

## CLINICAL EFFICACY OF 35% CARBAMIDE PEROXIDE AND SODIUM PERBORATE IN INTRACORONAL BLEACHING OF DISCOLOURED NON-VITAL TEETH

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### ABSTRACT

The objective of this study was to compare the efficacy and safety of 35% Carbamide peroxide (CP) and Sodium perborate (SP) as intracoronal bleaching agents in discoloured non-vital teeth. This prospective study was done at the Restorative Dentistry Department, University of Benin Teaching Hospital, Benin City, Nigeria. Seventy-six patients, each with a discoloured non-vital tooth were matched for shade and randomized into two groups and bleached with 35% CP and SP respectively. The teeth were bleached and evaluated at 5-day intervals. The shades of the bleached teeth were determined using the Vitapan classical shade guide® (Zahn Fabrick, Bad Sackingen, Germany). At baseline, 46 (60.5%) teeth had the darkest shade 16(C4) while 2 (2.6%) teeth had the lightest shade 10 (D4). In the first bleaching session, teeth bleached by 35% CP showed more Shade guide units (Sgu) movement towards lighter shades than SP ( $p < 0.05$ ). At the third bleaching session the mean Sgu movement for both reagents was 3 but SP showed a significant bleaching effect over 35% CP. At the final evaluation SP and CP had bleached 78.9% and 73.7% of teeth respectively to their desired shades; with a satisfaction of 76.8% ( $p = 0.004$ ). At six months recall, relapse was observed in 3(8.8%) teeth treated with CP and none in those treated with SP.

This study demonstrated that over a longer bleaching period; Sodium perborate is safe and has a better bleaching efficacy than 35% Carbamide peroxide.

### INTRODUCTION

Tooth discolouration is an aesthetic problem in vital and non-vital teeth. It is often associated with a wide range of causes. A common cause of non-vital tooth discolouration is intra pulpal hemorrhage and/or pulp necrosis;<sup>1, 2</sup> often associated with impact injuries of teeth.<sup>3</sup>

Discolouration in non-vital teeth can be successfully managed using intracoronal bleaching,<sup>4</sup> extracoronal<sup>5</sup> or a combination of both methods.<sup>6, 7</sup> However, the intracoronal method is commonly used. It may involve the use of heat to activate the bleaching agent (thermocatalytic technique) or the sealing of the reagent inside the pulp chamber for a short duration (walking bleach technique). The intracoronal dental bleaching method is a simple, conservative and cost-effective way of improving the colour of discoloured non-vital teeth after root canal treatment.<sup>8, 9</sup> It does not require sophisticated equipment; hence undertaken by most dental practitioners once certain precautions are observed.<sup>10</sup>

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KEYWORD: carbamide peroxide, sodium perborate, intracoronal bleaching, non-vital discoloured teeth

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A variety of reagents such as aqueous solution of 30% - 35% hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), sodium perborate used separately or in combination with hydrogen peroxide and carbamide peroxide;<sup>11, 12</sup> as well as a mixture of 16% carbamide peroxide and sodium perborate<sup>13</sup> have been employed in the bleaching of discoloured non-vital teeth. However, due to the complication of external cervical root resorption associated with the use of 30% hydrogen peroxide and thermocatalytic technique, its use has declined. Other complications associated with hydrogen peroxide are dentine permeability, alteration in dentine structure and general weakening of the physical properties of dental hard tissue.<sup>14</sup> These have prompted concerns about the use of hydrogen peroxide as an intracoronaral bleaching agent especially with heat application;<sup>4</sup> thereby necessitating the search for safe and efficacious bleaching agents.

In the search for safe<sup>9</sup> and efficacious<sup>15, 16</sup> change bleaching agents, other attributes such as the speed of re-establishing the natural tooth colour<sup>15</sup> and the cost of the bleaching agents have become equally important. Research has shown that sodium perborate and carbamide peroxide approximate the bleaching efficacy of hydrogen peroxide without its damaging side effects.<sup>6</sup>

In Nigeria and most African countries with low per capita incomes, it is necessary to seek quick acting and effective methods of treating discoloured non-vital teeth as a majority of the population may be unable to afford the alternative treatments like ceramic veneers and crowns. The aim of this study was to compare the efficacy and safety of 35% carbamide peroxide and sodium perborate as intracoronaral bleaching agents; with a view to encouraging their use.

