Original Article

Clinical Evaluation of Carbamide Peroxide and Hydrogen Peroxide as Vehicle of Intracoronal Bleaching Agent in A3 or Darker Shaded Discolored Teeth.

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Abstract

Introduction: 10% carbamide peroxide gel has been tried as an alternative intracoronal bleaching agent and it was found effective. The objectives of the study were to evaluate and compare the efficacy of carbamide peroxide and hydrogen peroxide as vehicle of dental bleaching agents when mixed with sodium perborate powder in patients having teeth of A3 or darker shades.

Materials and methods: On the basis of predetermined inclusion and exclusion criteria, 11 patients could be scrutinized whose teeth shade were A3 or darker than A3. According to the bleaching agents to be evaluated, patients were allocated under 2 groups. The shade of adjacent normal tooth was used as control. Preoperative and postoperative color assessments of the discolored teeth were done weekly by three clinicians independently using a standard clinical shade guide. Evaluation was continued up to achieving the shade of the adjacent control tooth or a maximum of 5 weeks by using a scale of evaluation. Collected data of the weekly efficacy score were analyzed using a statistical software SPSS version 11.5.

Results: The difference of treatment outcome between the groups on the study patients after 5 weeks of treatment was not statistically significant and also, neither of the two bleaching agents was significantly superior to each other in changing the shades among the patients having A3/darker shades. On comparing the weekly average efficacy score pattern between the groups, Hydrogen peroxide group revealed statistically significant score at the end of 4th week while at the same time Carbamide peroxide group revealed its most unsatisfactory score.

Conclusions: Within the study period, both the bleaching agents were able to bleach satisfactorily all the patients up to the desired normal shade. While comparing average efficacy score after 5 weeks, there was no statistically significant difference between the materials.

Keywords: Hydrogen peroxide, Carbamide peroxide, Sodium perborate etc.

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Introduction

Tooth discoloration usually results from behaviors, diseases, injuries and other exposures along with various physiological processes.[1,2,3,4,5] Most post-eruptive discoloration occurs as a result of trauma to the tooth leading to pulpal hemorrhage and necrosis. According to Nutting and Poe (1967) and Grossman (1976), bleeding and permanence of blood inside the conduit of the root is the most frequent cause of darkening of teeth. [6, 7]Dissemination of blood components into the dentinal tubules is the possible reason for discoloration of the nonvital teeth.[8, 9]Initially, the tooth crown becomes pinkish temporarily. Later, during haemolysis, blood degradation products such as haemosiderin, haematin, haematoidin and haematoporphyrin release iron.[10]This iron is then converted to black ferric sulphide with hydrogen sulphide produced by bacteria, which causes a bluish or black staining of the tooth.[7]

A brown or grayish tooth is characteristic of pulpal degradation without hemorrhage owing to protein degradation of necrotic tissue. Protein degradation of necrotic pulp tissue and pulp horns left behind by inadequate access to pulp chamber and incomplete removal of the contents of the cavity during endodontic therapy also leads to discoloration of teeth.[11, 12, 13]

Attractive teeth have always been the patients' primary desire. Tooth discoloration has a direct impact on the esthetics of a person. For this reason, bleaching, a chemical process for whitening materials is widely used in dentistry.[14] Bleaching is now the single most common esthetic treatment.[15]

Tooth discoloration that may be classified as extrinsic, intrinsic and a combination of both.[3] External bleaching technique is appropriate for the vital discolored teeth and the extrinsic, superficial and age related discoloration. Non-vital tooth whitening is appropriate for the significant color change in intrinsic discoloration of non-vital teeth. The whitening of endodontically treated teeth can be carried out by internal whitening treatment or the "Walking bleach" technique.[8,16,17,18,19] It is so named because in this technique, bleaching agent is sealed in the access cavity with provisional cement and bleaching occurs while the patient is "walking away" from the office.

