Research Article

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Effect of Carbamide Peroxide Bleaching Agents on Surface Microhardness of Human Enamel: An In Vitro Study

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ABSTRACT

Aim: Various concentrations of carbamide peroxide are being used as both office and at-home bleaching agents. The present study was carried out to evaluate the effects of these agents on the surface microhardness of sound human enamel.

Materials & Methods: 25 sound premolars extracted for orthodontic purposes were sectioned, windows were made on buccal and lingual surfaces and were divided into five groups: Group I- Control group exposed to artificial saliva; Group II- exposed to 10% carbamide peroxide gel for 6 hours daily; Group III- exposed to 15% carbamide peroxide gel for 4 hours daily ; Group IV- exposed to 20% carbamide peroxide gel for 2 hours daily; and Group V- exposed to 35% carbamide peroxide gel for 30 minutes daily as per the manufacturer`s recommendations for a period of 1 week. Microhardness test was then carried out on all the specimens using a Vicker`s Diamond indentor using a load of 100g for a period of 12 seconds per indentation. Three indentations were made for each specimen to get the average microhardness values..the results were then subjected to statistical analysis.

Results: Bleaching procedures with 10% gels showed no major decrease in microhardness; while those with higher concentrations showed significant reductions in enamel microhardness compared to control group. 20% and 35% gels showed a highly significant reduction in microhardness values.

Conclusion: This study has shown that all bleaching agents caused a reduction in enamel microhardness. This reduction was significant when higher concentrations of bleaching agents were used.

Keywords: Bleaching, Carbamide Peroxide, microhardness.

INTRODUCTION

Cosmetic dentistry is a very important part of restorative practice today. Availability of cosmetic procedures has increased for a majority of society, since standards of living have improved. Discolouration of anterior teeth poses a great psychological problem to the patient and must be treated effectively. Intrinsic discoloration may result either from natural causes like fluorosis or iatrogenic causes like tetracycline staining. Bleaching is one of the corrective measures to treat intrinsically discoloured teeth. It can be performed internally on non-vital teeth (eg walking bleach technique) or externally on vital teeth. Vital bleaching is a viable option to consider when treating intrinsically stained or discoloured teeth whose form and integrity are deemed acceptable.

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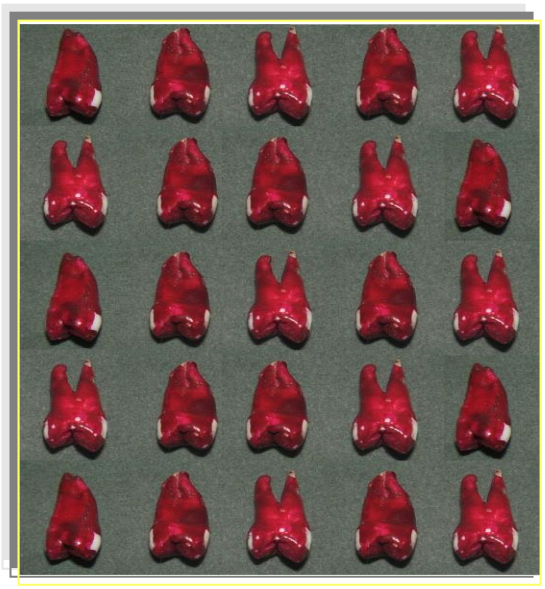


Fig 1: Teeth used for study.

Fig 2: Armamentarium used for preparation of tooth sections.

Fig 3: enlarged view of buccal and lingual windows.

Fig 4: Sectioned tooth.

Fig 5: Bleaching Agents used for the study.

Fig 6: Bleaching Agents used for the study.

Many vital bleaching techniques have been advocated in the past but all of them required use of caustic agents or etching of enamel or application of heat which have a deleterious effect on healthy pulp. These techniques also involved a considerable amount of chairside time, at a potentially significant cost to the patients often requiring re-treatment in 2-3 years due to regression[1].

Fig 7: Vicker's Microhardness Tester.

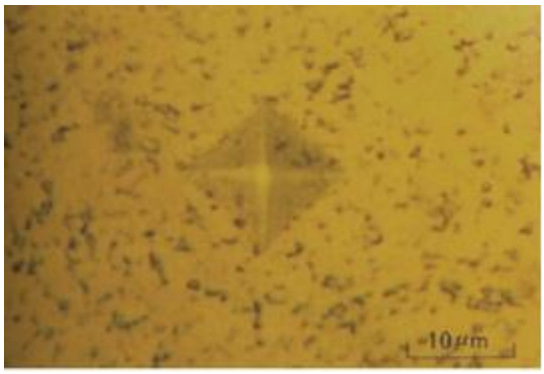


Fig 8: Indentation as seen through the microscope.

