



Carbamide peroxide whitening of nonvital single discolored teeth: Case reports

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Patients who present with a single discolored tooth represent a significant restorative challenge. These case reports describe an economic and conservative treatment option for these patients. The situations presented demonstrate techniques for bleaching with carbamide peroxide in a traditional nightguard or with an inside-outside technique to achieve acceptable esthetic results on isolated nonvital discolored teeth. Although these techniques may not be effective in all cases, they do not compromise or eliminate any future treatment options. (Quintessence Int 1999;30:155-161)

Key words: carbamide peroxide, discolored tooth, nonvital bleaching, tooth bleaching

Restoring a single discolored anterior tooth to esthetic harmony with the remaining dentition often poses a significant challenge to the dentist. When a patient presents with a single discolored tooth, it is incumbent on the dentist to determine the cause of the discoloration. A dark tooth can result from a variety of conditions, including staining from a corroded or leaking restoration, trauma (vital or non-vital), incomplete removal of pulpal tissue at the time of root canal therapy, or internal resorption. Once examination has ruled out an active pathologic condition as the cause of the discoloration, the patient's esthetic concern may be addressed.

Traditional restorative procedures for masking a dark tooth range from veneering with composite or porcelain to complete coverage with a porcelain-fused-to-metal or an all-ceramic crown. Often the best result that can be achieved with these irreversible procedures is an esthetic compromise, because of the difficulty of matching the appearance of natural tooth structure. Bleaching, or whitening, of a dark tooth is a conservative alternative to more conventional restorative treatment. Additionally, bleaching does not compromise or eliminate any future treatment options.

In-office bleaching of isolated teeth uses a 35% solution of hydrogen peroxide, which is applied to the surface of the tooth for varying periods of time. These applications may require several appointments.¹ A 35% solution of hydrogen peroxide is very caustic, and great care must be taken to protect the patient's oral tissues whenever it is used.

If the discolored tooth has been treated endodontically, the bleaching agent is often placed inside the coronal pulp chamber and catalyzed by heat or light to hasten the breakdown of the hydrogen peroxide and accelerate the bleaching process.² This process may be repeated as many times as necessary until an acceptable result is achieved. An alternative to this procedure is the "walking bleaching technique,"³ in which a mixture of hydrogen peroxide and sodium perborate crystals is sealed in the pulp chamber. The advantage of this technique is that less chair time is required, because the tooth whitening occurs outside of the office over a period of days or weeks.

The disadvantages of these previously described bleaching techniques are that they utilize very caustic materials and that the results may be difficult to predict or control. Additionally, the use of 35% hydrogen peroxide with heat increases the possibility of internal resorption in patients with a history of trauma.⁴ These techniques may require several office visits, and patients incur a fee each time. There is no way to accurately predict the number of treatments required prior to initiation of treatment.

Nightguard bleaching with carbamide peroxide (CP) outside the dental office is an alternative to the in-office bleaching techniques.⁵ Usually, this technique is used to lighten the entire dentition or at least one arch. However, nightguard bleaching may be modified

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and has been used successfully in many unique situations to lighten a single discolored tooth.⁶⁻¹⁸ Compared to bleaching with 35% hydrogen peroxide, nightguard bleaching requires less chair time and is less expensive but takes place over a longer period of treatment time. The slower results from this treatment may be viewed by some patients as a disadvantage, but the gradual lightening may actually increase the probability of a successful color match. The at-home application by the patient allows extended treatment times without additional office visits or fees. The potential side effects of bleaching with carbamide peroxide are also less severe than the complications associated with 35% hydrogen peroxide.¹⁹

The purpose of this article is to present three case reports in which nightguard bleaching with a 10% carbamide peroxide (Opalescence, Ultradent) was used on selected nonvital darkened teeth to conservatively treat the patients' esthetic concerns.

