Simultaneous bleaching of vital teeth and an open-chamber nonvital tooth with 10% carbamide peroxide

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Objective: *The purpose of this study was to evaluate the effectiveness of bleaching a nonvital tooth with an open pulp chamber while simultaneously bleaching the other vital teeth with 10% carbamide peroxide.*
Method and materials: *Ten discolored nonvital teeth were treated. Each nonvital tooth was prepared as in the conventional "walking bleaching" fashion, so that the gutta-percha was sealed from the pulp chamber. The 10% carbamide peroxide was injected into the chamber of the nonvital tooth and loaded into the custom-fitted tray for all teeth. The nonvital teeth were bleached from both the inside and the outside. The patient closed the orifice with a cotton pellet during the day and changed the cotton pellet after meals. The patient applied fresh solution nightly.*
Results: *All teeth were successfully lightened. The time required to lighten the nonvital tooth was related to the duration of the discoloration.*
Conclusion: *With proper patient selection and education, this technique can provide an effective way to lighten nonvital and vital teeth simultaneously, especially where extended treatment time may be required for difficult discolorations.* (Quintessence Int 1998;29:643–648)

Key words: carbamide peroxide, nightguard vital bleaching, nonvital bleaching, walking bleaching

Clinical relevance

The use of 10% carbamide peroxide in an open-chamber, tray-applied technique to bleach nonvital teeth can afford a simpler, more cost-efficient bleaching treatment option, especially for staining that would typically require several office visits.

Bleaching of nonvital teeth dates back to 1850.[1] A number of medicaments have been used, but the classic technique has evolved into using 30% hydrogen peroxide and sodium perborate.[2] This technique involves excavation of the pulpal chamber down to 2 mm below the cementoenamel junction (CEJ) and placement of a sealing plug over the gutta-percha up to the CEJ. Then 30% hydrogen peroxide is mixed with sodium perborate to form a paste. The paste is inserted carefully into the pulp chamber, and the access opening is sealed. The patient is dismissed for 1 week while the bleaching process takes place, and hence this technique is called the *walking bleaching technique*. When the patient returns, the solution is changed, and the cycle is repeated until a successful tooth color is achieved.

Another popular in-office technique for bleaching nonvital teeth involves placement of the 30% hydrogen peroxide into the pulp chamber and then application of heat to activate the process.[3] This technique is called the *thermocatalytic technique* because the heat speeds up the oxidation reaction of the peroxide. Heat can be applied with a flame-heated instrument or an electric heating instrument. Although the color change is more rapid when heat is greater, the procedure may overheat the tooth and initiate a cervical resorption process.[4,5]

Both nonvital bleaching techniques have been very successful and were widely practiced[6,7] until reports of external root resorption began to surface in 1979.[8] There are many hypotheses for this resorption.[9] A review of the literature since 1979 on root resorption indicates several common themes among the case reports:

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no sealer over the gutta-percha, heat, and trauma.[10] Other speculated causes include a lack of CEJ in 10% of teeth, where a dentin gap between cementum and enamel is present, and alteration of the pH of the surrounding bone from peroxide exit or cellular damage from overheating.[4]

In addition to the concern about the potential for external resorption, general concerns exist about both bleaching techniques. Common concerns include possibilities of chemical burns from handling 35% hydrogen peroxide clinically, the need for application of fresh solutions to be effective, the unknown number of office visits required for complete treatment, and the possibility of overlightening the tooth. The walking bleaching technique also presents the difficulty of maintaining the provisional seal between appointments. The difficulty with the thermocatalytic technique is determination and control of the proper heating temperature.

Some suggestions have been offered to avoid these concerns.[5,11] Suggestions include the use of sodium perborate alone for walking bleaching,[4,12] the use of calcium hydroxide powder to neutralize the pH,[13] or the application of a catalase after internal bleaching to inactivate the peroxide.[14] All options stress the importance of the sealer over the gutta-percha as well as avoidance of the use of heat. If heat is used, the temperature should not exceed that which would cause discomfort on a vital tooth.

With the advent of nightguard vital bleaching in 1989, many new treatment options became available to the profession.[15] Although most of the reports on nightguard vital bleaching involve vital teeth, there have been several reports on lightening the single dark tooth that has not received endodontic therapy or that is still vital but discolored.[16,17] When a patient has a single dark tooth to be bleached, there are two possibilities for treatment: bleaching only that one tooth or lightening the other teeth as well. This study concerns patients who also want to lighten the other teeth.

For those patients who only wish to lighten the single tooth, a technique for fabrication of a single-tooth bleaching tray has been reported previously.[18] It may be possible to use the tray design described in that report with the technology discussed in this study for affecting only one tooth. The single-tooth bleaching technique involves the use of a nonscalloped tray with or without reservoirs. In this tray, the tooth-imprint areas on either side of the darkened tooth are removed to allow the bleach to contact only the one tooth. Another single-tooth bleaching technique involves applying the bleaching material through an oversized provisional crown form,[19] but there is some difficulty in retaining the crown.

