Whitening Techniques Using the Diode Laser and Halogen Lamp in Human Devitalized Primary Teeth

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ABSTRACT

The aim of this study was to make an *in vivo* assessment of 2 whitening techniques in deciduous teeth, with the variable being the source of energy activation. Ten upper central incisors darkened by trauma were selected and whitening agent used was a 35% hydrogen peroxide. The teeth were distributed into 2 groups: group 1—activation with an infrared diode laser (GaAlAs), and group 2—activation with a halogen lamp. Assessment of whitening was done by color analysis with the Vita 3D scale at 3 different times: before whitening, immediately after whitening, and 1 week after whitening. A Kruskal-Wallace test showed that there were no significant difference between the 2 groups when comparing group 1 and 2 and comparing 2 and 3 immediately and after 1 week of treatment. Laser activation of the whitening agent was not more effective than halogen light activation for root canal-treated deciduous teeth. **(J Dent Child 2008;75:164-7)**

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At present, a great value is given to esthetic appearance. Quite often, severe chromatic changes in the anterior teeth result from traumatic injuries that frequently happen in childhood. These injuries significantly affect the quality of children's lives because of the extensive psychosocial period of development they are going through.[1] Children with darkened teeth may develop self-esteem problems and become introverted and insecure in their social environment.

In severe dental traumas, pulp hemorrhages can occur, with pulp blood leakage. Pulp hemorrhage alone is the main cause of severe tooth discoloration and not the pulp necrosis itself. Pulp necrosis preceded by hemorrhage, however, is the factor most frequently responsible for tooth darkening.[2] The technical advantages of whitening compared with the restoration techniques used for treating darkened teeth include the relatively low cost, preservation of the tooth structure, and the fact that changes of restorations are avoided.

There are a number of methods and approaches that have been described in the literature for the bleaching of teeth. Accelerating the rate of chemical bleaching by illuminating teeth with various sources—like halogen curing lights, plasma arc lamps, lasers, and light-emitting diodes—has been extensively reported in the literature.[3] Nevertheless, the efficacy of bleaching gels by light activation is still not well documented with randomized, controlled trials studies. Recent publications show that the benefit of using additional light may be limited.[4]

The aim of this clinical case study was to make an assessment of a whitening technique in primary teeth regarding color alteration, using two different sources of energy for activating the whitening agent

CASE DESCRIPTIONS

Before initiating the study, the project was reviewed and approved by the Ethics Committee of the Dental School of the University of São Paulo, São Paulo, Brazil. Five- to 7-year-old

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children (mean age=5 years, 10 months) showing incisors darkened by trauma were selected at the dental trauma clinic of the Pediatric Dentistry and Orthodontic Department of the University of São Paulo). Ten primary maxillary central incisors were selected. The endodontic treatment was performed. After their parents or guardians had been given explanations about the content of the research, they signed consent forms. The teeth were checked for adequate endodontic treatment via periapical radiographs.

After a clinical and radiographic exam and completion of the clinical chart, only teeth with adequate endodontic treatment—including root canal filling with filling paste—and absence of fistulas and periapical lesions were included in the sample. Complete isolation was put in place after the soft tissues had been protected with solid petroleum jelly. Prophylaxis with pumice stone and water was performed before the whitening technique was implemented. Lingual access to all teeth was achieved. The coronary pulp chamber floor in all teeth was sealed with glass ionomer modified by Vitremer resin (3M ESPE, São Paulo,SP, Brazil) for the purpose of sealing the root canals. Vitremer was manipulated according to the manufacturer's instructions.

The whitening agent used was a 35% hydrogen peroxide product (Whiteness HP, FGM, Joinville, SC, Brazil) and was manipulated according to the manufacturer's instructions. The whitening agent was placed inside the tooth in the intracoronary chamber and on the vestibular surface. A 37% carbamide peroxide product (Whiteness Super-Endo, FGM) was sealed with Cimpat imbibed in a cotton ball and left inside the intracoronary cavity for 7 days. When this time had elapsed, the teeth were restored with resin composite Z100 (3M ESPE, São Paulo, SP, Brazil).

