ORIGINAL ARTICLE

THE EFFECT OF 10% CARBAMIDE PEROXIDE BLEACHING GEL ON THE MICROHARDNESS OF IPS EMPRESS DIRECT: AN IN-VITRO STUDY

[1]KHULOOD ABDULAZIZ AL-MANSOUR
[2]ANFAL MOHAMMAD AL QUSSIER

ABSTRACT

The aim of the present in vitro study was to evaluate the effect of 10% carbamide peroxide home bleaching gel on surface microhardness of nanohybrid composite resin restorations (IPS Empress Direct, Dentin A2 and BL shades, Ivoclar-Vivadent, AG, Schaan, Liechtenstein). Forty Specimens of the nanohybrid resin composite were fabricated, cured and polished; 20 for each shade, 10 each for control and bleached groups. The bleaching agent, 10% carbamide peroxide home bleaching gel (Nite-White®, ACP, Discuss Dental, Culver City, CA, USA) was used for 14 days in the treated groups. The specimens were subjected to Vickers hardness test using Universal testing machine (Micromet® 2100, Buehler, Lake Bluff, IL, USA) with load 300g and for 15 seconds. Statistical analysis conducted at a significance level of P< 0.05 using independent T-test. There was no significance differences between control and bleached groups within the same shade (P=0.302 for A2 shade, and P=0.332 for BL shade). It was concluded that 10% carbamide peroxide home bleaching gel (NiteWhite®, ACP, Discuss Dental, Culver City, CA, USA) has no effect on the surface microhardness of nanohybrid composite (IPS Empress Direct, Dentin A2 and BL shades, Ivoclar-Vivadent, AG, Schaan, Liechtenstein) in both the chosen shades.

Kew Words: *Home bleaching, Composite resin, IPS Empress Direct, Microhardness, Vickers hardness, nano-hybrid.*

INTRODUCTION

Esthetics is the science of the beauty, where particular detail of an animated or in-animated object becomes appealing to eyes. There are several treatments for discolored teeth such as direct composite veneers, porcelain veneers, ceramic crowns and bleaching. Currently, bleaching is the most popular treatment because of its conservativeness, effectiveness and accessibility.[1] Bleaching was first used in 1870s and its use widened after introduction of home bleaching techniques in 1989 by Haywood and Heymann.[2,3] Bleaching can be classified as vital and non-vital tooth bleaching or home and in-office bleaching.[4] Both categories share the common principle of decomposition of peroxide into unstable free radicals from hydrogen peroxide or its compounds such as Carbamide peroxide. Free radicals further breakdown large pigmented molecules by an oxidation or a reduction reaction. These processes change the chemical structure of interacting organic substance of the tooth resulting in the color changes.[5,6]

Carbamide Peroxide (10%) is the most widely used home bleaching agent and is approved by American Dental Association (ADA).[7] Previous studies have shown that home bleaching is safe in terms its effect on tooth structure and oral soft tissues, however there are some concerns regarding its effect on dental restorative materials.[5,8,9] Composite resins have an organic matrix which make these materials more prone to chemical changes than inert ceramic or metal restorations.[10]

Nanohybrid resin-based composites have excellent physical and mechanical properties as in macro-filled composites, and excellent finishing and polishing qualities as in micro-filled composites. So, these composites can be used in both anterior and posterior teeth. In addition, these materials contain a range of filler sizes, large filler particles besides nano scale-sized fillers.[11]

Chemical softening resulting from bleaching agents may affect the physical and mechanical properties including the durability of composite restorations.[8,12] Studies that evaluated the relationship between bleaching and the surface microhardness of composite resin restorations reported contradictory results.[13] Hanning et al (2007) reported a decrease in superficial and deeper surface hardness of bleached composite resins follow-

[1] Khulood Abdul Aziz Al-Mansour, BDS, MSc, Lecturer, Department of Restorative Dental Sciences, College of Dentistry, King Saud University.

