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The Effect of in-office Tooth Whitening on the Microhardness of Esthetic Restoration (An invitro Study).

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ABSTRACT

Aims: To determine if the composite resin restoration need to be replaced after power bleaching at different times.**Materials and methods:** Three composite resins (a flowable, a conventional and ceramic composite) were used for this study. Transparent discs with 2mm thickness with a hole of 5mm diameter were used for the production of composite samples, six samples were made for each type of composite with a total of 18 samples were used. The bleaching procedure was followed on the top surface of each sample. For each sample a newly fresh material were mixed (lase peroxide sensy gel) and applied over the prepared sample. Bleaching took place for 15, 30 and 45 minutes according to the manufacturer instructions. For the microhardness measurements, a Vickers microhardness tester (Wolpert, Germany) was used, with a 200g load. Five microhardness measurements were obtained on the top surface of each sample on the following time periods: before bleaching, after 15 min., after 30 min. and after 45 min. of bleaching. Data were analyzed using T-test, a value of $p \leq 0.05$ was considered significant followed by the analysis of variance (ANOVA). **Results:** The results showed a significant increase in the microhardness of all the three types of composite resins after bleaching with a different time when compared to the control.**Conclusion** The bleaching agent that was tested has a significant increase of the microhardness of the composite resins and there is no sufficient reason to indicate the replacement of restorations.

Key words: Bleaching, Composite resin, Microhardness.

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INTRODUCTION

Several factors may alter the appearance of smiles, including alteration in the form, texture position and color of teeth. Discolored teeth can be treated with various restorative techniques, such as direct composite veneers, indirect porcelain veneers, ceramic crowns or even with bleaching[1].

Tooth bleaching has been routinely used since the late 1870. Bleaching techniques may be classified by whether they involve vital or non-vital teeth or by whether the procedure is performed in-office or has an at-home component[2]. The use of bleaching for improving the esthetics of natural dentitions has widened only after the introduction of home bleaching systems in 1990s [3]. The latter created a resurgence of bleaching primarily because of its relative ease of application , the lower cost, its general availability to all socio-economic classes of patients, the safety of materials used and the high percentage of successful treatments[4]. With the home bleaching technique, the patients apply bleaching solutions, most of which contain 10-15% carbamide peroxide, to their teeth in custom-fitted splints for a few hours per day. Over the few past years, in-office tooth bleaching systems employing the use of strong oxidizing agents have been re-introduced. The advantages are that treatment is totally under dentist control, the soft tissue are generally protected from the process and it has the potential for bleaching quickly in situations in which it is effective[5].

It was reported that slight surface alterations, as assessed by scanning electron microscopy and a decrease of surface micro hardness and fracture toughness might occur due to bleaching of dental hard tissues [6]. These possible effects on dental hard tissues are discussed as being minimum and not relevant provided that the bleaching agents are applied in a sensible manner and according to the manufacturer instructions [7]. Beside these aspects regarding influence of bleaching agents on hard dental tissues, some clinicians also express concerns about the effect of these agents on dental restorative materials[7].

Very often on the daily clinical practice, tooth colored restorations exist in the teeth that are planned to be bleached. The effects of such strong oxidizing agents on the physico-mechanical properties of restorative materials have not been widely studied.

Hardness is defined as the resistance of a material to indentation. As hardness is related to material's strength, proportional limit and its ability to abrade or to be abraded by apposing dental structures, any chemical softening resulting from bleaching might have implications on the clinical durability of restoration [8].

Although there are several reports on the effect of home bleaching systems on composites [9], little is known about the effects of the in-office bleaching techniques on the restorative material [10]. Therefore the aim of this in vitro study was to evaluate the effect of an in-office (power) bleaching on the hardness of composite restorations.

MATERIALS AND METHODS

Three clinically used esthetic restorative materials and an in-office laser bleaching device were selected for this study. The restorative materials were composite resins a flowable (Tericflow, ivoclar, vevadent), a conventional (Te-Econom, ivoclar, vevadent)) and ceramic composite (Tetraceram, ivoclar, vevadent) which are the commonly used categories of the esthetic restorative materials used now days.

