

# Treating Single Dark Teeth

Report of Four Cases Utilizing Varying Concentrations of Carbamide Peroxide



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## Abstract

Single dark teeth in the esthetic zone present a challenge to clinicians and arise from different etiologies. Among the different treatment approaches, use of external bleaching agents, such as carbamide peroxide (CP), is a conservative, effective treatment for discolored vital and nonvital teeth. This article presents the results of a study in which different CP concentrations were employed for different durations with external nightguard bleaching on four patients who presented with single dark teeth.

**Key Words:** esthetics, bleaching, conservative, single dark tooth

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## Learning Objectives

After reading this article, the participant should be able to:

1. Understand and utilize additional tools for the critical color matching of an anterior tooth to the adjacent dentition.
2. Communicate with the laboratory technicians—objectively, rather than subjectively—about the color required.
3. Understand the use of spectrophotometric analysis for shade determination and communication with the laboratory.

## Introduction

The single dark tooth presents an esthetic challenge for clinicians.<sup>1</sup> Such discoloration may occur due to extrinsic or intrinsic causes. Examples of extrinsic causes include regular consumption of food and/or beverages that contain staining colorants, and smoking. Intrinsic causes include biologic responses to trauma,<sup>2,3</sup> taking tetracycline, or exposure of the teeth to high levels of fluoride during development.<sup>4</sup> It has been reported that 25% of the population between the ages of 5 and 50 has signs of dental trauma,<sup>5-7</sup> mainly affecting the maxillary central incisors (69%) and maxillary lateral incisors (20%).<sup>8,9</sup>

The dental pulp can respond to trauma by surviving, necrosing, or undergoing pulp calcification (PC).<sup>10</sup> In addition, the trauma can cause extravasation of blood from the pulp into the dentinal tubules,<sup>11</sup> which produces a dark coloration of the dentin associated with the deposition of ferric sulfide after the hemolysis of red blood cells.<sup>12</sup>

Many patients with discolored teeth are unhappy with their appearance.<sup>13</sup> All patients must receive an accurate diagnosis that rules out pulpal or periodontal ligament pathology, beginning with review of their dental history; pulp testing; periapical radiographs; transillumination; dental photography; and, if necessary, computed tomography (CT) imaging.<sup>14</sup>

Once the diagnosis is established and any pathology treated, external bleaching, the least invasive option, should be the initial treatment for the discoloration.<sup>15-17</sup> The patient should be informed that direct composite resin restorations or indirect restoration of the teeth with crowns or veneers also may be necessary.

The use of bleaching agents such as carbamide peroxide (CP) in different concentrations can be effective on discolored vital and nonvital teeth.<sup>18</sup> CP was first advocated as a bleaching agent in 1989 by Haywood and Heymann.<sup>9,18,19</sup> Current products include gels that release oxygen, lighten dentin, and remove ferric sulfide discoloration (if present) from the dentinal tubules.<sup>20</sup> CP products are most safely applied externally in a bleaching tray, since internal bleaching of nonvital teeth has been associated with external root resorption, especially when higher concentrations are used.<sup>21,22</sup> Many previous clinical studies have demonstrated excellent results in changing the color of one or many teeth, vital or nonvital, utilizing only external bleaching.<sup>23,24</sup>



**Figure 1:** Bleaching tray with cutouts for normally shaded adjacent teeth, which will limit CP application to dark tooth, indicated by pink spot on cast.

## Case Reports

Four patients between the ages of 15 and 28, each of whom had one or two dark teeth in the anterior maxillary segment, presented to the Oral Rehabilitation Residency Program clinic in the dental school at the Meritorious Autonomous University of Puebla in Puebla, Mexico. All the patients gave legal consent for treatment and for their cases to be included in this article in accordance with local regulations.

Based on the patients' dental histories and clinical and radiographic examinations, it was decided to use all of the additional diagnostic methods mentioned above for the discolored teeth, including CT scanning. Based on these evaluations, each discolored tooth received a definitive diagnosis and treatment for any pathology. Once the diagnoses were made and pathologies treated, the external bleaching protocol with CP (Opalescence PF, Ultradent Products; South Jordan, UT) for each patient was chosen according to the degree of discoloration. CP was applied for all patients using bleaching trays without reservoirs and scallops and trimmed such that only the discolored teeth were treated (Fig 1).

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All patients must receive an accurate diagnosis that rules out pulpal or periodontal ligament pathology...

