

Bleaching and Esthetic Bonding of Tetracycline-Stained Teeth



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ABSTRACT

Nightguard vital bleaching or dentist-prescribed, home-applied bleaching has brightened many patients' smiles. However, tetracycline stains still present a problem. This article presents a case report citing many of the principles and knowledge about bleaching tetracycline-stained teeth, including at-home versus in-office treatment, sensitivity incidence/treatment, and longevity of treatment. The case report couples bleaching principles with the esthetic principles of smile analysis and bonding for total esthetic improvement. This combination of bleaching and bonding is very conservative, both physically and financially, in the restorative management of a patient with esthetic concerns.

LEARNING OBJECTIVES

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

- Explain the indications of bleaching tetracycline-stained teeth.
- Explain the limitations of bleaching tetracycline-stained teeth.
- Recognize the esthetic principles necessary to restoratively manage a patient with space problems and discolored composites.
- Counsel patients as to reasonable expectation and treatment success.

Nightguard vital bleaching or dentist-prescribed, home-applied bleaching using a custom tray and 10% carbamide peroxide has brightened the smile for many patients since its introduction in 1989.¹ However, one type of patient still presents some difficulty—the patient whose teeth have been stained by tetracycline ingestion. Research shows that tetracycline-stained teeth may respond to longer bleaching treatments.² For instance, whereas the normal bleaching time is 2 to 6 weeks, some tetracycline-stained teeth may take as long as 2 to 6 months or longer of nightly treatment to achieve a satisfactory result.³

Tetracycline comes in several analogues, which cause different discolorations in the teeth. The color and location of the staining determine the prognosis for successful bleaching. Gray discolorations are most difficult, especially when located at the cervical or gingival of the tooth.⁴ Generally dark grays only get lighter, but not white. Banded

discolorations are more difficult than uniform discolorations, especially if the center band is gray. Not only does tetracycline stain developing teeth in children, but it has also been shown to stain fully formed adult dentition.⁵ Minocycline, a tetracycline analogue, is the most commonly prescribed and safest drug used in young adults for treatment of facial acne. There are several reports in the literature of white teeth subsequently becoming gray during minocycline ingestion; but there is no better drug for acne treatment. Tetracycline is still a safe, inexpensive drug of choice for the treatment of Rocky Mountain spotted fever and other diseases such as cystic fibrosis; so dentists will continue to see some level of tetracycline staining. Extended bleaching treatment of tetracycline-stained teeth has been shown to be effective,⁶ and 7^{1/2}-year follow-up studies have demonstrated no detrimental effects on the tooth, pulp, or patient.⁷ Using these extended treatment times and a

low concentration (10%) of carbamide peroxide with conservative bonding of composite only where needed and an understanding of esthetic principles, tetracycline-stained teeth may still achieve a reasonable esthetic result, while avoiding full coverage restorations of crowns or veneers.^{8,9} The purpose of this case report is to demonstrate conservative bleaching and bonding of tetracycline-stained teeth.

CASE REPORT

The patient presented to the office concerned about the appearance of her teeth, which exhibited a diastema and tetracycline stains. Malformed parts of the teeth had been previously restored with composite restorations, which had now discolored. The patient had previously received bleaching treatment using 10% carbamide peroxide in a tray for 2 weeks but was unhappy with her current situation (Figure 1). She was unaware that research had determined that bleaching tetracycline-stained

teeth might take 4 to 6 months until the initial examination, so she consented to resume treatment in hopes of achieving a better result. An attempt was made to determine if “jump-starting” with in-office power bleaching treatment could shorten that extended tray-bleaching time. One half of the arch was isolated and treated with an in-office bleaching technique, using a light-activated 35% hydrogen peroxide gel (Opalescence Xtra Boost, Ultradent Products Inc) applied for 1 hour in three 20-minute intervals (Figure 2). While this procedure was being performed, a custom tray was made from a cast generated from a maxillary alginate impression. The tray design employed reservoirs on the six anterior teeth and was scalloped only on the anterior six teeth for gingival evaluation purposes. After the 1-hour bleaching treatment, only a minimal difference was noted. The patient later noted that the bleaching difference between the two sides only lasted about 2

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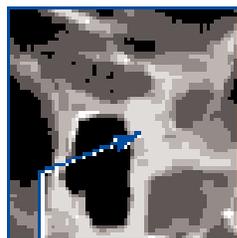
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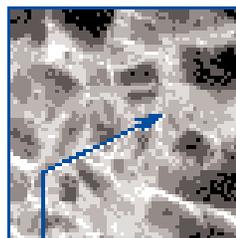
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Figure 1—Initial presentation of tetracycline-stained teeth after only 2 weeks of tray bleaching with 10% carbamide peroxide. Diastema is present and discolored composites in defective areas of the teeth.



