ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2018; 4(1): 286-289

www.oraljournal.com
Received: 18-11-2017
Accepted: 19-12-2017

Dr. Nalini Desai
Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka, India

Dr. Sahana S
Reader, Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka, India

Dr. Jayalaxmi KB
Prof and HOD, Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka, India

Dr. Satya Shravani
Student, Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka, India

Dr. Bharat
Student, Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka, India

Correspondence
Dr. Nalini Desai
Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka, India

The effect of a chemical activator on tooth bleaching with two different concentrations of carbamide peroxide: An *in vitro* study

Dr. Nalini Desai, Dr. Sahana S, Dr. Jayalaxmi KB, Dr. Satya Shravani and Dr. Bharat

Abstract
Aim and objectives: The aim of this study was to assess and compare the influence of manganese gluconate, a activator of bleaching agents, at a concentration of 0.01% on the efficiency of bleaching using two different concentrations of 10% and 16% carbamide peroxide and also to find out if, the effect of carbamide peroxide bleaching at 10% with manganese gluconate activator and carbamide peroxide bleaching at 16% without activator are comparable.
Material and methods: Forty samples of enamel were subjected to staining with 25% instant coffee solution for seven days at 37 degree C temperature. The values of the color of stained specimen were taken using a spectrophotometer. Then, the application of bleaching was done on the labial surface of the samples for eight hours daily for seven days. The final color measurement was done and the values of changes were calculated from the color measurements taken at the baseline. The total color change was calculated and designated by Delta (Δ E), which refers to color difference. The values obtained were subjected to statistical analysis. The color changes were analysed using ANOVA and tukey test at 5% level of significance.
Results: The use of manganese gluconate as chemical activator increased the efficiency of bleaching in both 10% and 16% carbamide peroxide. Also the effect of carbamide peroxide bleaching at 10% with manganese gluconate activator and carbamide peroxide bleaching at 16% without activator was comparable.
Interpretation and conclusion: Manganese gluconate in the concentration of 0.01% as a chemical activator increased the bleaching efficiency in both 10% and 16% carbamide peroxide bleaching concentrations. And the effect of carbamide peroxide bleaching at 10% with manganese gluconate activator and carbamide peroxide bleaching at 16% without activator are comparable.

Keywords: Bleaching, carbamide peroxide, spectrophotometer, manganese gluconate

Introduction
Tooth whitening has become increasingly popular and the desire for whiter teeth has become global. The esthetic impairment of tooth discoloration, especially in the anterior region, can be treated by a number of invasive therapies such as indirect crowns and veneers, microabrasion, or by the placement of direct composite. Bleaching offers a conservative, simplified, and economical alternative for tooth whitening. The use of hydrogen peroxide (H_2O_2) for tooth whitening can be traced back more than a century. The International Organization for Standardization (ISO) defines tooth bleaching as 'removal of intrinsic or acquired discolorations of natural teeth through the use of chemicals, sometimes in combination with the application of auxiliary means'.
Carbamide peroxide is a well-accepted agent used in at-home bleaching supervised by a dentist. It is applied to the external surfaces of teeth in the form of gel, with a customized tray. Carbamide peroxide is offered in a variety of different concentrations, ranging from 10% to over 20%, but the best combination of safety, limited side effects and speed of action is obtained with a 10% solution of carbamide peroxide approved by ADA. In an attempt to increase the efficiency of bleaching agents, higher concentrations were also used. This led to occurence of most common adverse effects in at-home vital bleaching like mild to moderate tooth sensitivity and/or gingival irritation. Thus, higher concentrations of bleaching agent may increase these side effects.

Aim and objectives

- To assess and compare the influence of manganese gluconate, a chemical activator of bleaching agents, at a concentration of 0.01% on efficiency of bleaching using two different concentrations (10% and 16%) of carbamide peroxide.
- To find out if, the effect of carbamide peroxide bleaching at 10% with manganese gluconate activator and carbamide peroxide bleaching at 16% without activator are comparable.

Source of teeth and storage

Forty extracted human permanent maxillary central incisor teeth were collected from the Department of Oral and Maxillofacial surgery, Krishnadevaraya College of Dental Sciences and Hospital, Bangalore and Government dental college, Bangalore.

The extracted teeth were cleaned of soft tissue, calculus and debris with ultrasonic scaler and were stored in saline till further period of study.

Methodology

Preparation of the specimen

The tooth crowns were sectioned transversely with a flexible diamond disk at the cemento-enamel junction. With the help of a carborundum disk driven by a low-speed micromotor, the teeth were sectioned longitudinally to expose the dentin. The lingual half was removed and discarded, and the labial half was used for the study.