Other single-tooth techniques have also been reported.[20] Some dentists elect to fabricate a scalloped tray with the reservoir only on the darkened tooth. Although this technique does not control the diffusion of the material to the adjacent teeth, it can be successful. It has been shown that the presence or absence of reservoirs does not affect the bleaching rate or efficacy,[21,22] but reservoirs allow for the seating of the tray with thick, sticky materials.[23] Reservoirs also minimize tooth sensitivity by avoiding the pinching effect of a tight tray.[24,25]

In 1996, one manufacturer's product catalogue (Ultradent Products) suggested the use of 10% carbamide peroxide, applied in a tray, for a tooth that is prepared for conventional walking bleaching but not sealed.[26] In this situation, both the other vital teeth and the open nonvital teeth were to be lightened. Ten percent carbamide peroxide is approximately equal to 3% hydrogen peroxide. Two recent articles have described the technique.[27,28]

The advantage of leaving the tooth open for multiple applications is that the patient does not have to return to the office to refresh the solution if one treatment is insufficient. For difficult discolorations, this can afford a reduction in both time and fee, as well as avoid the safety concerns of the higher concentrations of peroxide. The purpose of this study was to determine the efficacy of this vital/nonvital walking bleaching technique in a clinical trial.

Method and materials

Patients were selected from the Regional Military Hospital in Mexico between October 1995 and February 1996. The patients had to be 18 years or older and had at least one dark maxillary anterior tooth that they desired to have lightened. Other vital teeth were either already very light or required lightening as well. Selection criteria included the presence of all maxillary anterior teeth and the absence of caries, periodontal disease, and compromised tooth structure on the anterior teeth. Patients had to exhibit adequate oral hygiene. No other restrictions were applied.

After a dental examination, nine patients who met these criteria were selected. They had a total of 10 nonvital, darkened, endodontically treated teeth. Patients were asked to report the onset of the discoloration (in years). All tooth devitalization was a result of trauma. A radiograph was taken to ensure the adequacy of the endodontic therapy and the level of the CEJ. Written consent was obtained and photographs were taken.

An alginate impression of each patient was made, and a stone cast was generated. A bleaching tray, of the

Table 1 Ordering of vital shade guide by value*

Tab	B1	A1	B2	D2	A2	C1	C2	D4	A3	D3	B3	A3.5	B4	C3	A4	C4
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

*Light-to-dark ranking by manufacturer.

scalloped, reservoired design,[29] was fabricated according to the manufacturer's directions from a thermoplastic tray material (Sof-tray, Ultradent Products). The bleaching tray was fitted to ensure that the gingiva was not irritated by contact with the tray.

The shades of the vital teeth were recorded with a value-oriented shade guide (Vita Zahnfabrik). The sequence of light-to-dark shade tabs, as ordered by the manufacturer, was numbered from 1 to 16 (Table 1).

For the nonvital teeth, access was made through the lingual endodontic opening and the contents of the pulp chamber were removed. Gutta-percha was removed 2 to 3 mm beyond the CEJ. The remaining gutta-percha was sealed with glass-ionomer cement (Vitrebond, 3M Dental), placed 2 to 3 mm in thickness (Fig 1). After the glass-ionomer cement had been light cured, the chamber was cleaned by etching with 35% phosphoric acid for 2 minutes and then rinsing with water. No other restorative material was placed above the glass-ionomer base; ie, the access orifice was not sealed. Patients were instructed not to bite with the anterior tooth during the duration of the treatment.

Patients were instructed in the technique to insert a cotton pellet into the opening in the tooth during the day. This was done to prevent accidental impaction of food in the orifice. After each meal, the patient removed the cotton pellet by twisting a toothpick inserted into the cotton. The tooth was irrigated with a water syringe to ensure the absence of debris, and a fresh pellet of cotton was inserted.

At bedtime, the cotton was removed again, and the tooth was irrigated as before. Then 10% carbamide peroxide (Opalescence, Ultradent Products) was loaded into the bleaching tray and injected into the orifice. The tray was seated, and excess material was removed with a finger or toothbrush. The patient then slept with the loaded tray in place during the night. On removal of the tray in the morning, the patient again irrigated the tooth with water using a syringe and inserted a cotton ball into the chamber.

Patients bleached their teeth until the vital teeth no longer changed color and the nonvital tooth matched the color of the vital teeth. Patients were examined after each night's bleaching until the color was satisfactory. The number of nights for successful completion were recorded, as well as posttreatment photographs.