CASE REPORTS

Case 1

A 33-year-old patient presented with a chief complaint of a single dark maxillary left lateral incisor (tooth 22 [10]). Root canal therapy had been performed on this tooth 5 years previously as a result of a traumatic injury. The access was restored with resin composite. The patient's dentition also included two retained primary maxillary canines. The patient reported a previous, unsuccessful attempt at in-office "power bleaching" on tooth 22. Two years earlier, direct resin composite veneers had been placed on her primary canines to improve their contour, and a direct composite veneer had been placed on tooth 22 (Vita shade B1) in an attempt to mask the shade discrepancy. The attempted shade correction of tooth 22 was deemed unsuccessful by the patient (Fig 1a).

The intraoral examination of the patient disclosed no pathosis, and the periapical radiograph of tooth 22 revealed an intact tooth with successful endodontic therapy. The structural integrity of this tooth was sufficient, so as not to require a casting as a final restoration. The patient inquired about placement of a porcelain veneer on tooth 22, because she had been told that it could better mask the shade discrepancy. The patient was informed that placement of a porcelain veneer only on this tooth could mask the difference in shade but might provide an unsuccessful esthetic result when placed next to the primary canine (tooth 63[H]) that had been veneered with composite. If this outcome occurred, the only alternative would be to place additional porcelain veneers on both primary canines. The

possibility of having to place three porcelain veneers was economically impractical for this patient.

The treatment option of internal bleaching with 10% CP in a nightguard was presented to the patient. Compared to placing porcelain veneers, this alternative was much more conservative and less expensive. Internal bleaching with 10% CP instead of a traditional walking bleaching technique was chosen because there is less risk of internal resorption associated with the use of carbamide peroxide, and the treatment time could be customized, for a more predictable result.²⁰ The patient was informed of the potential treatment sequelae of sensitivity of the vital teeth and irritation of gingival tissues. The patient elected to pursue this conservative method of treatment.

At the first treatment appointment, a maxillary alginate impression was made and a nightguard bleaching tray was fabricated. While the nonscalloped tray was being fabricated, the composite was removed from the endodontic access preparation on tooth 22, and pulpal remnants were removed from the pulp chamber. A light-cured glass-ionomer cement (Vitrebond, 3M Dental) was used to seal the root canal orifice. The glass-ionomer material was placed over the canal entrance at the level of the cemento-enamel junction in a thickness of about 0.5 mm and light cured for 30 seconds (Fig 1b).

The patient was then instructed in the use of 10% carbamide peroxide (Opalescence) as the bleaching agent via the "inside-outside technique."²¹⁻²³ She was instructed to inject a small amount of 10% CP into the pulp chamber of tooth 22 for the inside bleaching. Because the facial aspect of the tooth was covered with a composite veneer and thus inaccessible to the bleaching agent, the 10% CP for the outside bleaching was placed into the nightguard so that it would contact the lingual surface. The patient was instructed to wear the nightguard while she slept. Each morning the chamber was to be irrigated with water from a Monoject syringe (Sherwood Medical), and a cotton pellet was to be placed in the chamber to prevent food entrapment during the day.

While in the office, the patient rehearsed the placement of the 10% CP as well as the insertion and removal of the cotton pellet. The pellet was manipulated with a toothpick. Prior to dismissal, the patient was instructed to monitor the daily progress of the whitening process and to stop treatment if the tooth matched the adjacent teeth. If no match was achieved, she was to note if a stable color level was achieved (no further color change for several days) and return in 1 month.

At the 1-month recall visit, the bleaching result was satisfactory, and the endodontic access was sealed with Cavit (ESPE Premier) for 2 weeks before the



Fig 1a Tooth 22 at initial presentation, after in-office bleaching procedure followed by restoration with a direct composite veneer.