Staining of the specimen

The dentin surfaces were etched with 37% phosphoric acid gel for 15 seconds. The specimens were then washed with an air/water jet for 30 seconds to expose the dentin tubules and cause efficient darkening. For pigmentation, the teeth were immersed in 200mL of recently prepared 25% instant coffee solution (50 grams of coffee powder added to 200mL of distilled water at 100 ^{0}C). Kept in a bacteriologic oven for seven days at a temperature of 37 ^{0}C. After staining, the enamel surfaces were polished with a diamond polishing paste using felt disks. For the purpose of delimiting the color reading area, a circular adhesive label of 6mm in diameter was adhered to the center of buccal surface. The entire buccal and other surfaces were coated with colorless nail varnish. After the nail varnish dried, the label was removed, exposing the dental enamel window of 6mm in diameter. Lktig 790 The other purpose of varnishing the specimen was to prevent the bleaching gels from penetrating the dentinal tubules during the storage and bleaching periods and interfere with the color. After these procedures, the samples were stored separately in plastic receptacles, immersed in distilled water.

Grouping of the specimen

The forty stained samples will be randomly divided into four groups of ten samples in each group, based on the concentration of bleaching used.

- Group I (n=10): Bleaching with 10% Carbamide peroxide gel
- Group II (n=10): Bleaching with 10% Carbamide peroxide gel with addition of 0.01% manganese gluconate.
- Group III (n=10): Bleaching with 16% Carbamide peroxide gel
- Group IV (n=10): Bleaching with 16% Carbamide peroxide gel with addition of 0.01% manganese gluconate.

Bleaching process

Gels used in Group I and group III were applied directly from the tube onto the tooth structure. Gels used in group II and group IV were mixed with 0.01% manganese gluconate powder in equal proportion and applied onto the tooth structure.

The application of bleaching gels was done on demarcated labial areas of the tooth crowns for eight hours daily. During the non-bleaching intervals, the teeth were washed under running water to completely remove the bleaching agents and then stored in distilled water at 37 ^{0}C.

Color measurement

The color of the labial faces of the teeth was measured using Vita Easyshade spectrophotometer. Two separate readings were taken in the area within the diameter of 6mm: initial measurement and a measurement after seven days. For each specimen, means were calculated for the values of L*, a*, and b*. The L*value defines the lightness of the color, a* and b* define the chromatic characteristics of the color, with a* referring to the red-green axis and b* referring to yellow-blue axis. The values of the changes of L*(ΔL), a*(Δa), and b*(Δb) were calculated from color measurements taken at baseline and after seven days. The total change in color, or the variation in perception of color, of each tooth was calculated and designated as Delta E (ΔE), which refers to color difference between time periods. The parameter was calculated according to the following formula:

$$\Delta E = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$$

Statistical analysis

One-way analysis of variance (ANOVA) and Tukey test were used to compare the color changes in different groups. A significant level of $p<0.05$ was used for all tests and comparisons.

The final outcome measures of delta E obtained after spectrophotometric measurements for each group is presented in table 1.

Table 1: ΔE values for each group.

Group 1		Group 2		Group 3		Group 4	
A1	16.92	B1	19.80	C1	21.30	D1	28.31
A2	19.38	B2	21.23	C2	26.38	D2	29.68
A3	16.28	B3	18.81	C3	22.16	D3	26.18
A4	15.69	B4	17.30	C4	18.18	D4	27.83
A5	16.47	B5	18.17	C5	21.53	D5	21.34
A6	17.74	B6	21.31	C6	23.81	D6	23.38
A7	15.40	B7	18.13	C7	20.1o	D7	28.61
A8	10.17	B8	12.80	C8	18.23	D8	25.19
A9	13.15	B9	18.31	C9	17.16	D9	26.19
A10	13.54	B10	16.34	C10	16.83	D10	25.18

Method of statistical analysis

Table 2: The results averaged (mean +/- standard deviation) for each group.