[2] Anfal Mohammad Al-Qussier, BDS, Demonstrator, Majmaah University, Riyadh. **Correspondence:** Dr. Khulood Al-Mansour, RDS Department, PO Box 60169, Riyadh 11545. Kingdom of Saudi Arabia. Phone: +966 505211386 Fax: + 966 11 805 4720 EMail: kalmansour@ksu.edu.sa

ing different bleaching regimens,[10] while Sharafeddin and Jamalipour (2010) concluded that exposure of microfilled composite (Heliomolar Composite, Vivadent Schaan, Liechtenstein) to 35% carbamide peroxide gel (Opalescence Quick, Ultradent Production Inc, USA) resulted in no significant effect on the surface hardness. Exposure of a hybrid composite (Spectrum TPH composite, Dentsply De-Trey, Konstanz, Germany) to the 35% carbamide peroxide showed an increase in surface hardness.[4] These contradictions call for further research in this area. The aim of present study was to evaluate (in-vitro) the effect of 10% carbamide peroxide home bleaching gel (NiteWhite®, ACP, Discuss Dental, Culver City, CA, USA) on the surface micro-hardness of nanohybrid composite resin restorations (IPS Empress Direct, Dentin A2 and BL shades, Ivoclar-Vivadent, AG, Schaan, Liechtenstein).

METHODOLOGY

Two shades of nanohybrid composite (IPS Empress Direct, Dentin A2 and BL shades, Ivoclar-Vivadent, AG, Schaan, Liechtenstein) were used in this study to investigate the effect of 10% carbamide peroxide home bleaching gel (NiteWhite®, ACP, Discuss Dental, Culver City, CA, USA) on the surface microhardness of the restorations (Table 1).

Specimen Preparation

Forty Specimens were fabricated to obtain balanced

TABLE 1: COMPOSITE RESINS AND BLEACHING AGENTS TESTED

Material's name	Composition	Material type	Manufacture
IPS Empress Direct, Dentin	50.2% Barium glass filler, mixed oxide, Ba-Al fluorosilicate glass 20% Dimethacrylate 9.8% Ytterbium trifluoride 19.6% Prepolymer 0.4% Catalysts and stabilizers <0.1% Pigments	Nanohybrid Composite Resin	Ivoclar Vivadent, AG, Schaan, Liechtenstein
Nite White® ACP 10% CP	10% Carbamide Peroxide Potassium Nitrate Amorphous Calcium Phosphate Fluoride	Home Bleaching Gel	Discuss Dental, Culver City, CA, USA

TABLE 2: COMPARISON OF MEAN SURFACE MICRO-HARDNESS SCORES BETWEEN THE CONTROL GROUPS AND EXPERIMENTAL GROUPS

		C1	B1	C2	B2
Mean (SD) Scores		56.24(3.23)	58.87 (7.13)	52.23(8.53)	49.42(2.49)
95% Confidence Interval for Mean	Lower Bound	53.93	53.77	46.12	47.64
	Upper Bound	58.56	63.97	58.33	51.20
P-value		0.302		0.332	

C1=A2 shade control group, B1=A2 shade bleached group, C2=BL shade control group, B2= BL shade bleached Group. Significant difference at P< 0.05

TABLE 3: COMPARISON OF MEAN SURFACE MICRO-HARDNESS SCORES WITHIN CONTROL GROUPS AND EXPERIMENTAL GROUPS

		C1	B1	C2	B2
Mean (SD)		56.24(3.23)	52.23 (8.53)	58.87(7.13)	49.42(2.49)
95% Confidence Interval for Mean	Lower Bound	53.93	46.12	53.77	47.64
	Upper Bound	58.56	58.33	63.69	51.20
P-value		0.181		0.001	

C1=A2 shade control group, C2=BL shade control group, B1=A2 shade bleached group, B2=BL shade bleached group. Significant difference at P< 0.05

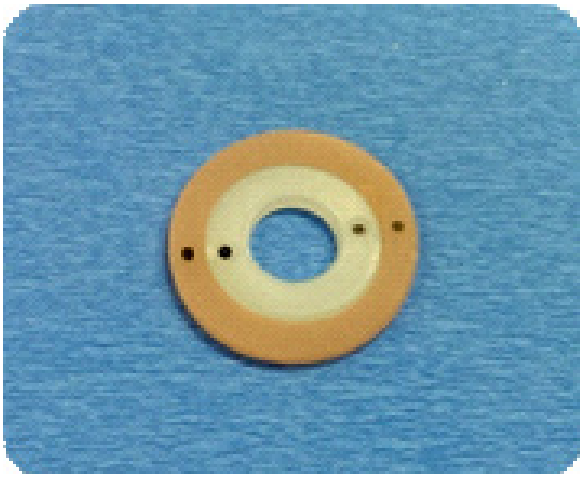


Fig 1: Acrylic mold (10x2 mm)