Bleaching in dentistry, usually utilizes products containing some form of hydrogen peroxide.[15]This active agent of bleaching either can be applied directly or produced in a chemical reaction from Sodium Perborate[20] or Carbamide peroxide [21]. Because of its low molecular weight, hydrogen peroxide diffuses easily through the organic matrix of the enamel and dentin.[22, 23,24]It is very unstable and acts as a strong oxidizing agent through the formation of free radicals [25], reactive oxygen molecules and hydrogen peroxide anions[26]. These reactive molecules can attack the long-chained, dark-colored chromophore molecules and split them into smaller, light colored and more diffusible molecules.

Bleaching agent selection is done by evaluating the speed and efficacy in re-establishing the natural color of the teeth and their biological behavior to surrounding structures. Evaluation of the efficacy of the different medicaments of internal tooth bleaching by various studies has been done mostly on artificially stained teeth. The conclusion of those in vitro studies was that sodium perborate in water, sodium perborate in 3 and 30% hydrogen peroxide, and 10% carbamide peroxide were efficient for internal bleaching of non-vital teeth. Clinical studies are also necessary to assess the combined efficacy of 10% carbamide peroxide-sodium perborate mixture in different tooth shades.

Materials and Methods

This prospective study was conducted in the Department of Conservative Dentistry and Endodontics, Bangabandhu Sheikh Mujib Medical University (BSMMU). As per inclusion criteria- mature, permanent, intact, anterior, asymptomatic endodontically treated teeth with good apical seal including single access opening and teeth having traumatic history were included for the study. According to the exclusion criteria- immature permanent teeth and teeth having discoloration caused by reasons other than trauma, restoration other than the endodontic filling, crown fracture, resorption, cervical abrasion, post endodontic symptoms etc were excluded from the study. Within the study period, 11 patients having A3 or darker tooth shade were selected and written consent forms were obtained after explaining the study protocol to the patients in detail.

Purposive sampling technique was adopted. According to the bleaching agents to be evaluated, patients were allocated under following 2 groups:

Group I- Hydrogen peroxide mixed with sodium perborate (n=6).

Group II- Carbamide peroxide mixed with sodium perborate (n=5).

Study Procedure

Following two weeks of history taking and the professional prophylaxis, the shade of the discolored tooth was recorded by three clinicians on the basis of a value oriented shade guide (VITAPAN Classical) on the preoperative data sheet. Common finding among the three evaluators was finally judged as the preoperative shade. Shade of the adjacent normal tooth was also determined in the similar way. Photographs were taken with a digital camera to record the baseline shades to be compared later on with the succeeding shades during the treatment procedures.

After removing the old restoration, the access cavity was cleaned with 1% sodium hypochlorite in a cotton pledget to remove the accessible remnants of necrotic pulp tissue. Filling of the coronal third of the root was removed up to 3 mm below the cemento-enamel junction using Gates Glidden drills for provision of a space for barrier placement. 4 mm thick layer of glass ionomer cement (type II) was used as a barrier for all the cases.

Sodium perborate powder was mixed with 30% hydrogen peroxide solution in a ratio of 2:1 (g/ml) to make a thick consistency of wet sand and the pulp chamber was packed with the paste by a plastic instrument. A cotton pellet was used to remove the excess liquid and also to compress the paste into all areas of the pulp chamber. After placing a tiny dry cotton pellet, undercut area was cleared off the bleaching agent and the access cavity opening was sealed with zinc phosphate cement for 7 days. Similar technique was also used during 10% carbamide peroxide application.

After 7 days, patients were examined for any change in the shades of the discolored teeth relative to the preoperative one with the help of the Vita shade guide and the shade changes were recorded on the data collection sheet.

Weekly clinical evaluation was done by three clinicians independently and was also recorded on the post-operative data sheet on the basis of a predetermined evaluation scale ranging from 5 to 1.[19]

The Evaluation Scores were as follows--

5 = Best or Optimal.

4 = Very Good.

3 = Good.

2 = Better than previous week.

1 = Identical to previous week/ failure.

According to the shade guide VITAPAN CLASSICAL-

● Reddish- brownish tooth color denoting with increasing intensity as A1, A2, A3, A3.5 & A4 where A3, A3.5 & A4 are usually darker than natural teeth

Photographs of the teeth were taken with the shade tabs in position.