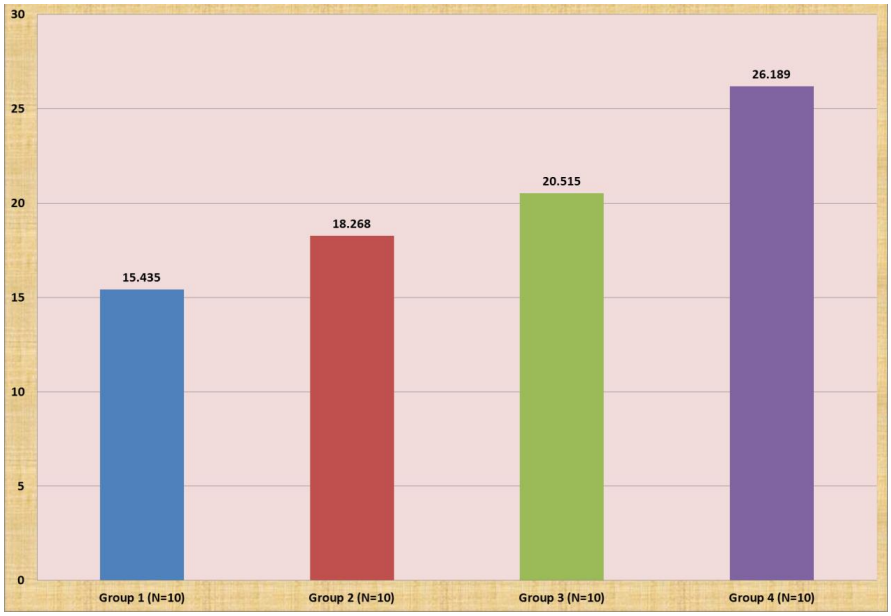
	N	Mean	SD	Median	Min.	Max.	Chi-square	'p' value
Group 1	10	15.435	2.648	10.17	19.38	6	28.256	>0.001
Group 2	10	18.268	2.441	12.80	21.31	6		
Group 3	10	20.515	3.153	16.30	26.38	5		
Group 4	10	26.189	2.553	21.34	29.68	5		

The one way analyses of variance ANOVA and tukey test methods of statistically analysis have been used in this study. One way analyses of variance was used to test the difference between groups and to find out which of the two groups means is significantly difference post hoc test of Tukey test was used. The results for each parameter averaged (mean + standard deviation) for continuous data are presented in Table 3 and graph 1.

Table 3: Pairwise comparision of delta E using Tukey test.

Groups	Mean Difference	P Value
Group 1 vs group 2	-2.833	0.109
Group 1 vs group 3	-5.080	0.001
Group 1 vs group 4	-10.754	<0.001
Group 2 vs group 3	-2.247	0.266
Group 2 vs group 4	-7.921	<0.001
Group 3 vs group 4	-5.674	<0.001

There was a statistically significant difference mean delta E between groups as determined by one-way ANOVA (p<0.001). A Pair wise comparison between the study groups (Tukey post-hoc test) revealed that the mean delta E was statistically significant between Group 1 with Group 3and Group 4 (p<0.001). Similar observation was observed between Group 2 and Group 4 (p<0.001) and between Group 3 vs Group 4 (p<0.001). There was no statistically significant difference between the Group 1 vs Group 2 (p=0.109) and Group 2 vs Group 3 (p=0.266).



Graph 1: Comparision of mean ΔE values among the study groups.

Discussion

The current tooth bleaching materials almost exclusively use carbamide peroxide and hydrogen peroxide as active ingredients in tooth bleaching regardless of in-office or at-home uses. Although bleaching process is complex, the vast majority work by oxidation. Oxidation is a chemical process by which organic materials are eventually converted into carbon dioxide and water. Bleaching slowly transforms an organic substance into chemical intermediates that are lighter in color than the original. This oxidation-reduction reaction which takes place in bleaching process is known as a 'redox reaction'. In redox reaction the oxidizing agent (eg, hydrogen peroxide) has free radicals with unpaired electrons, which it gives up becoming reduced; the reducing agent (the substance being bleached) accepts the electrons and becomes oxidized. In the present study, manganese gluconate (0.01%) was used as chemical activator. Mixing manganese gluconate with hydrogen peroxide, acts in a simple manner, accelerating peroxide degradation, forming water and free radicals; without dissociating themselves or participating in the reaction that does not occur with iron, which ends up in participating in the reaction, making electron exchanges.

In order to accelerate the releasing of free radicals, professionals have used devices that transfer energy to hydrogen peroxide, increasing its decomposition. The activating sources are not responsible for the bleaching process properly; they only intend to increase the degradation of the bleaching gel.

In the present study the digital spectrophotometer was used. The shade assessment in Spectrophotometer was done by objective method, eliminating the subjectivity of the shade scale method. The studies of Li and Joiner found that objective methods were superior for assessing the teeth. Moreover, according to Baltzer and Jinoian, assessment by spectrophotometer is not influenced by external medium and by the tone of the skin and tissues adjacent to the teeth. The digital spectrophotometer measures the shade of teeth based on the CIEL*a*b* color space system, allowing the determination of color in three dimensional space. This system was defined by the International Commision on Illumination in 1967 and is referred to as CIELAB.

In group 1, mean value of 15.435 was seen where samples were bleached with 10% carbamide peroxide without chemical activator. Group 2 showed the mean value of 18.268 where the samples were bleached with 10% carbamide peroxide with the activator. Pairwise comparison of delta E using tukey test showed a statistically significant difference between groups 1 and 2.