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**Patient 1**

A 26-year-old female presented with a discolored maxillary right central incisor (#8) (Fig 2), which was diagnosed as PC secondary to trauma. Her treatment protocol was nightly bleaching with 10% CP for 8 weeks. Two weeks after treatment, #8 was found to match the adjacent teeth (Figs 3 & 4). The patient experienced slight gingival irritation in her final days of bleaching, which the authors attributed in retrospect to a slightly overextended tray (Fig 1).



**Figure 2:** Patient 1 prior to treatment; discolored #8.



**Figures 3 & 4:** Patient 1 after treatment.

**Patient 2**

A 28-year-old male presented with a discolored maxillary left central incisor (#9) (Fig 5), which was diagnosed as PC secondary to trauma. His treatment protocol was nightly bleaching with 15% CP for 8 weeks. Two weeks after treatment, #9 was found to match the adjacent teeth (Figs 6 & 7).



**Figure 5:** Patient 2 prior to treatment; discolored #9.



**Figures 6 & 7:** Patient 2 after treatment.

“ Once the diagnoses were made and pathologies treated, the external bleaching protocol with CP for each patient was chosen according to the degree of discoloration. ”

**Patient 3**

A 16-year-old male presented with a discolored maxillary right central incisor (#8) with a Class IV incisal edge fracture (Fig 8). It was unresponsive to pulp testing, demonstrated periapical pathology, and was diagnosed as irreversible pulpitis. Prior to bleaching, endodontic therapy and a temporary Class IV resin composite were completed. Nightly bleaching of only the discolored tooth with 20% CP for 4 weeks followed. Internal bleaching was not considered due to the risk of external resorption. Following treatment, #8 was found to be slightly darker than the adjacent teeth but considered acceptable by the patient. Two weeks after the cessation of bleaching, a definitive Class IV resin composite was placed (Figs 9 & 10).



**Figure 8:** Patient 3 prior to treatment; discolored and fractured #8.

**Patient 4**

A 25-year-old male presented with a discolored maxillary left central incisor and maxillary right canine (#9 and #6) (Figs 11 & 12), which were diagnosed as post-orthodontic external apical resorption. Both teeth demonstrated complete calcification of the pulp chamber and root canals (Figs 13 & 14) and did not respond to pulp testing. Due to the absence of periapical pathology and the unlikelihood of finding and instrumenting the root canals, endodontic therapy was not considered. Because of the calcified pulp chambers, the risk of dental sensitivity was considered low, so a bleaching protocol of 35% CP applied only to the discolored teeth for 4 weeks was employed. Two weeks after treatment, #9 and #6 were found to be much lighter than at the outset of bleaching but they remained slightly darker than the adjacent teeth (Figs 15-17). Although pleased, the patient hoped for an ideal outcome and continued his bleaching protocol for an additional two weeks. However, no additional color change was observed. Despite this, the patient declined restorative treatment.



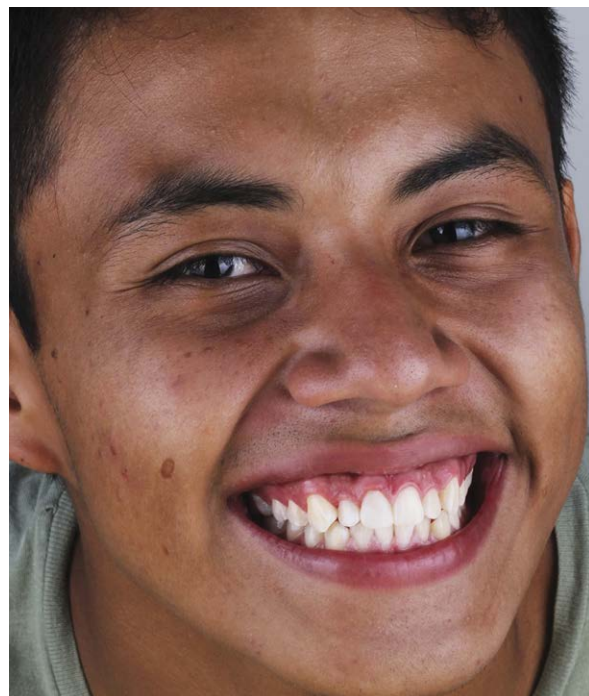
**Figures 9 & 10:** Patient 3 after bleaching and definitive resin composite restoration.