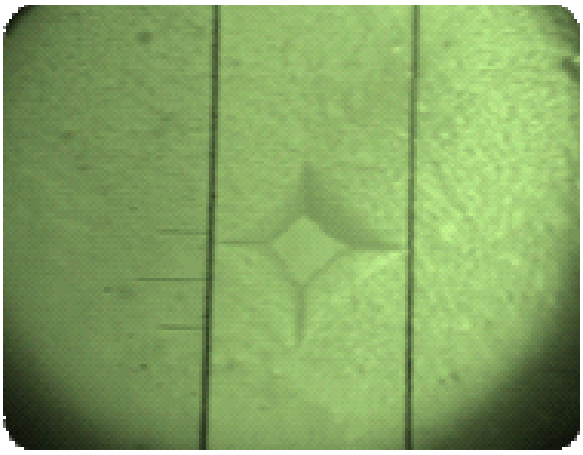
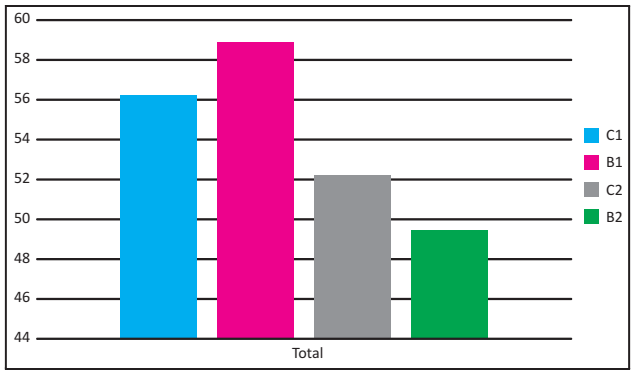


Fig 2: Indentation under Micromet® magnifier 40X



C1=A2 shade control group, C2=BL shade control group, B1=A2 shade bleached group, B2=BL shade bleached group.

Fig 3: Mean Surface Microhardness of Tested Materials

0distribution of the sample. The specimens were prepared using acrylic molds 10 mm in diameter and 2 mm in thickness (Fig 1). Each specimen was prepared as one increment and light cured from top using a LED light curing unit (Blue-Phase G2, Ivoclar Vivadent, AG, Liechtenstein) according to manufacturer's instructions within the range of 1200-1400 Mw/cm2 and, verified with a curing radiometer (Blue-Phase meter, Ivoclar Vivadent, AG, Liechtenstein). Untreated side of each sample was marked to identify the top surfaces. After curing, the top surface of specimens was polished with a sequential medium, fine, super-fine polishing disks (Sof-lex, 3M ESPE, St. Paul, MN, USA) using a mandrel on slow speed handpiece with a constant speed for the same duration.[12] After polishing, specimens were cleaned for 2 minutes in ultrasonic bath and stored in distilled water at 37ºC for 24 hours. Then the specimens of both shades were randomly subdivided into control group and an experimental group.

- Control Group (10 for each shade): These specimens were stored in distilled water bath at 37ºC for 14 days and did not receive any bleaching. The storage in distilled water for 14 days ensured the minimum wet-aging factor affecting bleached group[14,15] (C1=-Shade A2 control group, and C2= Shade BL control group).
- Experimental Group (10 for each shade): These specimens were treated with 10% Carbamide peroxide home bleaching gel (NiteWhite®, ACP, Discuss Dental, Culver City, CA, USA) 6 hours per day for 14 days according to the suggested exposure hours by the manufacturer (B1=Shade A2 bleached group, and B2= Shade BL beached group).

Bleaching Process

Prior to each bleaching procedure, specimens in the experimental group were taken out from distilled water bath and dried with air jet spray for 60 seconds. Bleaching gel was then applied to the top surfaces using micro-brush and left for 6 hours. After bleaching, specimens were washed with water jet spray for 60 seconds and stored back in distilled water bath for bleaching procedure on next day.[16]

Surface Analysis (micro-hardness measurement)

Microhardness was measured by Vickers Hardness test. Each specimen was placed on a platform with the surface being tested facing the diamond indenter. Using a 300g load and 15 seconds loading time (Micromet® 2100, Buehler, Lake Bluff, IL, USA), each specimen was indented five times at five different points and then the mean reading was recorded (Fig 2).