For the preparation of samples, the color A3 was used for every material. Transparent discs with 2mm thickness with a hole of 5mm diameter were used for the production of composite samples. The discs were positioned on a transparent celluloid matrix strip lying on a glass slab. They were then filled with composite resin. After insertion of the material into the discs, another transparent celluloid matrix strip was put over them and pressed over the disc in order to flatten the composite surface. Every sample was light cured for 40 s, once, using a halogen curing light (hangzhou A.L.S. dental appliance CO.LTD) with the light cure tip is in contact with the sample. Then the samples were placed in a plastic molds filled with acrylic resin (cold cure), the composite samples were placed in the center of the acrylic resin inside the plastic molds.

Six samples were made for each type of composite with a total of 18 samples were used, each of the composite materials were fabricated and polished with medium, fine and super fine disks on a slow speed hand-piece in accordance with the manufacturer instructions. All samples were stored in distilled water at room temperature for 2 days before any procedure. The bleaching procedure was followed on the top surface of each sample. For each sample a newly fresh material were mixed (lase peroxide sensy gel, 35% hydrogen peroxide, D.M.C. EQUIPAMENTOS LTDA) for each 3 drops of hydrogen peroxide 1 drop of the thickening gel were used. The mixed gels then were applied to the prepared samples with the help of a spatula. A 1mm-2mm thick gel layer should be applied over the prepared sample. Then the samples were irradiated with WHITENING LASE II (D.M.C. EQUIPAMENTOS LTDA) for 6 minutes then let rest for 3 minutes then apply light for 6 more minutes. Each gel application should not last more than 15 minutes if time exceeded 15 minutes another fresh material were used.

Bleaching took place for 15, 30 and 45 minutes according to the manufacturer instructions which means 2 samples of each type of composite were bleached for 15 minutes another 2 samples of each type of composite were bleached for 30 minutes and another 2 samples of each type of composite were bleached for 45 minutes. The WHITENING LASE II has visible emitters with a wave length: 470 nm and laser type: InGaN and infrared emitters with a wave length: 830nm and laser type: AsGaAl. At the end of every bleaching procedure, the treated specimens were washed under running water and were placed in fresh distilled water until the next application or until the end of the time period.

For the microhardness measurements, a Vickers microhardness tester (Wolpert, Germany) was used, with a 200g load. Five microhardness measurements were obtained on the top surface of each sample on the following time periods: before bleaching, after 15 min., after 30 min., after 45 min. of bleaching.

Data were analyzed using T-test, a value of $p \le 0.05$ was considered significant followed by the analysis of variance (ANOVA) to indicate if there is any statistical difference between the applications of 35% hydrogen peroxide on composites at different time with control ($p \le 0.05$).

RESULTS

Table (1) show the mean Vickers hardness values (VHN) and the standard deviation (S.D) for each time period tested for all groups of restorative materials after bleaching with 35% hydrogen peroxide

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Table (1): Mean Vickers hardness values (VHN±S.D) for each time period tested with p value.

Material	Control	Bleaching for 15min	Bleaching for 30min	Bleaching for 45min
Conventional	104.80±4.97	111.60±2.88 p=0.029	116.40±2.41 p=0.002	106.60±3.36 p=0.521
Flowable	78.0±2.45	83.0±2.24 p=0.010	86.0±1.58 p=0.000	109.20±5.81 p=0.000
Ceramic	82.80±6.53	100.0±2.55 p=0.001	100.20±1.92 p=0.000	94.60±3.05 p=0.006

According to the analysis of variance ANOVA Tables (2,3,4) power bleaching with 35% hydrogen peroxide produced a statistically significant effect on the microhardness of the composite resins. The results showed an increase in the microhardness of all the three types of composite resins after bleaching with a different time when compared to the control.

Table (2): ANOVA Results of the VHN (kg/mm²) for the conventional composite after bleaching at different times.

Source of variance	Df	SS	MS	F-value	P-valu
Between groups	3	410.15	136.717	10.916	0.000
Within groups	16	200.40	12.525		
Total	19	610.55			

Table (3): ANOVA Results of the VHN (kg/mm²) for the flowable composite after bleaching at different times.

Source of variance	**Df**	**SS**	**MS**	**F**	**P**
Between groups	3	2870.15	956.71	81.07	0.000
Within groups	16	188.80	11.80		
Total	19	3058.95			

Table (4): ANOVA Results of the VHN (kg/mm²) for the ceramic composite after bleaching at different times.

Source of variance	**Df**	**SS**	**MS**	**F**	**P**
Between groups	3	998.00	332.66	21.39	0.000
Within groups	16	248.80	15.55		
Total	19	1246.80			

The Duncan's multiple range test and the mean microhardness of each type of composites at different times are shown in Tables (5,6,7).