The introduction of Night-guard Bleaching technique has rekindled a resurgence of interest in tooth bleaching[2]. This technique offers an apparently safe and effective means of bleaching teeth inherently discoloured by aging, fluorosis, chromogenic food stuff and even by tetracycline. This technique employs the use of 10% carbamide peroxide in a soft night-guard worn by the patient at night for approximately 6 weeks[3]. The majority of the bleaching is accomplished outside the office, thus significantly saving cost and time for the patient. Furthermore, under the supervision of the dentist, it can be resumed at any time with only periodic supervision required, should any regression occur. Many variations of this technique with different concentrations of carbamide peroxide are being used by dentists for both office bleaching and home bleaching techniques. Despite the widespread use of bleaching agents, our present knowledge of possible adverse effects is still controversial. The major disadvantage towards esthetic enhancement was that of alteration of the chemical structure of the tooth surface like a decrease in calcium and phosphorous of dentin and enamel and a possible decrease in the microhardness[4].

In view of the controversy regarding the use of carbamide peroxide, the present study was undertaken to evaluate the effect of carbamide peroxide-containing bleaching agents on the surface micro hardness of sound human enamel.

AIMS AND OBJECTIVES

The aims and objectives of the present study include

1. To know the effect of carbamide peroxide bleaching gels on the surface micro hardness of sound human enamel when used as per the manufacturer`s recommendations.

2. To compare the effect of four carbamide peroxide gels with different concentrations on the surface micro hardness of sound human enamel.

3. To evaluate the effect of higher concentrations of carbamide peroxide on the surface micro hardness values of enamel.

MATERIALS AND METHOD

Twenty five non-carious premolar teeth extracted for orthodontic purposes from patients between the age group of 15-18 years were used for the study. The extracted teeth were washed thoroughly under running tap water to remove blood, saliva and other debris. Soft tissue and other debris covering the tooth surface were removed using hand scalers. Astick-on paper of 3×3mm was applied on the buccal and lingual surfaces of the crowns of extracted premolar teeth. An acid-resistant varnish was then applied over the whole tooth. The stick-on paper was then removed to expose a window of 3×3 mm both on buccal and lingual surfaces. The teeth were sectioned with the help of a double-faced diamond disk mounted on a micromotor with a straight handpiece. The teeth were randomly divided into five groups; each group was exposed to respective concentrations of carbamide peroxide gel for their recommended time periods daily for a total period of 1 week. After the recommended time of exposure daily, the teeth were removed from solution, washed with de-ionized water and placed in artificial saliva for the

Table 1: Microhardness values of Group I.

Specimen No.	**Micro hardness Values (VHN**			**Average (VHN)**
1	350.48	353.55	355.10	**353.05**
2	361.40	377.90	344.47	**361.26**
3	355.10	363.00	338.60	**352.24**
4	367.87	297.84	312.70	**326.14**
5	330.09	231.50	236.49	**266.02**
6	325.95	321.89	363.00	**336.94**
7	325.95	325.10	311.42	**322.02**
8	360.00	331.74	308.40	**334.38**
9	351.51	343.20	331.50	**342.07**
10	330.50	300.55	297.80	**309.61**
			MEAN	**330 ± 27.5**

Table 2: Microhardness Values of Group 2

Specimen No.	Micro hardness Values (VHN			Average (VHN)
	1	2	3	
1	377.90	328.70	295.47	334.02
2	323.23	334.30	328.70	328.70
3	331.48	328.70	324.58	328.26
4	291.96	289.66	312.70	298.10
5	293.12	305.13	310.15	302.80
6	319.22	324.58	350.48	331.43
7	390.13	366.23	381.34	379.23
8	290.80	323.23	289.66	301.23
9	328.70	325.10	291.96	346.93
10	324.58	316.54	280.12	307.08
			MEAN	326 ± 25.1

Table 3: Microhardness Values of Group 3.

Specimen No.	Micro hardness Values (VHN			Average (VHN)
	1	2	3	
1	249.68	228.26	285.13	254.36
2	338.60	276.39	311.42	308.80
3	311.42	348.97	316.59	325.66
4	317.90	324.58	293.12	311.87
5	287.38	287.38	223.53	266.10
6	294.29	289.66	278.54	287.49
7	260.08	253.39	149.63	221.03

8	255.27	267.03	261.05	261.12
9	246.20	263.80	295.90	268.63
10	310.50	290.80	314.50	305.26
			MEAN	281 ± 32.4

Table 4: Microhardness Values of Group 4.