In group 3, mean value of 20.515 was seen where samples were bleached with 16% carbamide peroxide without chemical activator. Group 4 showed the mean value of 26.189 where the samples were bleached with 10% carbamide peroxide with the activator. Pairwise comparison of delta E using tukey test showed a statistically significant difference between groups 3 and 4. Group 1 and group 3 in which bleaching was done without chemical activator showed statistically significant difference.

Whereas, group 2 with mean of18.268 and group 3 with mean of 20.515 showed the mean difference of 2.247 which was not statistically significant. Therefore, 10% carbamide peroxide with chemical activator and 16% carbamide peroxide without chemical activator were comparable and showed no statistically significant result.

Therefore, use of chemical activator increased the efficacy of bleaching in both 10% and 16% carbamide peroxide. It was also seen that, the effect of carbamide peroxide bleaching at 10% with manganese gluconate activator and carbamide peroxide bleaching at 16% without activator had no statistically significant difference and were comparable.

Conclusion

Within the limitations of this study,

- Increase in the concentration of bleaching agent increases the efficiency of bleaching.
- Manganese gluconate in the concentration of 0.01% as a chemical activator increased the bleaching efficiency in both 10% and 16% carbamide peroxide bleaching concentrations.
- The effect of carbamide peroxide bleaching at 10% with manganese gluconate activator and carbamide peroxide bleaching at 16% without activator are comparable.

References

1. Donald A. The role of bleaching in esthetics. Dental Clinics of North Ameri- ca. 1989; 33(2):319-336.
2. Zekonis R, Matis BA *et al*. Clinical evaluation of In-office and At-home bleach- ing treatments. Oper Dent. 2003; 28(2):114-121.
3. Hedge MN. International research journal of pharmacy. 2012; 3(11).
4. Fearon J. Tooth whitening: concepts and controversies. Journal of Irish Dental Association. 2007; 53(3):132.
5. Auschill TM, Hellwig E, Schmidale, Sculean A, Arweiler NB. Efficacy, side- effects and patient acceptance of different bleaching techniques (OTC, in-office, at home). Oper Dent. 2005; 30(2):156-163.
6. Fitch CP. Etiology of the discoloration of teeth. Dent Cosmos. 1861; 3:133-136.
7. Haywood VB, Heymann HO. Nightguard vital bleaching. Quintessence Int. 1989; 20(3):173-176.
8. International Organization for Standardization. Dentistry-Products for External Tooth Bleaching. ISO 28: 399. Geneva: ISO, 2011.
9. Attin T. The safety and use of carbamide peroxide gels in bleaching therapy. Dtsh Zahnarztl Z. 1998; 53:11-6.
10. Attin T, Hannig C, Weigand A, Attin R. Effect of bleaching on restorative materi-als and restorations: a systematic review. Dent Mater. 2004; 20:852-61.
11. Feinman RA, Goldstein RE, Garber DA. Bleaching teeth. Chicago: Quintessence Publ. Co, 1987.
12. Kihn PW, Barnes DM, Romberg E, Peterson K. A clinical evaluation of 10 percent vs. 15 percent carbamide peroxide tooth whitening agents. J Am Dent Assoc. 2000; 131:1478-84.
13. Zekonis R, Matis BA, Al Shetri SE, Eckert GJ, Carlson TJ. Clinical evalu- ation of in-office and at-home bleaching treatments Oper Dent. 2003; 28(2):114-121.
14. Haywood VB. Frequently asked questions about bleaching Compendium of Continuing Education in Dentistry. 2003; 24(4A):324-338.
15. Hasson h, Ismail AI, Neiva G. Home-based chemically induced whitening of teeth in adults (Review) Cochrane Database of Systematic Reviews. 2006; 4 1-43.
16. Viscio d, Gaffar A, Fakhry-Smith S, Xu T. Present and future technologies of tooth whitening The Compendium of Continuing Education in Dentistry. 2000; 28:S36-S43.
17. Chen JH, Xu JW, Shing CX. Decomposition rate of hydrogen peroxide bleaching agents under various chemical and physical conditions Journal of Prosthetic Dentistry. 1993; 69(1):46-48.
18. Frysh H, Bowles WH, Baker F, Rivera-Hidalgo F, Guillermo G. Effect of Ph on hydrogen peroxide bleaching agents Journal of Esthetic Dentistry. 1995; 7(3):130-133.
19. Travassos AC, Torres CRG, Borges AB, Barcellos DC. *In vitro* assessment of chemical activation efficiency in dental bleaching by the in-office technique. Oper Dent. 2010; 35(3):287-94.
20. Joiner A. The bleaching of teeth: A review of the literature Journal Dentistry. 2006; 34(7):412-419.