The shade of the adjacent natural tooth was determined as the ultimate target. Fresh bleaching agent was replaced within the access cavity weekly up to achieving that target or for a maximum of 5 weeks. On each of the weekly evaluation day, the lightened shades of the treated teeth were recorded, the evaluation scores were documented and photographs were taken. After the desirable whitening had been achieved, the access cavities were packed with the thick mixes of calcium hydroxide for 2 weeks after which permanent restorations were done.

Pre-Operative

After 1st Week

After 2nd Week

After 3rd Week

After 4th Week

After 5th Week

Fig 1: Hydrogen peroxide was mixed with sodium per borate in bleaching of a patient having A4 shade.

All the data collected during the treatment procedures were submitted for statistical analysis. The statistical analysis had done for the test of significance.

Data analysis

Data were processed and analyzed using SPSS (Statistical Package for Social Sciences) version 11.5. Chi-Square ($\chi 2$) Test was done for distribution of study subjects by treatment outcome. Unpaired Student's t-Test was done for comparison of average efficacy score between the groups and Repeated measure ANOVA and Bonferroni statistics were done for multiple comparisons of weekly average efficacy score between the groups. P value < 0.05 was considered significant. The summarized data were then presented in tables and line-charts.

Result

The present study was undertaken to evaluate the efficacy of hydrogen peroxide and carbamide peroxide as non vital tooth bleaching agents when both of them were mixed with sodium perborate powder in a ratio of 1: 2 (ml/g). A thick mix of bleaching agent was packed within the pulp chamber of the discolored tooth having A3/darker shade. Weekly evaluations were recorded by three clinicians independently on data collection sheet using an evaluation scale. The summarized data were then presented in form of tables and line-charts.

Table I: Comparison of overall efficacy of bleaching agents after 5 weeks of treatment on the study shades (n=11)

Groups	Average efficacy score after 5 weeks in A3 or darker shades	p-value#
Hydrogen peroxide	2.52 ± 0.47	0.077NS
Carbamide peroxide	2.0 ± 0.37	

Data were analyzed using unpaired Student's t-Test and were presented as mean ± SD and $p < 0.05$ was considered significant. NS=Not significant. n=Number of study shades.

Table I shows the overall efficacy of the two bleaching agents on A3/darker shades after 5 weeks of treatment and interprets that neither of the agent was significantly superior to each other in changing the shades of teeth.

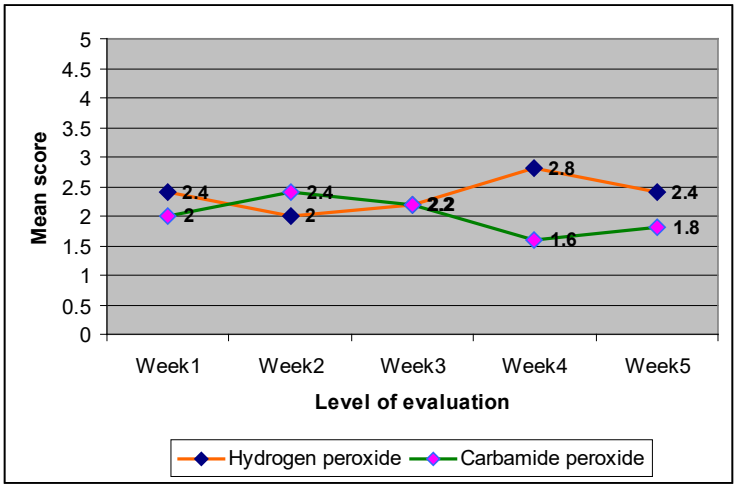

Fig. 2: Weekly average efficacy score pattern between the groups in patients having A3/darker shades.

Starting with an acceptable performance (score >2) in bleaching during 1st week, the Hydrogen peroxide group did not experience any significant change from 1st to 3rd weeks. But after 3rd week, there was an increase in efficacy score that again declined at week 5. The Carbamide peroxide group though initially showed an increase in efficacy between 1st and 2nd week, the efficacy score again declining for the residual week which reached well below the acceptable range (score < 2) at the end of 4th week.