Specimen No.	Micro hardness Values (VHN			Average (VHN)
	1	2	3	
1	253.39	270.10	257.18	260.22
2	276.39	237.33	277.40	263.73
3	276.39	286.25	305.13	289.26
4	344.47	374.51	271.13	330.04
5	245.16	284.02	268.05	265.74
6	345.96	376.20	374.51	365.56
7	221.99	222.76	201.95	215.56
8	289.66	303.90	305.13	299.56
9	286.20	290.30	240.15	272.21
10	231.64	275.10	277.75	261.49
			MEAN	282 ± 41.7

Table 5: Microhardness Values of Group 5.

Specimen No.	Micro hardness Values (VHN			Average (VHN)
	1	2	3	
1	249.68	228.26	285.13	254.36
2	338.60	276.39	311.42	308.80
3	311.42	348.97	316.59	325.66
4	317.90	324.58	293.12	311.87
5	287.38	287.38	223.53	266.10
6	294.29	289.66	278.54	287.49
7	260.08	253.39	149.63	221.03
8	255.27	267.03	261.05	261.12
9	246.20	263.80	295.90	268.63
10	310.50	290.80	314.50	305.26
			MEAN	281 ± 32.4

Table 6: Mean VHN of The Groups.

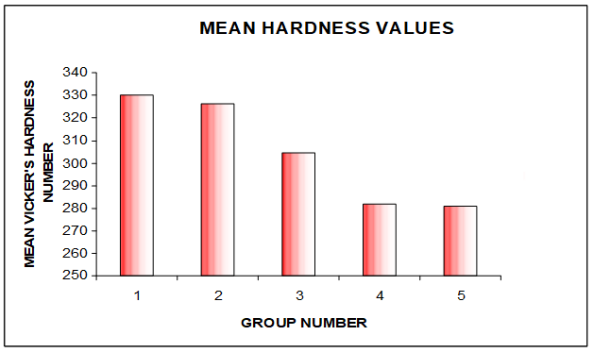
Groups	Mean VHN	Standard Deviation
I	330	27.5
II	326	25.1
III	305	30.2
IV	282	41.7
V	281	32.4

Table 7: Comparison of groups.

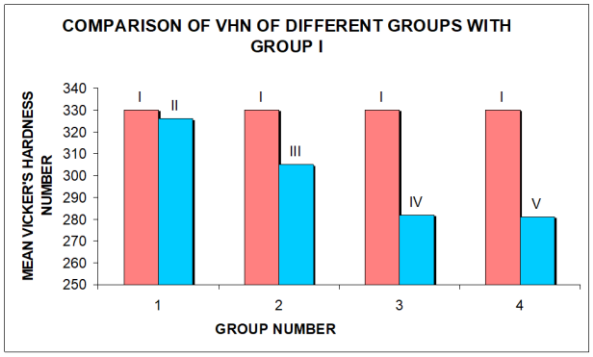
Groups	t value	p	Inference
I & II	3.90	0.701	NOT SIGNIFICANT
I & III	1.98	0.063	NOT SIGNIFICANT
I & IV	-3.01	0.008	SIGNIFICANT
I & V	-3.67	0.002	SIGNIFICANT

Table 8: Multiple Comparisons.

Groups	Comparison Groups	df	P Value	Inference
I	II	18	0.701	NS
	III	18	0.063	NS
	IV	18	0.008	S
	V	18	0.002	S
II	I	18	0.701	NS
	III	18	0.109	NS
	IV	18	0.007	S
	V	18	0.005	S



Graph 1: Mean hardness values.



Graph 2: Comparison of VHN of different groups with group 1.

remainder of the day. The procedure was carried out on all the specimens for a period of 1 week. The teeth in the control group were kept in artificial saliva for the entire period of 1 week.

The grouping of specimens is as follows:

Group I– Control Group – 5 teeth exposed to artificial saliva for a period of 1 week.

Group II – 5 teeth exposed to 10% Carbamide Peroxide gel (Opalescence-10%) for 6 hours daily.

Group III – 5 teeth exposed to 15% Carbamide Peroxide gel (Opalescence PF 15%) for 4 hours daily.

Group IV- 5 teeth exposed to 20% Carbamide Peroxide gel (Opalescence PF 20%) for 2 hours daily; and

Group V – 5 teeth exposed to 35% Carbamide Peroxide gel (Clinex Gel 35%) for 30 minutes daily.

After a period of 1 week, micro hardness tests were performed on all teeth using a Vicker`s Diamond Indentor using a load of 100g for a period of 12 seconds per indentation[5]. Three indentations were made for each specimen to get the average micro hardness value. The micro hardness test was done using a Leica VHMT-MOT Micro hardness Tester with a Vicker`s diamond indenting tool. The

values obtained were then subjected to statistical analysis.