Figure 2—Dam isolation and light-activated 35% hydrogen peroxide gel for evaluation of effects of in-office bleaching treatment, using a split-arch technique.



Figure 3—Maxillary arch after 2 months' use of 10% carbamide peroxide (Opalescence) bleaching treatment.

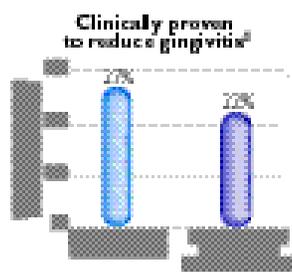


Figure 4—At 5 months of 10% carbamide peroxide bleaching, the patient was satisfied with the extent of color change.

days before the treated side was indistinguishable from the untreated side. The patient was given the maxillary tray (Sof-Tray, Ultradent Products Inc) and an ADA-approved 10% carbamide peroxide (Opalescence, Ultradent Products Inc) to apply nightly. Other products that could have been used are Colgate Platinum (Colgate Oral Pharmaceuticals) and Rembrandt Classic (Oral-B/Rembrandt). A log form was used to gather data as to when color change was noticeable, note the presence of sensitivity, and count the number of syringes used with this tray design and arch size. The old composite was not removed before bleaching because it has been determined that bleaching will progress under existing composite or veneer restorations.¹⁰ After 2 months of treatment, the central and lateral incisors were beginning to reach their maximum lightness, but the canines had not completed their lightening (Figure 3). The patient expressed interest in obtaining a higher concentration of carbamide peroxide, again to hopefully shorten the treatment time.¹¹ She was given 16% carbamide peroxide, but after 5 days had to discontinue use because of tooth sensitivity. After several days' rest for the teeth, she resumed the 10% carbamide peroxide application in the custom tray. There were no gingival irritations on the scalloped or non-scalloped portions of the tray with 10% carbamide peroxide. She used roughly 28 syringes in the first 60 days' treatment. Her total treatment time was approximately 5 months, with some times of no treatment because of

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Figure 5—The relationship of the dental midline is not exactly coincident with the facial midline.



Figure 6—Smile analysis evaluates the teeth and gingival architecture in the confines of the lips and natural smile.



Figure 7—White orthodontic wax was placed to fill the diastema. This wax allowed the patient to preview the treatment.



Figure 8—Small amounts of three different shades of composite resin were placed to select the best shade match.



PHILIPS

illness, travel, or other personal situations (Figure 4).

When the maxillary arch was completed to the patient's satisfaction as compared with the mandibular teeth, bleaching treatment of the mandibular arch was begun. The patient periodically experienced sensitivity on the mandibular incisors. This sensitivity was treated successfully with potassium nitrate and fluoride in the bleaching tray (Ultra EZ, Ultradent Products Inc). Total treatment time for the mandibular arch was also approximately 5 months. Treatment of one arch at a time gave a good comparison to the patient for bleaching progress, minimized the number of teeth available to be sensitive, and avoided any significant impact on occlusion. Single-arch treatment also reduces the entry fee for the patient to experience bleaching when finances or outcomes are in question.

When the bleaching was completed and the patient was satisfied with the shade of the maxillary anterior teeth, a smile analysis was completed. This analysis evaluated:

1. The relationship of the dental midline and the facial midline (Figure 5).
2. The incisal length of the maxillary incisors relative to the wet/dry line of the lower lip in a full smile (Figure 6).
3. The mesial-distal and incisal-gingival proportion of the lateral incisors and canines if the midline diastema was closed.
4. The presence of consistent and symmetrical gingival tissue contours.

The patient was uncertain whether she wanted the diastema closed. Orthodontic wax was added to the midline diastema



Figure 9—The left central incisor was restored to match the facial midline and finished completely.