Table (5): Duncan's Multiple range test of the conventional composite at different times.

	time	***No.***	***Mean***	***Duncan's groups***
Conventional composite	**control**	**5**	**104.8**	**A**
	15 min.	**5**	**111.6**	**B**
	30 min.	**5**	**116.4**	**C**
	45 min.	**5**	**106.6**	**A**

Table (6): Duncan's Multiple range test of the flowable composite after bleaching at different times.

	time	***No.***	***Mean***	***Duncan's groups***
Flowable composite	**control**	**5**	**78.0**	**A**
	15 min.	**5**	**83.0**	**B**
	30 min.	**5**	**86.0**	**B**
	45 min.	**5**	**109.2**	**C**

Table (7): Duncan's Multiple range test of the ceramic composite after bleaching at different times.

	time	*No.*	*Mean*	*Duncan's groups*
Ceramic composite	**control**	**5**	**82.8**	**A**
	15 min.	**5**	**100.0**	**B**
	30 min.	**5**	**100.2**	**B**
	45 min.	**5**	**94.6**	**C**

DISCUSSION

Bleaching agents affect lightening of discolored tooth structure through decomposition of peroxide into free radicals. The free radicals break down large pigmented molecules that reflect a specific wavelength of light and are responsible for the color stain in enamel, into smaller less pigmented molecules through oxidation and reduction [11].

The advantage of the in-office whitening procedure is the light source's ability to heat the hydrogen peroxide, thereby, increasing the rate of decomposition of oxygen to form oxygen free radicals and enhancing the release of stain-containing molecules [12]. According to this the in-office bleach is the most powerful among other bleaching types but 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 [13].

Studies investigating the effect on microhardness of microfilled, macrofilled and hybrid type composite resin restorative materials after long term exposure carbamide peroxide solutions, have reported some what conflicting results. Burger and cooley (1991), reported a significant increase in the mean microhardness of each type. Bailey and swift (1992) found the microhardness of the hybrid and microfilled composite resins to decrease. Blackwell et al. (1993) observed little differences between control and experimental groups of any of three types after exposure for 31 days to the Rembrandt bleaching gels[14, 15, 16]. The present study found that exposure to lase peroxide sensy gel (35% hydrogen peroxide) produce an increase in mean microhardness for composite resin.

The materials used in the present study were stored in distilled water for 24 h in order to allow for post-irradiation hardening of the composites [17]. It was applied to the surface of the samples for 15, 30 and 45 min, representing the clinical conditions of the in-office bleaching procedure [5]. This was in contrast to several other bleaching studies in which materials were exposed continuously to bleaching products for several days to simulate cumulative effects over a period of time [18]. Yap and Wattanapayungkul [19] also used small exposure times (30 min) using light activation simultaneously.

The bleaching agent used in this study have a significant effect on the microhardness, for all materials tested. This coincides with the results of Burger and Cooley (1991) who reported a significant increase in the mean microhardness of microfilled, macrofilled and hybrid type composite resin after long-term exposure to carbamide solutions [14] also the results are concides with results of Turker and Biskin, 2002 which showed that the microhardness of the same composite resin was increased or decreased depending on the different bleaching agent that was used [20].

Such wide variations in data suggest that some tooth-colored restorative materials may be more susceptible to alteration and some bleaching agents are more likely to cause those alterations [21]. The latter may be attributed to the differences in pH values between the bleaching agents [21]. Fortunately, the pH of most current bleaching agents is close to neutral. Having also in mind that the hardness of a material is correlated with the inorganic filler content (Say et al. 2003), it could be supposed that the effect of the bleaching agents on this content should be the reason for the changes of the microhardness of the restorative materials after bleaching [22].

According to the results of this study, an increase in the microhardness of composite need no replacement of the tested restorative materials after in-office bleaching.

CONCLUSIONS

Summarizing the results of this study, it can be concluded that:

(1) The bleaching agents that were tested have a significant increase of the microhardness of the composite resins.

(2) The application times used for bleaching in the present study, representing the bleaching periods used for in-office bleaching, were harmless for the restorative materials used;

(3) According to the results of the present study there is no reason to avoid bleaching, when composite materials are present in the oral cavity and there is no sufficient reason to indicate the replacement of restorations, except the cases that have esthetic involvement.

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