RESULTS & DISCUSSION

The mean VHN values for Group I was 330 with a standard deviation of 27.5; Group II was 326 with a standard deviation of25.1; Group III was305 with a standard deviation of 30.2; Group IV was 282 with a standard deviation of 41.7 and Group V was 281 with a standard deviation of 32.4. Thus a progressive decrease in micro hardness from Group I to V was observed. In inter group comparisons, there was no statistically significant difference between control group and 10% Carbamide Peroxide group. This result correlates with several studies that have demonstrated the safety of 10% carbamide peroxide gels showing no significant changes in micro hardness values (HaywoodVB[6]; Potocnik et al[7];White DJ etal[8]).

In this study, a model comprising periods of treatment with bleaching agents and remineralization in artificial saliva was utilized, thereby attempting to simulate physiological conditions during bleaching procedures. Application of bleaching agents was performed as recommended by the manufacturers in accordance with the study by Attinet al[9]. During the experiment, the enamel specimens were stored in artificial saliva that has been proven to act as an effective agent for re-hardening the softened enamel in several in vitro studies[9].

Though the group treated with 15% gel demonstrated a decrease in micro hardness compared to control group, it was not statistically significant. The presence of fluoride in Opalescence PF 15% may have contributed to some remineralization after bleaching[10].This group also shows no statistically significant change in micro hardness when compared to groups IV and V, i.e.,20% and 35% carbamide peroxide. This shows that 15% carbamide peroxide has a potential for causing greater changes in microhardness values equal to 20% and 35% gels.

Groups IV and V (20% and 35% carbamide peroxide) showed statistically significant decrease in microhardness values compared to control group and also to Group I (10% gel). Thus, it has been demonstrated that higher concentrations of carbamide peroxide cause significant reduction in microhardness levels in accordance with several studies[2,9,11,12].

SUMMARY AND CONCLUSION

This study has shown that all bleaching agents and their respective treatment regimens caused a reduction in enamel microhardness. This reduction in microhardness was significant when higher concentrations (20% and 35%) of bleaching agents were used.

From the results of the study, it can be concluded that

1. Carbamide peroxide bleaching gels have a definite effect of reducing the surface microhardness of sound enamel.
2. Increase in concentration of carbamide peroxide further reduced the surface microhardness values to statistically significant levels.
3. There is no statistically significant reduction in surface microhardness observed with 10% carbamide peroxide gel applied for 6 hours daily for a period of 1 week whereas significant reduction is found with 15%; and with 20% and 35%, the reduction in microhardness is found to be highly significant.

The widespread use of bleaching agents to whiten teeth for esthetic reasons increases concern about the safety of peroxide-containing tooth whiteners on dental hard tissues. The results of this study indicate that tooth-whitening agents must be used with caution and one must think twice before opting for higher concentrations.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Robertson WD&Melfi RC-“ Pulpal response to vital bleaching procedures.” J of Endo 1980;6:645-49.

2. Shannon H, Spencer P, Gross K- "Characterization of enamel exposed to 10% carbamide peroxide bleaching agents." Quintessence Int 1993;24:39-44.

3. Haywood VB &Heyman HO-"Nightguard vital bleaching." Quintessence Int 1989;20:173-76.

4. Feagin F, Koulourides T, Pigman W- "Characterization of enamel surface demineralization, remineralization and associated hardness changes in human and bovine material." Arch Oral Biol 1969;14:1407-17.

5. Cirano FR&Romito GA-"Determination of enamel and coronal dentin microhardness. " Braz J Oral Sci 2003;2:258-63.

6. Haywood VB-"Historical development of whiteners-clinical safety and efficacy." Dent Update 1997;24: 98-104.

7. Potocnik I, Kosec L, Gasper D-" Effect of 10% carbamide peroxide gel on enamel microhardness, microstructure and mineral content." J of Endo 2000; 26:203-06.

8. White DJ, Kosek KM, Zoladz JR-"Peroxide interactions with hard tissues: effects on surface hardness and surface/ subsurface ultrastructural properties." Compendium of continuing Education in Dentistry 2002; 231 (A) 42-48.

9. Attin T, Muller T, Patyk A, Lennon AM- " Influence of different bleaching systems on fracture toughness and hardness of enamel." Oper Dent 2004; 29: 188-95.

10. Chen HP, Chang CH, Liu JK, Chuang SF, Yang JY- "Effect of fluoride containing bleaching agents on enamel surface properties." J Dent 2008;36(9): 718-25.

11. Rotstein I, Dankner E, Goldman A, Stabholz A, Zalkind M – " histochemical analysis of dental hard tissues following bleaching.'' J of Endo 1996; 22: 23-25.

12. Basting RT, Rodrigues AL, Serra MC- " Effect of 10% carbamide peroxide, carbopol and/ glycerine on enamel and dentin microhardness." Oper Dent 2005; 30: 608-16.