The teeth were distributed into 2 different groups:

A) In group 1 (experimental; diode laser [DL]; N=5), the bleaching agent was activated by the infrared diode laser (GaAlAs; Softlase, ZAP Lasers, Pleasant Hill, Calif.) at a wavelength of 808±5 nm using 1.0 W power and a quartz optic fiber of 400 µm in continuous emission mode, with a pulse width of 50 µ/second. The fiber was cleaved before its initial use to ensure its efficiency. An energy meter was used to control intensity that emerged from the equipment, had a calculated intensity of 850 mW/cm^2 to 890 mW/cm^2. The fiber was applied perpendicularly at a distance of 1 mm from the buccal surface. The fiber covered the bleaching agent for 10 seconds with a scanning movement of the optic fiber from the mesial to distal direction and from the cervical to incisal direction and with alleatory movement for 30 total seconds to distribute the laser irradiation through the whole buccal surface. The gel was left on the tooth for 3 minutes to enable greater activation and allow the tooth to cool. After washing, the procedure was repeated. Great care was observed to protect against the laser, such as using protective glasses and warning about its use.

B) In group 2 (control; halogen lamp [HL] (N=5), the bleaching agent was activated by the halogen lamp (Demetron Research Corp, Orange County, Calif., USA), applied perpendicularly at a distance of 1 mm of the buccal surface, and covered the bleaching agent for 40 seconds. The radiometer was used previously to check electromagnetic radiation intensity, with diameters ranging from 8 to 13 mm and intensity variations ranging from 0 to 1,000 mW/cm^2 (model no. 100 P/N 105003, Demetron Research Corp, Orange County, Calif., USA). The intensity was higher than 380 mW/cm^2. The whitener gel was left on the tooth for 3 minutes to allow it to act longer and the tooth to cool. After washing, the procedure was repeated.

Assessment of whitening was done by color analysis with the Vita 3D scale. Calibration exercises were undertaken before color assessment (intrarater reliability: K=0.98; interrater reliability: K=0.96) by 2 blinded evaluators (both of whom had 15 years experience as a dentist). The color of the teeth was assessed 3 times: (1) before whitening; (2) immediately after whitening; and (3) 1 week after whitening. To obtain the Vita 3D scale analysis, scores were determined in an ascending scale for each value, starting from the darker (5M3=score 1) to the lighter (1M1=score 26) color. The variation of these scores before and after treatment was analyzed. To check whether there was any significant difference between the groups, a Kruskal-Wallace test was performed.

RESULTS

For this in vivo data, 8 children were followed up with and 10 teeth darkened by traumatic injury were assessed. The data are described in Tables 1 and 2, respectively. When analyzing the data in Tables 1 and 2, it may be observed that 4 of the 5 primary teeth in group 1 were more severely darkened, while only 2 of the 5 teeth in group 2 were severely darkened. Even so, the 2 primary teeth in group 2 were not as severely darkened (color 4M1 and 4M3) as those in group 1 (color 5M2, 5M3, 5M3, 5M1) prior to whitening.

Table 3 describes the means and standard deviations of the scores obtained at the different times: before, immediately after whitening, and 1 week after whitening. Group

Table 1. Vita 3D Scale Colors of Group 1 Patients' Primary Teeth Before, Immediately After, and 1 Week After Whitening

Darkened teeth	Color before whitening	Immediate color	Color after 1 week
1	5M2	2M2	3M2
2	5M3	3R2.5	5M3
3	5M3	3R2.5	5M3
4	5M1	4M1	5M1
5	3M3	2L2.5	3L1.5

Table 2. Vita 3D Scale Colors of Group 2 Patients' Primary Teeth Before, Immediately After, and 1 Week After Whitening

Darkened teeth	Color before whitening	Immediate color	Color after 1 week
1	3R1.5	1M2	1M1
2	4M1	1M2	1M1
3	3R1.5	1M1	1M1
4	3L1.5	2M2	2M1
5	4M3	1M2	3M1

Table 3. Means and Standard Deviations for the Vita 3D Scale Scores

Group	Before whitening±(SD)	Immediately after whitening±(SD)	1 week after whitening±(SD)
1	4.00±5.10	14.80±6.72	7.20±7.69
2	11.00±4.24	24.40±1.95	22.60±5.64

2 showed good whitening effectiveness between the times before and immediately after whitening and was maintained with a slight drop of color at 1 week. The color variability for group 1 was apparently greater than that for group 2.