Fig 1b Lingual view of tooth 22 demonstrating the glass-ionomer base at the entrance of the root canal orifice. Note the contrast in shades between the darker lingual enamel and the lighter facial composite veneer.

placement of a definitive composite restoration (Herculite XRV, shade B1, Kerr/Sybron). This 2-week delay was necessary to ensure an adequate bond between the composite restoration and the tooth structure²⁴ and to allow the shade to stabilize before the color of composite was selected. Prior to the incremental placement of the composite, the pulp chamber and margins were etched with 37% phosphoric acid for 15 seconds. The preparation was rinsed for 10 seconds and lightly air dried to remove standing water. Then Optibond FI adhesive system (Kerr/Sybron) and the composite restoration were placed according to the manufacturer's recommendations (Fig 1c).

The facial composite veneer on tooth 22 was no longer necessary to mask the shade discrepancy. However, because tooth structure had been removed from the facial surface of the tooth prior to its original restoration, the composite was left in place.

Case 2

This 36-year-old patient presented after endodontic therapy had been completed on the maxillary left lateral incisor and canine (teeth 22[10] and 23[11]). Tooth 23 had no proximal restorations and was only slightly discolored. The lingual access opening on tooth 23 had been closed with an acceptable composite restoration. Tooth 22 had a mesioincisal composite restoration, which showed clinical signs of leakage, and the entire tooth was severely discolored (Fig 2a). Treatment choices for tooth 22 ranged from bleaching, followed by restoration with a resin composite, to placement of a post and core and crown on the tooth.

The walking bleaching technique was not the treatment of choice for this patient, because the leaking restoration present in tooth 22 made it impossible to achieve an adequate seal of the pulp chamber from the



Fig 1c Tooth 22 14 months after completion of the inside-outside bleaching procedure and restoration of the endodontic access preparation with resin composite. The original veneer is still in place and could not be eliminated because the tooth had been previously prepared.

oral environment without replacing the composite. If the composite were replaced prior to bleaching, selection of the appropriate composite shade would be difficult. Even if a shade were selected to match the adjacent teeth there would be no guarantee that it would match tooth 22 after it was bleached.

In-office power bleaching was considered for this patient, but the severe discoloration present in this tooth would necessitate more than one appointment to achieve an acceptable result, thus increasing the cost and time commitment of the patient and dentist. Placement of a crown, with or without a post and core, involves removal of a significant amount of sound tooth structure and would have dramatically increased the cost to the patient. The choice was made to try nightguard bleaching first, because other options were not compromised by this approach.



Fig 2a Pretreatment condition of tooth 22 shows the severe discoloration that has resulted from the leaking composite restoration.



Fig 2b Tooth 22 after a combination of nightguard and inside-outside bleaching procedures.



Fig 2c Posttreatment condition of tooth 22, which has been restored with resin composite to match the new enamel shade.

In contrast to the previous case, for which an inside-outside bleaching technique was used, traditional nightguard bleaching was initially chosen for this patient because of the patient's inability to return for follow-up visits in a timely manner. Another factor in this decision was that the other endodontically treated tooth (23) was slightly yellower than adjacent teeth and had already been sealed with an acid-etched composite restoration. The treatment plan was to lighten both teeth 22 and 23 with the single procedure of nightguard bleaching.

A conventional scalloped, reservoired tray was fabricated to cover all the teeth but not to extend to tissue.²⁵ The 10% CP material was applied nightly. After about 30 nights of treatment, the shade of tooth 23 was harmonious with the rest of the dentition (Fig 2b). At this time, the patient's availability had improved, so the bleaching of tooth 22 was completed in about 2 months with the inside-outside bleaching technique described in case 1.

After the bleaching was completed, the remaining composite restoration was removed. Because the tooth did not completely match the adjacent teeth, a shade B1 composite was placed in the pulp chamber to lighten the tooth further. Then the mesioincisal portion of the tooth was restored with shade D2 composite restoration (Herculite XRV) (Fig 2c). This conservative approach still leaves all other treatment options open.