**Discussion**

Discolored single teeth are frequently seen in clinical practice and have various etiologies, with traumatic injury being the most common. Three of the four patients discussed here presented with discolored teeth secondary to trauma. The fourth patient ultimately was diagnosed with external apical resorption due to excessive forces during orthodontic treatment. According to Yamaguchi, if a tooth is subjected to heavy continuous force, a sequence of abrupt movements occurs and undermining resorption is capable of altering the vascularity of the pulp, which can produce a color change in the tooth.<sup>25</sup>

**Bleaching Only the Dark Teeth**

The authors consider external bleaching the treatment of choice for single dark teeth because it is effective, conservative, inexpensive, and safe,<sup>18</sup> and believe that external bleaching should be undertaken prior to any restorative treatment.<sup>9</sup> However, bleaching, like any treatment, should not be undertaken until an accurate diagnosis is obtained. The authors also wish to emphasize that external bleaching must be undertaken only on the dark teeth. Bleaching all the teeth introduces the risk of the dark teeth appearing even darker in contrast to the adjacent dentition, which likely will lighten more in appearance than the dark teeth. In the unlikely event that the dark teeth can be lightened to the extent that adjacent teeth appear darker after bleaching, cautious bleaching of all the teeth can be undertaken to improve color match.



As previously stated, the authors believe that internal bleaching of endodontically treated teeth introduces unacceptable risk of external resorption,<sup>26</sup> since approximately 7% of teeth that have undergone internal bleaching will develop external resorption defects.<sup>27</sup> Use of intracoronal peroxide also has been shown to reduce the microhardness of dentin and enamel<sup>28</sup> and mechanically weaken the tooth.<sup>29</sup>

### Bleaching Not Always the Best Option

The authors acknowledge that for some patients, bleaching will not produce a sufficiently attractive result, and that either resin composite or ceramic veneers become necessary, often including at least six teeth in the esthetic zone for continuity of shade and texture. The discolored tooth often is considerably darker than the adjacent teeth, and in order to mask the undesirable shade, it would be necessary to aggressively prepare the tooth so that the thickness of the restorative material is enough to conceal the dark tooth structure. For ceramic veneers, approximately 0.2 mm of facial tooth reduction is needed per shade change.<sup>30</sup> For example, if the single dark tooth is A4 and the adjacent teeth are A1, the discolored tooth would require a facial reduction of at least 0.6 mm for the final restoration to match the adjacent teeth. Facial enamel reduction of 0.5 mm or more may expose dentin at the cervical area, increasing the risk of veneer bond failure,<sup>31</sup> and could be considered overtreatment unless more conservative options have been shown to be ineffective. The authors consider use of bleaching prior to veneers the best means of lessening this amount of tooth reduction.

### Case Specifics

A non-reservoir tray design was selected for these patients, since less material is needed per application, reducing cost to the patient, and the tightness of the tray is maintained.<sup>9</sup> Different concentrations of the same brand of bleaching gel were used for different amounts of time to test the time-dependence of the product. According to Haywood, higher concentrations of CP can slightly decrease the time necessary for bleaching, although the final shade will be no different than that obtained when using lower concentrations.<sup>9</sup> In Case 1, the patient used 10% CP for 8 weeks and the results were considered satisfactory. This patient was the only one that experienced gingival inflammation, and the authors believe this was due to slightly overextended tray margins. In Case 2, the patient used 15% CP for 8 weeks, and a significant improvement was observed in shade after 7 weeks of bleaching. In Case 3, the patient used 20% CP for 4 weeks, and an improvement in shade was recognized after 2 weeks of bleaching. In Case 4, the patient used

35% CP for 4 weeks, and achieved considerable lightening. This patient would have preferred to see more improvement, but the teeth would not lighten any further, even after an additional 2 weeks of bleaching.

While the patients discussed here who used higher concentrations of CP may have achieved maximum lightness in less time compared to those who used lower concentrations, given their small number, the authors were not able to distinguish whether higher concentrations of CP achieved faster results than 10% CP. For all concentrations, the end result was the same in that the single dark teeth were lightened to optimally—or in one case, satisfactorily—match the adjacent teeth. Based on these observations, the authors advise compliance with Haywood's recommendations that patients use 10% carbamide peroxide products due to their proven safety and efficacy.<sup>18</sup>

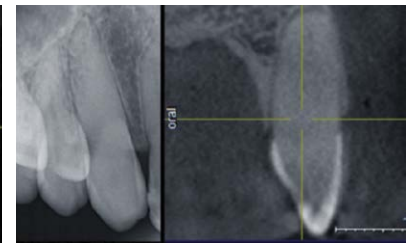
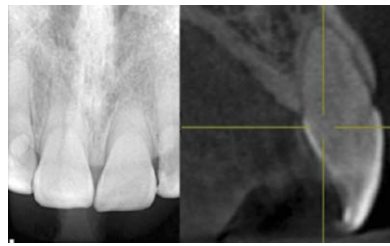
The authors elected not to perform shade determinations pre- and postoperatively, as is customarily done when all teeth are being whitened. Instead, normally shaded teeth adjacent to the dark teeth that did not receive bleaching were used as the basis for comparison.