## MATERIALS AND METHODS

This was a prospective study for which subjects were drawn from patients attending the Restorative dental clinic of the University of Benin Teaching Hospital, Benin City, Nigeria, between March 2009 and February 2010. After the approval of the study protocol by the Ethics Committee of the University of Benin Teaching Hospital, Benin City, Nigeria; 76 consecutive patients, each with a discoloured non-vital tooth were matched by shade and randomized into two groups of 38 teeth each after obtaining their consent. Teeth included in the study were free of dental caries, periodontal diseases and had an indication for intracoronaral bleaching with a satisfactorily obturated root canal. Excluded from the study were subjects that previously had tooth/teeth whitening, or who had obliterated/calcified pulp chambers, discolorations from restorative materials or subjects that smoked or indulged in habits likely to affect the progress of the bleaching. Before the commencement of treatment, the baseline shade of each tooth as well as that of the contralateral or control tooth was determined by each of the 3 trained shade evaluators (reliability of 88%) under a white fluorescent light or natural light separately with the agreed shade documented. The shade was determined using the Vitapan classical shade guide® (Zahn Fabrick, Bad Sackingen, Germany). The Vita shade tabs were arranged in a value order as prescribed by the manufacturer from the lightest to the darkest shade; with assigned ranking numbers 1(B1) to 16 (C 4) from the lightest shade to the darkest shade. This was to allow for statistical computations.

Prior to treatment, all the subjects had oral prophylaxis to remove any extrinsic stain and isolation was provided during treatment by a rubber dam secured with dental floss. The access cavity was re-established to the obturating Gutta percha

which was removed to about 3mm apical to the cemento-enamel junction using a Gates-Glidden drill (Mani, Tochigi, Japan) of appropriate size. A cervical intermediate base of high viscosity glass ionomer cement (Fuji IX, GC™) was placed over the gutta percha and allowed to set.

The bleaching agents used in the treatment of each of the two groups were 35% carbamide peroxide (CP) (Opalescence Quick®, Ultradent Products, Inc. South Jordan Utah, USA) and sodium perborate (SP) (Sultan products®, USA) respectively; to which the subjects and the evaluators were blinded. The CP gel was syringed into the pulp chamber to cover the underside of the labial tooth surface with enough space left for a tiny cotton wool pellet while the SP powder was dispensed using a measuring scoop and mixed with distilled water. The mix obtained was carried into the pulp chamber by a small amalgam carrier (reserved for this specific use) and condensed against the labial wall of the tooth. A tiny piece of cotton wool was placed over the material in both cases and the access cavity temporarily sealed with glass ionomer cement (Fuji II, GC™). After the glass ionomer cement had set, the occlusion was checked and corrected where necessary.

The subjects were recalled at 5 days interval for assessment and change of reagent where necessary. The evaluators assessed the shade independently and documented the agreed outcome. The bleaching process was repeated and subjects assessed repeatedly until a shade that matched that of the control tooth was obtained or until there was no further shade change. The shade changes were documented as Shade guide units (Sgu) movement from the baseline shade to a lighter shade. At the end of the bleaching process, the access cavity was temporized, the final shade documented and

post bleaching radiograph exposed. The patients were given a two week appointment for the final restoration with a hybrid composite resin (Silux Plus™, 3M ESPE) of matching shade; the occlusion was checked and adjusted where necessary. The post bleaching shades were taken and the subject given the post bleaching instructions and a recall appointment for evaluation for side effects. The presence of tooth fracture and microleakage of the composite resin restorations were assessed as present or absent while the development of external cervical root resorption and periapical pathologies were monitored using periapical radiographs at each recall. The data collected from the subjects were recorded in the subjects' data collection forms. Data analysis was done using Statistical Package for Social Sciences (Chicago, SPSS; 2005 version 16.0). The analysis was done using simple frequencies, calculation of mean values and cross tabulations of variables. Differences between the means Sgu movement between the bleaching agents at each bleaching session was tested using student t test. Statistical significance was inferred at  $p < 0.05$ .

## RESULTS

A total of 76 anterior teeth in 76 patients (32 females (42.1%) and 44 males (57.9%)) were included in the present study. The age range of the subjects was 19-48 years, with a mean age of 26.3 years  $\pm$  5.51. Most of the patients 27 (35.5%) were in the age range 23-26 years while majority (89.5%) of the subjects had tertiary education or were undergoing tertiary education. Only 10.5% of the subjects had secondary school education.

The shade distribution of the teeth at baseline and shade tab movement with each bleaching session is presented in table 1. At baseline, using the Vita shade guide, majority of the teeth 46 (60.5%) had

Table 1: Distribution of teeth according to shade tab position at baseline and at the bleaching sessions.