Case 3

A 37-year-old man complained that his maxillary right central incisor (tooth 11[8]) was too dark and his prosthetic maxillary left central incisor (tooth 21[9]) was too light compared to all of his other teeth (Fig 3a). The patient had been accidentally struck in the mouth 24 years ago, resulting in avulsion of tooth 21

and apparent subluxation of tooth 11. The missing tooth 21 was replaced with an acrylic resin tooth attached to a metal-based removable partial denture (RPD). No treatment was rendered for tooth 11 because of a lack of symptoms.

The clinical examination confirmed tooth 11 to be several Vita shade tabs darker than the other natural anterior teeth. A radiograph showed that the canal system was almost totally calcified, and the appearance of the periapical region was within normal limits. Electric pulp testing of this tooth elicited no response. The mobility of this tooth was normal, and there were no periodontal probings deeper than 3 mm.

The prosthetic tooth replacing 21 was overcontoured and appeared to be one to two shade tabs lighter than the adjacent natural teeth. This discrepancy further exaggerated the color mismatch with tooth 11. The maxillary RPD was in good condition and possessed adequate retention.



Fig 3a Initial appearance of tooth 11, illustrating its shade mismatch with the prosthetic tooth (21) and the other natural teeth.



Fig 3b Midtreatment condition of tooth 11 following 2 months of nightguard bleaching. The shade of this tooth is similar to the other natural teeth, which are not as light as prosthetic tooth 21.



Fig 3c Appearance of the patient following an additional 6 weeks of nightguard bleaching in addition to recontouring and polishing of tooth 21.

Finances limited the patient's treatment options. Therefore, a treatment plan that included nightguard bleaching of tooth 11 along with esthetic recontouring and polishing of the acrylic resin prosthetic replacement for tooth 21 was accepted. A nonscaloped, nonreservoired maxillary bleaching tray was fabricated for the patient on a cast that did not include the RPD, because carbamide peroxide has been shown to discolor dental acrylic resin.²⁶ Because the tray could not be worn with the RPD in place, bleaching was performed only at nighttime. A reservoir was omitted from tooth 11 in an attempt to enhance the adaptation of the bleaching tray and to limit the volume of bleach in the area of tooth 11 to avoid inadvertent lightening of the maxillary right lateral incisor (tooth 12[7]). An alternative technique would include preparing a tray with a facial window on tooth 12. If tooth 11 did not respond to treatment, any lightening of tooth 12 would accentuate the color

mismatch. The patient was instructed to use the tray at night while sleeping and was given a 2-month supply of 10% CP.

After 2 months of nighttime bleaching, the shade of tooth 11 was nearly equivalent to that of the adjacent natural teeth (Fig 3b). The acrylic resin tooth replacing tooth 21 was recontoured and polished to mirror tooth 11 in size and shape. The patient was very pleased with the results of the bleaching treatment at this time. However, there was some concern about the appearance of tooth 21, which was still lighter than all his natural teeth. Therefore, it was suggested to the patient that he try bleaching his entire maxillary arch in an attempt to match the shade of the acrylic resin tooth on the partial denture. This bleaching treatment was initiated at this appointment and was completed in 6 weeks, providing the patient with a dramatically improved appearance in an economic manner (Fig 3c).

DISCUSSION

Two points arising from these case reports deserve discussion. One is the duration of treatment with the nightguard technique using 10% carbamide peroxide. Most manufacturers' instructions suggest 2 weeks or less. The implication is that all teeth should respond to treatment in that time frame. However, many published articles on clinical research trials and case reports have shown otherwise.

The first article in the literature on nightguard vital bleaching, by Haywood and Heymann,⁵ reported a treatment time of 5 weeks and recommended 6 weeks, although the authors mentioned that some patients may respond in only 2 weeks. The largest clinical trial on nightguard vital bleaching used 6 weeks as the

treatment time because many patients do not respond adequately in 2 weeks.¹⁶ The guidelines for the American Dental Association Seal of Acceptance for peroxide-containing whitening products specify that treatment options can range from 2 to 6 weeks.²⁷