Statistical Analysis

All collected data were entered into a computer and analyzed using SPSS statistical software (Version #18) for Windows. Statistical analysis conducted at a significance level of $P < 0.05$ using independent T-test.

RESULTS

The results of Vickers microhardness test of the two shades of nanohybrid composite (IPS Empress

Direct, Dentin A2 and BL shades, Ivoclar-Vivadent, AG, Schaan, Liechtenstein) are presented in Tables 2 and 3, and Fig 3. There were no significant differences in the mean surface micro-hardness scores between the control groups and experimental groups for both the shades (p=0.302 and 0.332 respectively) of the tested nanohybrid composite. However; there was a significant (p=0.001) difference in the mean surface micro-hardness scores between the bleached groups of the two shades; shade A2 demonstrated a higher mean score (58.8) as compared to the BL shade (49.4) [Table 3].

DISCUSSION

The present study showed no effect of 10% Carbamide Peroxide home bleaching gel (NiteWhite®, ACP) on the surface microhardness of the two shades of nanohybrid resin-based composite (IPS Empress Direct, Dentin A2 and BL shades). This can be attributed to the composition of the IPS Empress Direct composite which contains 50.2% Barium glass filler, mixed oxides and Ba-Al-fluorosilicate glass and 20.0% Dimethacrylate (Table 1). The absence of Triethylene glycol dimethacrylate (TEGDMA) in IPS Empress Direct may also play a role in the surface micro-hardness. It has been reported that TEGDMA diluents monomers may increase the softening of resin matrix and reduce its resistant to bleaching agents.[17] Another factor could be the composition of the bleaching gel used (NiteWhite®, ACP) which contain amorphous calcium phosphate (Table 1). Turker and Biskin (2002)[18] reported that exposure of microfilled resin-based composite to 16% Carbamide Peroxide (NiteWhite®, ACP) for eight hours per day for four weeks resulted in increased microhardness of the material. The same composite exposed to 10% Carbamide Peroxide (Opalesence, Ultradent Product) and (Rembrandt, Den-Mat) resulted in decreased surface microhardness.

There are contradicting reports about effects of various Carbamide Peroxide concentrations on the surface microhardness of microfilled resin-based composites. Taher (2005)[19] reported a significant decrease in surface microhardness of composite resin after home bleaching with 15% carbamide peroxide gel (Opalesence, Ultradent). AlQahtani (2013)[17] also concluded that 10% Carbamide Peroxide (Opalesence, Ultradent Product) reduced the surface microhardness of nano-filled, Silorane-based low-shrink, and hybrid resin-based composite restoration, with no significant reduction in microhardness of microhybrid composites. On the other hand, Zuryati et al (2013)[16] concluded that there was a significant increase in surface hardness of nano-composite (Filtek Z350; 3M ESPE) after bleaching with 10% Carbamide Peroxide (Opalesence, Ultradent); however, a significant decrease was observed when 20% concentration was utilized. This controversy in the published data could be attributed to several factors such as the use of different types, compositions and shades of the tested composites.[4] In addition, different bleaching products, their concentrations and differences in their pH; and hardness tests methods could have also played their role in inconsistent results.[19,20] The bleaching treatment in this study was applied at the same time as the composite post polymerization process, which may have led to an increased surface hardness.[21] More investigations are recommended to evaluate different concentrations and regimens of the bleaching agents.

CONCLUSIONS

1 There was no adverse effect of 10% Carbamide Peroxide home bleaching gel (NiteWhite®, ACP) on the surface microhardness of the two shades (Dentin A2 and BL) of nanohybrid composite (IPS Empress Direct, Ivoclar-Vivadent).

2 Shade A2 demonstrated a higher mean surface micro-hardness score (58.8) as compared to the BL shade (49.4) after bleaching with 10% Carbamide Peroxide.

ACKNOWLEDGEMENT

The authors would like to thank Mr. Nasser Meflehi for his help in the statistical analysis. Conflict of Interest: The authors have no commercial interest in the materials tested in this study.

REFERENCES

1 Polydorou O, Mönting JS, Hellwig E, Auschill TM. Effect of in-office tooth bleaching on the microhardness of six dental esthetic restorative materials. Dent Mater Off Publ Acad Dent Mater 2007; 23(2): 153-58.