Figure 10—A curing shield was placed between the operatory light and the patient to extend working time for sculpting the composite restoration.



Figure 11—The right central incisor was restored against the finished restoration on the left central incisor to close the diastema and fill the proximal space.



Figure 12—Note the buccal-lingual width of the incisal edge was maintained, and the occlusion was distributed equally, while remaining off the composite where possible.

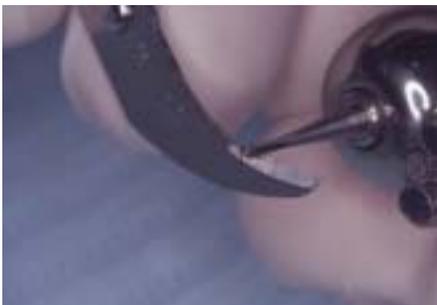


Figure 13—Removing all but 2 mm to 3 mm of the cutting edge of a No. 12 surgical blade allows the operator to grasp the blade without cutting the thumb.



Figure 14—Polished restorations providing diastema closure with facing surfaces being mirror images of each other.



Figure 15—When the midline is correct, marks were made so the widths of the two central incisors are the same, and the line angles are identical in shape.



Figure 16—The distal surface of the right central incisor was restored with retraction cord placed to exposed the mesial gingival decay on the lateral incisors.

(Figure 7) to simulate the closure of the space for the patient. This quick chairside technique helped the patient decide to fill the space between the central incisors. Sculpting and curing composite resin to the unetched enamel could have achieved the same effect. Other options for diagnostic evaluations are using the bleaching casts for a diagnostic wax-up, using scotch tape on a photograph to color in the teeth, or employing computer simulation.

The smile analysis revealed that the facial midline did not exactly coincide with the dental midline but was reasonably close enough to match. The incisal length of the centrals and the mesial of the lateral incisors did not interfere with phonetics or function. The proper proportion of the central, laterals, and canines could be maintained near the golden proportion of 1.6:1.0:0.618 if the midline diastema was closed and the mesial of the lateral incisors was augmented. Also the height-to-width ratio of the incisors could be maintained near 10:8. Finally, the gingival height and contours were acceptable except for the right lateral incisor. The patient was informed that this area

might require a facial gingivoplasty to be consistent with the left lateral incisor.

Because teeth may bleach to a shade lighter than B1 (Vita Classic Shade Guide, Vita Zahnfabrik; US Distributor, Vident), manufacturers now make composite materials in lighter shades. Teeth also do not all achieve the same shade post-bleaching, so a range of shades lighter than B1 from which to choose is desirable. It is also desirable to have composites that are both opaque and translucent. The correct shade and brand of composite was selected (B1) and confirmed by placing and curing small amounts of different shades and types of composite (Figure 8) directly on the wet teeth. It is important to use either water or bonding resin beneath the resin before curing so the refractive index of the light penetrating the resin to the tooth is not altered. It is also important to cure the composites for the final shade because even light-cured composites change shade on curing. The choice of composite also must include the determination of whether an opaque or translucent material is needed. It is often necessary to place the restoration in layers,

using the opaque material beneath the translucent material to prevent the graying effect of the light shining through large restorations. Because of the amount of space to close, an opaque composite shade B1 was chosen (Amelogen, Ultradent Products Inc). Another opaque product that could have been used is Renamel Microfill (Cosmedent, Inc).

The mesial of the left central incisor was restored first, contoured and polished to fill the portion of the midline diastema to correct the midline discrepancy (Figure 9). The appropriate emergence profile was established to allow for oral hygiene efforts and yet to fill the space between the contact point and the gingival papilla. This was compared to the midline of the face (Figure 5) to confirm the position. To allow extended working time while placing and sculpting the composite material, a curing shield was held between the operatory light and the patient (Figure 10). This technique allows unlimited working time with lighter composites, which otherwise would set up from the operatory light or the ambient room light. The mesial of the right central incisor was then restored as a mirror

image of the left central incisor (Figure 11). The buccal-lingual dimension of the incisal edge of the existing tooth was maintained to add bulk and strength to the restoration and to produce a translucency similar to that of the natural tooth. The occlusion was evaluated and any anterior guidance was distributed to as many teeth as possible (Figure 12), as well as adjusted to avoid occlusion on the composite bonding where possible. A No. 12 surgical blade was altered and used to trim and contour any excess proximal composite.¹² With this technique, the composite resin can be carved in a manner similar to carving amalgam (Figure 13).