**Figure 11:** Patient 4 before treatment; discolored #9



**Figure 12:** Patient 4 before treatment; discolored #6.



**Figures 13 & 14:** Patient 4, periapical and CT images of #9 and #6.



**Figures 15-17:** Patient 4 after treatment.



## Summary

External nightguard bleaching is a simple, effective treatment approach to the single dark tooth, regardless of etiology. The two patients in this study who presented with a single dark tooth caused by PC secondary to trauma used 10% CP for 8 weeks and 15% CP for 8 weeks, respectively, and both attained optimal color matching to the adjacent untraumatized teeth. The patient who presented with irreversible pulpitis secondary to trauma and subsequently underwent root canal treatment used 20% CP for 4 weeks and achieved the same result, whereas the patient who was diagnosed with external apical resorption secondary to orthodontic treatment and used 35% CP for 4 weeks attained a satisfactory but not optimal match.

“ Many previous clinical studies have demonstrated excellent results in changing the color of one or many teeth, vital or nonvital, utilizing only external bleaching. ”

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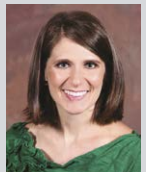
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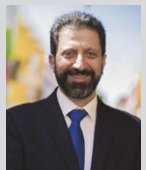
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3 Hours Credit

This Continuing Education (CE) self-instruction exam is based on the article, *Treating Single Dark Teeth: Report of Four Cases Utilizing Varying Concentrations of Carbamide Peroxide* by Dr. Linda N.G. Martinez, Dr. Maria J.R. Muslera, Dr. Mario F. Romero, Dr. Courtney S. Babb, Dr. Alejandro D. Kanan, Dr. Guillermo F. Romero, and Dr. William W. Brackett. This article appears on pages 58-65.

The examination is free of charge and available to AACD members only. AACD members must log onto [www.aacd.com](http://www.aacd.com) to take the 10 question exam. Note that only Questions 1 through 5 appear in the printed and digital versions of the jCD; they are for readers' information only.

1. Which of the following is an objective way to communicate color?

- a. Visual comparison with the Vita 3D shade guide.
- b. Digital photography using multiple shade tabs.
- c. The use of color measurement instruments.
- d. Black and white photography to determine the value.

2. How does a spectrophotometer objectively communicate color?

- a. By measuring the amount of light reflected from objects throughout the visible spectrum.
- b. By analyzing the color of a specific shade tab and then comparing this to the tooth.
- c. By using infrared light to penetrate gently into the tooth structure to evaluate the warmth of different areas.
- d. By comparing the reflective color of a tooth to a variety of shade tabs.

3. Which of the following defines the ability of color measurement instruments to objectively color map a tooth?

- a. Spectrophotometers can analyze a three-dimensional image of a tooth.
- b. Spectrophotometers provide accurate color communication for both gingiva and teeth.
- c. Colorimeters can analyze a three-dimensional image of a tooth.
- d. Colorimeters are more sophisticated instruments for color measurement than spectrophotometers.

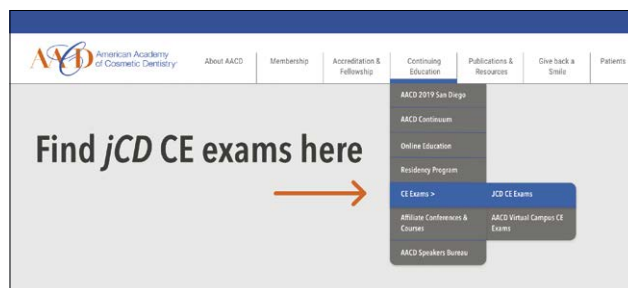
4. In the case presented, why was a color analysis completed before and after whitening?

- a. To select the proper type of porcelain material to be used.
- b. To evaluate the effect of the tooth color on the color of the gum tissue.
- c. To determine the shade of porcelain to be used for the temporary restorations.
- d. To determine whether the magnitude of color change was within the perceptibility threshold.

5. The CIELAB color space coordinates use which of the following for color analysis?

- a. Red-green and yellow blue compared to the lightness.
- b. The difference in color change determines the color selection.
- c. Lightness and color change is compared to Vita shade tabs.
- d. L\* a\* and b\* values were examined to determine the difference in color change.

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