However, in this era of instant gratification, both the dentist and patient are interested in the shortest possible treatment time. Marketing claims stress rapid treatment rather than optimum color change. Most companies choose to advertise the shortest reasonable time, which may work for some patients. However, dentists should be aware that certain patients or discolorations often require times that extend beyond 2 weeks. Normal or slightly stubborn teeth may require 4 to 6 weeks, as previously described.^{25,28,29} Nicotine-stained teeth may require 3 months.¹² Tetracycline-stained teeth may require 2 to 6 months of nightly treatment.^{17,30,31} One report on extended treatment time for tetracycline-stained teeth indicated that 12 months was required to obtain a successful outcome.³² This type of treatment time variation also exists for the single dark tooth. If the treatment time is limited to 2 weeks, the best color outcome will not always be achieved.

The opportunity for extended treatment is one of the primary advantages of the inside-outside bleaching technique. The patient can receive treatment for a longer period of time without having to return to the office. Patients are usually willing to treat for longer times if the dentist initially prepares them for that possibility. Typically, teeth take 2 to 6 weeks of treatment with 10% CP, and tetracycline-stained teeth take 2 to 6 months. However, the best advice is to "bleach until they are white," because there have been no documented negative consequences from this philosophy.

The other point of discussion is regarding the type of tray design employed for bleaching. There is no universal style of bleaching tray. Instead the design is related to the type of material being used, the type of discoloration being treated, and the specific patient being served. Bleaching trays can be designed with or without facial or lingual scalloping, and with or without reservoirs.²⁵ Materials that are more viscous and sticky work best in reservoir trays to allow complete seating of the tray. However, neither reservoirs nor foam inserts are necessary for bleaching.³⁵ Also, scalloping (trimming the tray to approximate the free gingival margins) allows the dentist to eliminate most soft tissue contact, which may prevent tissue irritation. Conversely, bleaching material is more likely to leak from a scalloped tray and may irritate the tongue and lips. More viscous gels stay in the tray more readily.

When the discoloration is located at the gingival area, the authors use nonscalloped tray designs to

ensure proper application of the material to the discolored site. In the two cases presented where nonscalloped trays were used, one involved an edentulous space adjacent to the primary treatment site. This situation precluded the use of a scalloped tray. The other situation involved the need for lingual application of the bleaching material, and it was thought that a nonscalloped tray would provide a better seal and be tolerated better by the patient.

If a more fluid bleaching material is used, a non-reservoired tray design retains the material in the tray better and is more comfortable for the patient. If tissue irritation occurs, the tray can then be scalloped. The original trays used for nightguard bleaching did not have reservoirs and were not scalloped. The gingival irritation resulted partly from the rigidity of the tray material used and partly from the chemical nature of the material that came into contact with the soft tissue.¹⁶ With the newer, more flexible tray materials, there is less potential for gingival irritation.

Sticky bleaching materials adhere to gingival tissues more easily and can cause contact irritation. More water-soluble materials do not seem to cause this problem. The bleaching material used in these case reports, a viscous, sticky gel, is generally used with a scalloped, reservoir tray, but such a design is not essential. Certainly if other materials are used, an appropriate tray design must be used.

These variations in patient response, material type, and discoloration situation are just a few of the reasons why nightguard bleaching should always be supervised by the dentist.³⁴ The proper selection of tray design and material, as well as the monitoring of side effects, is essential for maximum bleaching benefit. Also, the acquisition of preoperative radiographs to verify the absence of periapical pathosis is crucial for nonvital teeth and always important for vital teeth.

CONCLUSION

Several conservative treatment options involving the nightguard bleaching of single, dark, nonvital teeth with 10% carbamide peroxide have been presented. If these conservative approaches are used first, other, more traditional treatment options are still available if needed. The cost-benefit ratio of this procedure is very attractive to patients, and treatment does not involve significant office time for the dentist. Additionally, the safety concerns associated with the use of 35% hydrogen peroxide are eliminated. Bleaching often provides a more natural esthetic result than do crowns or veneers, and bleaching can improve the results of previous restorative treatment.

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