Shade tab Position & Shade	No. of teeth at Baseline		No. of teeth after first bleaching		No. of teeth after second bleaching		No. of teeth after third bleaching		No. of teeth after fourth bleaching	
	n	%	n	%	n	%	n	%	n	%
1 (B1)	-	-	-	-	-	-	-	-	-	-
2 (A1)	-	-	-	-	6	7.9	2	2.6	-	-
3 (B2)	-	-	-	-	24	31.6	4	5.3	-	-
4 (D2)	-	-	1	1.3	6	7.9	-	-	-	-
5 (A2)	-	-	4	5.3	19	25.1	11	14.6	5	6.6
6 (C1)	-	-	2	2.6	2	2.6	2	2.6	-	-
7 (C2)	-	-	3	3.9	2	2.6	-	-	-	-
8 (D3)	-	-	10	13.2	7	9.2	2	2.6	1	1.3
9 (A3)	-	-	10	13.2	5	6.6	1	1.3	-	-
10 (D4)	2	2.6	17	22.3	-	-	-	-	-	-
11 (B3)	2	2.6	6	7.9	1	1.3	1	1.3	-	-
12 (A3.5)	2	2.6	12	15.8	1	1.3			-	-
13 (B4)	6	7.9	7	9.2	-	-	-	-	-	-
14 (C3)	2	2.6	4	5.3	-	-	-	-	-	-
15 (A4)	16	21.2	-	-	-	-	-	-	-	-
16 (C4)	46	60.5	-	-	-	-	-	-	-	-
*Teeth	-	-	-	-	3	3.9	53	69.7	70	92.1
Total	76	100	76	100	76	100	76	100	76	100

\* Number of teeth that have completed the bleaching process and those that have stopped bleaching at each session

Table 2: The mean of shade guide unit movement at each bleaching session by each reagent

Bleaching Session	Reagent	No of Teeth *	(M ± SD)	t	p value
First bleaching	CP	38	5.87 ± 1.88	3.39	0.001
	SP	38	4.50 ± 1.64		
Second bleaching	CP	35	4.60 ± 1.56	2.88	0.005
	SP	38	5.84 ± 2.09		
Third bleaching	CP	11	1.27 ± 1.62	3.33	0.001
	SP	12	2.42 ± 1.38		
Fourth bleaching	CP	4	0.00	-	-
	SP	2	0.00		

\*Number of teeth bleached at the end of each session, excluding those that have reached desired shade or have stopped responding to bleaching.

M = Mean of shade guide units movement. SD = Standard Deviation

the darkest shade represented by shade tab 16 (C4), while the lightest shade (D4) was observed in 2 (2.6%) teeth. The darkest shade observed at the end of the first bleaching session was represented by shade tab 14 (C3) whereas at the end of the fourth session, the darkest and lightest shades among the bleached teeth were represented by shade tab 8 (D3) and 2 (A1) respectively. None of the teeth bleached successfully at the end of the first bleaching session. However, at the end of the second bleaching session only 3 (4%) teeth had bleached successfully. At the third bleaching session 23 (30.3%) teeth were bleached while the 6 (26.1%) teeth bleached at the fourth session did not show any shade improvement over that recorded at the third session. The shade changes were documented as Shade guide units (Sgu) movement. Table 2, shows the mean Sgu movement at each bleaching session.

At the conclusion of the bleaching procedure, SP and CP had bleached 30(78.9%) and 28(73.7%) of teeth respectively to their desired shades; an outcome that showed 76.3% satisfaction ( $p=0.004$ ) amongst the study population. At six months recall, relapse was observed in 3(8.8%) of those treated with CP and none in those treated with SP. Side effects were not observed in subjects treated with SP but apical radiolucencies were observed in 2 teeth bleached with CP.

## DISCUSSION

Intracoronal bleaching is an established, simple, conservative and cost effective method of improving the aesthetic appeal of discoloured teeth that have been root treated.<sup>8, 9, 17</sup> Several bleaching agents have been employed in the bleaching of discoloured non-vital teeth since the inception of tooth bleaching. In this study carbamide peroxide (CP), a popular reagent used in the bleaching of vital teeth was

compared with sodium perborate (SP) in a controlled clinical trial to determine their efficacy in the bleaching of discoloured non vital teeth.

The dominant (35.5%) age range of the subjects in this study was 23-26 years. This is similar to the observation of Akarslan et al.,<sup>18</sup> which suggested that subjects within this age group were more dissatisfied with their dental aesthetics and therefore more likely to seek tooth whitening treatment. In accordance with our finding, the result of a previous study showed that highly educated persons are more aware of their tooth colour; and consequently more likely to seek aesthetic treatment.<sup>19</sup> On the contrary Xiao et al,<sup>20</sup> observed that an increase in the level of education resulted in satisfaction with tooth colour.