Table II: Changes in weekly average efficacy score in different study groups in patients having A3/darker shades (n=11)

Weeks	Groups		p-value#
	Hydrogen peroxide (n = 6)	Carbamide peroxide (n = 5)	
Week 1	2.4 ± 0.9	2.0 ± 0.7	0.438 NS
Week 2	2.0 ± 0.7	2.4 ± 0.5	0.611 NS
Week 3	2.2 ± 0.8	2.2 ± 0.8	0.951 NS
Week 4	2.8 ± 0.8	1.6 ± 0.8	0.016 *
Week 5	2.4 ± 0.5	1.8 ± 0.8	0.346 NS

Data were analyzed using **Repeated measure ANOVA** and **Bonferroni statistics** and were presented as **mean ± SD,** level of significance was **0.05**. * =Significant NS=Not significant**.** n=number of study subjects.

Table II shows the changes in weekly average efficacy score following treatment with Hydrogen peroxide and Carbamide peroxide in patients having A3/darker shade. Weekly evaluation did not reveal any significant difference between the groups in terms of efficacy score except at the end of 4th week ($p< 0.05$).

Discussion

By weight, carbamide peroxide contains 33% hydrogen peroxide, so a bleaching gel with 10% carbamide peroxide contains a similar level of active hydrogen peroxide as one containing 3.3% hydrogen peroxide. When compared the efficacy of hydrogen peroxide containing products with carbamide peroxide containing ones having equivalent hydrogen peroxide content and both the products were delivered by similar format and formulations, approximately similar efficacy was reported by various in vitro[27] and in vivo studies.[28,29] Among those studies, the clinical study by Nathoo et al. (2003) demonstrated that, once a day application of either a 25% carbamide peroxide gel or an 8.7% hydrogen peroxide gel both gave a statistically significant tooth shade lightening after 2 weeks use, compared to baseline, but found no statistically significant differences between the products.[29] In all these studies, liberated hydrogen peroxide from the carbamide peroxide products were equivalent to the hydrogen peroxide containing products. On the other hand, equal efficacy was observed even when comparative bleaching agents were not consistent in their concentrations, as for example the study where 35% hydrogen peroxide and 35% carbamide peroxide were compared as intracoronal bleaching agent.[30]In this study of Lim et al. (2004) equal efficacy was observed, in spite of having dissimilar hydrogen peroxide content.[30] In the present study also, 30% hydrogen peroxide and 10% carbamide peroxide when mixed with sodium perborate bleached equal number of teeth after 3rd week (23%) and after 5 weeks of treatment, their overall efficacies interpret that neither of the agent was significantly superior to each other in changing the shades of teeth ($p=0.077^{NS}$).

In cases of A3 or darker shades, statistically significant difference was observed between the bleaching efficacy of hydrogen peroxide and carbamide peroxide when mixed with sodium perborate, only after 4th week and insignificant difference was observed during the rest of the weeks. This A3 or its darker color is the reddish-brownish tooth color occurring due to protein degradation of necrotic pulp tissue and pulp horns. This color is the characteristic of pulpal degradation without hemorrhage. In absence hemolysis, iron and ferric sulphide cannot be formed. Thus the highly pigmented carbon-ring compounds and the unsaturated double bonds of long, colored organic molecules are absent here. So whitening of the protein degradation products appear slower.

After 4th week, Hydrogen peroxide exhibited a significantly better efficacy due to its inherent rapid formation of free radicals [19] in comparison to Carbamide peroxide which is slow but steady in its work.[23]

Conclusion

Within the study period, both the vehicles were able to bleach satisfactorily equal number of patients up to the desired normal shade. The Overall efficacy after 5 weeks of treatment showed that there was no statistically significant difference between the materials. Although weekly evaluation revealed Hydrogen peroxide group to work better at the end of 4th week, but considering the associated potential side effects, increase in the concentration of Hydrogen peroxide is not desirable.

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