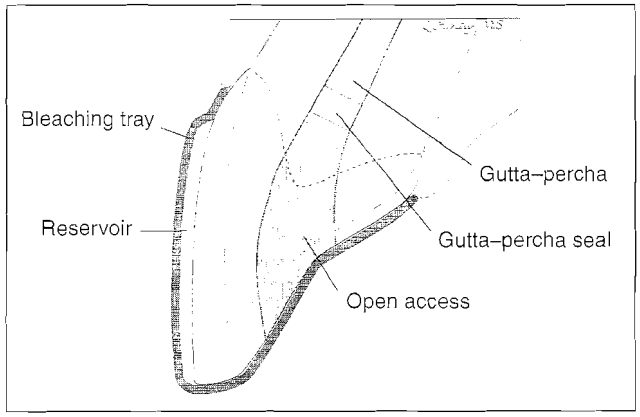

Fig 1 Anterior tooth with a reservoired bleaching tray seated over an open internal access. Glass-ionomer base seals the gutta-percha from the oral environment during treatment with 10% carbamide peroxide.

If sensitivity of the vital teeth was experienced during bleaching, the patient was given a neutral fluoride gel (FlorOpal, Ultradent Products) to place in the tray at the onset of sensitivity. The use of fluoride is considered an active method to treat sensitivity. A more passive way to treat sensitivity is to reduce the time or duration of treatment (less hours) or to reduce the frequency of treatment (skip days).[30]

Since the completion of this project, a more active approach to treating sensitivity, which involves the application of potassium nitrate (Ultraleve, Ultradent Products), has been introduced. Potassium nitrate is generally found in desensitizing toothpaste,[31] but a recent report has shown that the application of the material in the tray has good results on any type of sensitivity.[32] At the time of this study, only fluoride was generally recommended for bleaching sensitivity. One early report in a laboratory bleaching experiment on the use of stannous fluoride during bleaching had suggested fluoride was contraindicated.[33] However, this recommendation may have been a result of the staining nature of the stannous fluoride used in the study. Some current bleaching products now incorporate a neutral fluoride with no apparent inhibition of the bleaching process (15% Opalescence with Fluoride, Ultradent Products).

When the patient returned to the office after completion of the bleaching, the orifice to the nonvital tooth was debrided and temporarily sealed for 2 weeks with a

TABLE 2 Nonvital time of discoloration and number of treatments

Patient age (y)	Duration of discoloration (y)	No. of nightly treatments to lighten
24	3	10
36	4	10
36	4	10
24	8	15
28	8	14
39	10	14
49	10	15
35	12	14
28	16	16
38	22	18

TABLE 3 Treatment results in shade tab ranks

	Baseline rank		Completed rank		Shade difference	
Tooth	Mean	Range	Mean	Range	Mean	Range
Nonvital	15.9	15–16	1.0	1	14.9	14–15
Vital	7.5	4–12	1.0	1	5.9	3–11

Fig 2a Central incisor discolored from trauma, shown after endodontic therapy has been completed.

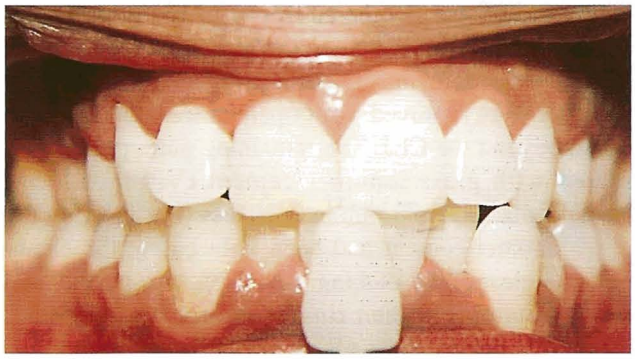

Fig 2b Color change after treatment with external application of 10% carbamide peroxide in a custom tray to all the teeth and an internal application to the open chamber of the nonvital tooth.

non–eugenol-containing temporary cement (Fermit, Ivoclar). The non–eugenol-containing material was used to avoid future contamination of the acid-etched resin composite restoration, which was to be used to close the orifice to the canal.

Placement of the final restoration was delayed for 2 weeks to allow the oxygen to dissipate from the tooth. Residual oxygen in the tooth results in a reduction of bond strength[34] as well as an artificially light shade. Two weeks after termination of bleaching, the bond strengths are potentially normal[35] and the shade has stabilized.[36] This shade stabilization (a slight rebound darkening) is thought to result from the change in optical qualities of the tooth, created by the residual oxygen in the tooth as a result of the oxidation process of bleaching.

Two weeks after completion of bleaching, the temporary restoration was removed and the orifice was restored with an acid-etched composite (Charisma, Heraeus Kulzer). If the tooth needed any further lightening, a lighter composite was used in the root and coronal portions of the tooth.