Four bleaching sessions were carried out. In the first session, 35% carbamide peroxide was found to have bleached more teeth to lighter shades than sodium perborate with a statistically significant difference in mean shade tabs movement ( $p < 0.05$ ). Similar results were reported by Lim et al.,<sup>9</sup> and Weiger et al.,<sup>21</sup> who observed that sodium perborate mixed with water had a slower onset of action; hence it did not achieve significant tooth lightening at the first bleaching session. At the review of the outcome of the second bleaching session, it was observed that 35% Carbamide peroxide bleached three teeth to the desired shade while sodium perborate did not show similar effect in teeth with matched shades. This is similar to a previous report<sup>9</sup> which revealed that 35% carbamide peroxide and hydrogen peroxide were more effective than sodium perborate at the first bleaching session. This is contrary to the findings of Ganesh et al.,<sup>12</sup> that there was no significant difference between the bleaching actions of 10% CP and SP after two bleaching sessions. The mean Sgu movement of teeth bleached by sodium perborate towards the

lighter shade value at the second bleaching session was statistically more significant ( $p < 0.05$ ) than that observed for 35% carbamide peroxide. This is consistent with earlier reports<sup>9, 21</sup> which showed that sodium perborate exhibited improved bleaching effect from the second bleaching session.

At the end of the third bleaching session, 69.7% of the bleached teeth had achieved maximum bleaching effects. The mean of shade guide unit's movement for both reagents was less than 3sgu. However, sodium perborate showed significant bleaching effects over 35% carbamide peroxide at this stage. This is contrary to previous opinions that indicated that maximum intracoronal bleaching effect is achieved after two bleaching sessions with insignificant changes thereafter<sup>22</sup>. However, the finding of this study that maximal efficacy of sodium perborate can be achieved after the third bleaching session agrees with a later report.<sup>23</sup>

At the conclusion of the fourth bleaching session, sodium perborate had successfully bleached 78.9% of the teeth to the desired shades while 35% carbamide peroxide achieved 73.7% success. Research using artificially discoloured teeth has shown 35% carbamide peroxide to equate the bleaching efficacy of hydrogen peroxide but better than sodium perborate mixed with water after one bleaching session.<sup>9</sup> However, this study showed that 35% carbamide peroxide has an initial rapid bleaching effect while sodium perborate in the end bleached more teeth to a satisfactory outcome than 35% carbamide peroxide. This may be attributed to the different aetiologies of discolouration in the non vital teeth;<sup>24</sup> as in the case of subjects in this study.

Over bleaching was observed in 13% of teeth bleached using sodium perborate. Although, it has been reported that some clinicians deliberately over bleach teeth to

compensate for future relapse;<sup>10</sup> there is no report in literature indicating that sodium perborate over bleaches teeth. It is however important to note that over bleached tooth/teeth are aesthetically unsightly hence sodium perborate should be used and monitored over short appointments.

Shade stability was observed in bleached teeth at the third month of recall for both reagents, but relapse was observed at sixth month recall in 3 subjects treated with 35% carbamide peroxide. Studies<sup>11, 25</sup> agree that there is a tendency for relapse in the shades of bleached teeth. The relapse observed in this study may be due to a failure or difficulty in achieving the desired shade ab initio; which Howell<sup>26</sup> believes predisposes to shade relapses particularly in teeth with darker shades prior to bleaching. However, relapse occurred in this study regardless of the baseline shade. Although the sodium perborate bleached teeth showed better colour stability, a longer observation period is required; since relapse may take weeks to several years to occur.<sup>25</sup>

The side effects evaluated in this study were tooth fracture, microleakage of the composite resin restoration in access cavity, the development of external cervical root resorption and periapical pathologies. However, none was evident except the presence of periapical pathologies as indicated by periapical radiolucencies in two patients at the sixth month recall. These radiolucencies occurred in teeth bleached with 35% carbamide peroxide; this may be attributed to endodontic failure<sup>17</sup> or failure of the intracoronal cervical barrier.

This study was limited by the unavailability of a portable digital colorimeter (HunterLab, Virginia, USA) to accurately determine the shades of discolouration; hence the use of Vitapan classical shade guide® (Zahnfabrik, Bad Sackingen, Germany) which is subjective and limited

in colour range. Another limitation was the relatively short postoperative follow up period. However, the findings from this study justify a long term investigation to determine absolute post bleaching shade stability and to monitor the development of post bleaching complications.

## CONCLUSION

This study demonstrates that sodium perborate used over a long period is safe and has a better bleaching efficacy than 35% carbamide peroxide. However, when a faster bleaching action is required, 35% carbamide peroxide should be used but with an understanding of its possible limitations. Intracoronal bleaching of discoloured non-vital teeth can be carried out using any of the two reagents.

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