To check whether there was any significant difference between the 2 groups, a Kruskal-Wallace test was performed. For the variation between before and after whitening, a descriptive level of 0.39 was obtained, from which it was concluded that there was no significant difference between the 2 groups. When the test for the variation between immediately after whitening and 1 week after whitening was performed, a descriptive level of 0.11 was obtained, concluding that there was no significant difference between the 2 groups.

DISCUSSION

At present, there is an increasing trend towards the development of esthetic treatments for minimally invasive techniques in dentistry. The whitening of teeth darkened due to pulp hemorrhage and tissue remains or pulp degeneration products has a good prognosis. Primary teeth darkened as a result of traumatic injuries may be whitened by the whitening technique.[5] Professional at-home tooth whitening is an efficient method for treating young permanent teeth darkened as a result of dental trauma in children and adolescent.[6] One could argue that placement of a bonded esthetic restoration after removal of stained dentin may be less conservative in terms of cost and number of appointments. Others, however, may consider that dental tissue integrity is more important than time and money. Therefore, the intention of this clinical case study was to clarify some topics related to whitening in deciduous teeth, instead of choosing one technique.

The difficulty of defining the color scale in assessing whitening must be considered. All the color scales present with a single color, not considering the polychromacity in the different thirds of natural teeth. The spectrophotometer can make more precise assessments of tooth color than direct visual assessment.[3,7,8] The difficulty of assessing color by the Vita 3D scale was also noticed in this study, since it is a subjective method and the results can be influenced by many factors (eg, lighting conditions, experience, age, fatigue of human eyes, room decor). Quite frequently, the choice was made by approximation, as there was no color in the Vita 3D scale that corresponded to the color found in the darkened primary tooth or to the tooth shade after it had been whitened. When analyzing the color variation by the Vita 3D scale, it was necessary to attribute scores so that the color before and after whitening could be compared. The mean value for group 1 Vita 3D scale scores was 9.22, slightly lower than group 2's value of 12.45. After performing the Kruskal-Wallace test, however, it was found that there was no significant difference between the 2 groups. It must be highlighted that the sample size was small and not randomly allocated. Therefore, the results have to be analyzed with caution.

Group 2 showed the best effective whitening results with mean color variation scores of 22.60 (found 1 week after whitening treatment) when compared with group 2 (mean variation scores=7.20). When analyzing the results in Tables 1 and 2, however, it may be observed that 4 of the 5 primary teeth in group 1 were more severely darkened, while only 2 of the 5 teeth in group 2 were less severely darkened. The darker the tooth, the worse is the prognosis.[2,9] Therefore, in this study, it cannot be stated that the activation sources for group 1 was responsible for achieving better sesults.

New forms of whitening activation by light, such as laser light, should be studied to be able to assess their true value in whitening procedures. A recent systematic review concluded that heat- and light-activated whitening is still controversial, whether the activation results in superior tooth brightening compared to nonactivated whitening therapies.[4]

The effect of the whitening agent and dehydration of the tooth by absolute isolation explain the decrease in staining observed at the end of the whitening session. The subtle initial reversal may occur due to the release of oxygen out of the tooth and to the return of oral equilibrium. The relapse of color after the first week of treatment was observed in 6 of the 10 patients analyzed.

From the esthetic point of view, comparing primary with permanent dentition, the fact that primary teeth have an accentuated, opaque white shade may explain why any type of stain, whether it is yellowish or grayish, is more noticeable. Consequently, even after whitening treatment, if this stain has not been completely eliminated it will show. These considerations are perhaps a reason why pediatric dentists quite frequently consider whitening treatment to be

unsatisfactory for primary teeth. With the current trend of increasingly seeking to implement preventive and invasive procedures at all times, however, whitening devitalized primary teeth to solve a young patient's esthetic problem must be considered an alternative.

CONCLUSION

Laser whitening agents are not more effective than halogen light activation for root canal treated primary molars.

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