2 Fasanaro TS. Bleaching Teeth: History, Chemicals, and Methods Used for Common Tooth Discolorations. J Esthet Restor Dent 1992; 4(3): 71-78.

3 Hajizadeh H, Ameri H, Eslami S, Mirzaeepoor B. The effect of bleaching on toothbrush abrasion of resin composites. J Conserv Dent JCD 2013; 16(1): 17-20.

4 Sharafeddin F, Jamalipour G. Effects of 35% carbamide peroxide gel on surface roughness and hardness of composite resins. J Dent Tehran Iran 2010; 7(1): 6-12.

5 Silva Costa SX, Becker AB, de Souza Rastelli AN, de Castro Monteiro Loffredo L, de Andrade MF, Bagnato VS. Effect of four bleaching regimens on color changes and microhardness of dental nanofilled composite. Int J Dent 2009; 2009: 3138-45.

6 Hafez R, Ahmed D, Yousry M, El-Badrawy W, El-Mowafy O. Effect of In-Office Bleaching on Color and Surface Roughness of Composite Restoratives. Eur J Dent 2010; 4(2): 118-27.

7 Basting RT, Fernandéz Y Fernandez C, Ambrosano GMB, de Campos IT. Effects of a 10% carbamide peroxide bleaching agent on roughness and microhardness of packable composite resins. J Esthet Restor Dent Off Publ Am Acad Esthet Dent Al 2005; 17(4): 256-62; discussion 263.

8 Polydorou O, Hellwig E, Auschill TM. The effect of at-home bleaching on the microhardness of six esthetic restorative materials. J Am Dent Assoc 2007; 138(7): 978-84; quiz 1022.

9 Haywood VB, Heymann HO. Nightguard vital bleaching: how safe is it? Quintessence Int 1991; 22(7): 515-23.

10 Hannig C, Duong S, Becker K, Brunner E, Kahler E, Attin T. Effect of bleaching on subsurface micro-hardness of composite and a polyacid modified composite. Dent Mater Off Publ Acad Dent Mater 2007; 23(2): 198-203.

11 Schmidt C, Ilie N. The mechanical stability of nano-hybrid composites with new methacrylate monomers for matrix compositions. Dent Mater Off Publ Acad Dent Mater 2012; 28(2): 152-59.

12 Li Q, Yu H, Wang Y. Colour and surface analysis of carbamide peroxide bleaching effects on the dental restorative materials in situ. J Dent 2009; 37(5): 348-56.

13 El-Murr J, Ruel D, St-Georges AJ. Effects of external bleaching on restorative materials: a review. J Can Dent Assoc 2011; 77: b59.

14 Sharafeddin F, Sharifi E. The effect of microwave/laboratory light source postcuring technique and wet-aging on microhardness of composite resin. Dent Res J 2013; 10(3): 370-75.

15 Da Fonte Porto Carreiro A, Dos Santos Cruz CA, Vergani CE. Hardness and compressive strength of indirect composite resins: effects of immersion in distilled water. J Oral Rehabil 2004; 31(11): 1085-89.

16 Zuryati A-G, Qian OQ, Dasmawati M. Effects of home bleaching on surface hardness and surface roughness of an experimental nanocomposite. J Conserv Dent JCD 2013; 16(4): 356-60.

17 AlQahtani MQ. The effect of a 10% carbamide peroxide bleaching agent on the microhardness of four types of direct resin-based restorative materials. Oper Dent 2013; 38(3): 316-23.

18 Türker SB, Biskin T. The effect of bleaching agents on the microhardness of dental aesthetic restorative materials. J Oral Rehabil 2002; 29(7): 657-61.

19 Taher NM. The effect of bleaching agents on the surface hardness of tooth colored restorative materials. J Contemp Dent Pract 2005; 15:6(2): 18-26.

20 Price RB, Sedarous M, Hiltz GS. The pH of tooth-whitening products. J Can Dent Assoc 2000; 66(8): 421-26.

21 Mohamad D, Young RJ, Mann AB, Watts DC. Post-Polymerization of dental resins composite evaluated with Nanoindentation and Micro-Raman spectroscopy. Arch Orofac Sci 2007; 2: 26-31.

CONTRIBUTION BY AUTHORS

1 Khulood Abdul Aziz Al-Mansour: Idea and designing of the study, data collection and final manuscript preparation

2 Anfal Mohammad Al Qussier: Literature review, data collection and initial preparation of the manuscript.