bond. The reduced molar mass of the decomposing products may lead to a reduction in micro-hardness of the material.

Composite fillings with compromised physical properties are more prone to abrasion. Therefore, bleaching of restorations involving the occlusal surface should be avoided. Sodium perborate is usually applied for internal bleaching of root canal treated teeth, it was also experienced and noticed that internal bleaching

affect the surrounding composite restoration.

The results of this study are in agreement with that of Pinar et al.[24] It is possible that our results complimented each other because of similar materials. Both the above mentioned studies used nano filled composites, 35-36% carbamide peroxide and 35-38% hydrogen peroxide as bleaching agents. Highly concentrated bleaching agents could be the strongest factor and may influence the hardness of composite resins.

A shortcoming of this study was failure to use artificial saliva as a control or storage medium. A thermostat to maintain temperature resembling the oral cavity would simulate better storage conditions.

CONCLUSION

Bleaching agents reduce surface microhardness of composite restorative materials significantly.

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3 Faisal Ahmed:	Sample preparation, immersion of samples, data analysis.
4 Ahmed Tariq:	Assistance in write up of manuscript, sample preparation.