Results

Four men and five women were treated. Their ages ranged from 24 to 49 years (average of 33.7 years). The nonvital teeth included six maxillary left central incisors, three maxillary right central incisors, and one maxillary left lateral incisor. The mean initial shade of the vital teeth was ranked 7.5. The nonvital teeth had an average initial ranking of 15.9. The baseline shades of the teeth and the number of years that the patient believed the nonvital tooth had been dark are shown in Table 2. The nonvital teeth had been discolored an average of 10.7 years.

Four patients experienced sensitivity of the vital teeth during treatment and applied the fluoride in the gel syringe as per the manufacturer's instructions. They were able to continue bleaching until completion.

The final shades of the vital and nonvital teeth were all ranked 1. There was an average shade change of 5.9 in the vital teeth and an average shade change of 14.9 in the nonvital teeth (Table 3). All patients reported satisfaction with the color change in both the vital and nonvital teeth (Figs 2a and 2b).

The time needed to achieve the color change was generally proportional to the duration of the discoloration. The longer the tooth had been discolored, the longer it took to remove the discoloration. However, the maximum number of nights of treatment needed was 18.

Discussion

Bleaching, rather than crowning, anterior endodontically treated teeth has become a viable treatment option, based on research on longevity of various treatment options.[37] At one time in dentistry, all teeth that had received endodontic therapy subsequently received a post and core followed by a complete crown. However, the use of the post and core does not strengthen the tooth, as originally thought; rather, the preparation of the post space often further weakens the tooth. The best approach for providing strength to an endodontically treated anterior tooth is to maximize the amount of remaining dentin.

Current opinion is that an anterior endodontically treated tooth with minimal insult should be restored with an acid-etched resin composite when possible.[38] A crown should be used only if a crown would be indicated on a vital tooth in the same condition. A post and core is used only if there is a need to generate a core form to retain the crown. Hence, there are more teeth that are structurally sound but discolored and for which bleaching is the treatment of choice.

At this time, use of 30% hydrogen peroxide for the walking bleaching procedure is less favored than in previous years because of the concern for cervical resorption as well as previously mentioned handling problems. Sodium perborate alone is an acceptable technique.[39] However, both materials are generally sealed in the chamber. Sealing the materials in the chamber may require multiple treatment applications and office visits to achieve the desired outcome. This can result in a higher fee for the patient and nonproductive appointments for the dentist. The advantage of this open-chamber treatment technique is that the patient can continue treatment for as long as needed to adequately remove the discoloration without additional office visits.

Also in this situation, the tooth is being treated both internally and externally with the whitening material, which is applied daily as a fresh solution. Another important factor in this type of treatment is that the patient is in control of the amount of lightening on a daily basis. This control may help to prevent the overlightening phenomenon of sealed chamber approaches. More importantly, this technique allows the patient to determine when success has been achieved without concern for additional costs.

The disadvantage of this type treatment is the concern that the patient will not return to the dental office to have the restoration placed in the orifice. Because there is no pain, the open teeth can easily succumb to caries and be lost if the tooth remains unrestored. There is no concern about caries during the process because 10% carbamide peroxide materials have anticariogenic properties and elevate the pH beyond the area of carious activity.[40] The concern about caries arises after the discoloration is removed and carbamide peroxide is no longer being placed into the orifice.

Dentists must be careful in their patient selection and education to ensure that patient return for the final restoration. However, clinicians using this technique have reported that the presence of a hole in the lingual surface of an anterior tooth is so distracting to patients that they readily return. Also, the tooth may darken if debris is packed into the hole, prompting a speedy return. The patient may choose to wear the tray empty during eating if the cotton plug technique is not satisfactory, but eating in this manner is difficult.

Other techniques advocated for bleaching the single dark tooth with carbamide peroxide have omitted the tray. The patient injects the material into the tooth every 2 hours, as time permits, and places a cotton pellet in the tooth when not bleaching.[41]

Conclusion

Ten percent carbamide peroxide can be used effectively to bleach darkened nonvital teeth internally. The 10% carbamide peroxide solution is placed in the open chamber of an endodontically treated anterior tooth that has been prepared for the traditional walking bleaching technique. The same agent is also placed in a custom-fitted tray and seated as in the normal nightguard vital bleaching technique. In this manner, the external portion of the nonvital tooth and the remaining vital teeth are bleached at the same time as the internal portion of the nonvital tooth.

This technique can provide a practical, low-cost, minimal-risk technique for bleaching teeth. Patients have control over the amount of whitening as well as the ability to apply fresh solution daily until the discoloration has been removed. No additional appointments are needed for more stubborn stains. The length of time required to lighten the endodontically treated tooth is related to the amount of time the tooth has been discolored.

Acknowledgments

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