Restoration was continued from the midline distally (Figure 14) by next augmenting the distal surfaces of the central incisors (Figure 15) and then the mesial surfaces of the lateral incisors (Figure 16). As these surfaces were restored, it was important to view them from the incisal (Figure 17) to create the proper facial embrasures. These facial embrasures help define the line angles in the composite that simulate the line angles and embrasures on the contralateral teeth (Figure 18). To help visualize these

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Figure 17—When restoring the mesial of the lateral, the matrix band did not form the composite well, causing a loss of embrasure and increasing the apparent width of the tooth.



Figure 18—By defining the facial embrasure line angles, the tooth appears the correct size and contour.



Figure 19—The prominent line angles are marked to create mirror images of adjacent teeth and equal-sized same teeth. Measurements are from the midline out.



Figure 20—The final restorations are polished.



Figure 21—Six months after placement of restorations and completion of bleaching.



Figure 22—Two years after placement of restorations and completion of bleaching.



Figure 23—The EZ Now Tray was fabricated because the original prediastema closure tray would no longer fit.



Figure 24—Four-year postoperative views after repair of the distal fracture of composite on left lateral from bruxism habit.

line angles, pencil lines were drawn over the most prominent contours (Figure 19). They were adjusted mesially or distally with a surgical blade, disks, or finishing diamonds to their final location. Moving line angles toward the proximal surfaces makes the tooth appear wider. The line angles on the central incisors generally form a U shape, while the line angles on the lateral incisors form a V shape. These composite restorations were made to be consistent with normally occurring incisor anatomy. When the contours, line angles, and embrasures were finalized, the restorations were polished (Figure 20).

The outcome appeared natural and allowed for a conservative treatment, with all other treatment options still available if this procedure did not work satisfactorily or did not last long enough. At 6 months and 2 years postoperatively, the restorations were functioning well (Figures 21 and 22). The patient was concerned about wanting to touch up the bleaching in the future, even though there had been no relapse at this time. Because trays made on the original casts would no longer fit as a result of the diastema closure and other bonding procedures, a direct

thermoplastic tray was fabricated chairside without casts (EZ Now Tray, Ultradent Products Inc) to satisfy her concerns (Figure 23). The EZ Now Tray uses water heated to boiling in a microwave oven to soften the tray. After the water is heated, the tray is gently “waved” in the water until the anterior flange begins to curl. It is then shaken free of water, and inserted in the mouth without collapsing the tray. When the softened tray is inserted in the mouth and “finger-adapted” to the patient’s teeth, the patient becomes the “vacuum-former,” providing suction with his/her lips, while occluding into maximum intercuspation. When the tray has cooled, the flanges are removed with scissors. The tray is then resoftened in the water, which has now cooled somewhat. The patient again applies suction for the final fit. The anterior handle is then removed with scissors. This tray is available only to dentists either in bleaching kits or in bulk. The tray has a thin but tough anterior portion, with a thicker lingual portion to provide rigidity when softened. The time to fabricate an EZ Now Tray is roughly the same time as making an alginate impression.

At the 4-year recall, the patient had chipped one area on

the composite bonding, which was in occlusal function (Figure 24). Roughing, re-etching, and bonding the same composite material easily repaired this chip. Her previous temporomandibular dysfunction history warranted that a splint was appropriate, so a bruxism splint was fabricated to protect the bonding as well as allow for episodic treatment during stressful times of her life. The patient has been very pleased with her bleaching and bonding experience and enjoys the new look of her teeth.

CONCLUSION

This case report supports previous literature that tetracycline-stained teeth generally take 2 to 6 months for successful bleaching. In this clinical situation, using an in-office 35% hydrogen peroxide to “jump-start” or shorten the treatment time did not alter the outcome, and may incur a nonjustified fee unless the patient has an immediate need for lightening in the next few days. As reported in other articles,^{13,14} higher concentrations of carbamide peroxide may invite increased sensitivity. Sensitivity may be treated using potassium nitrate and fluoride in the bleaching tray in place of the bleaching material.¹⁵ For this

patient, bleaching/bonding was a good conservative first step of treatment for diagnosis of the esthetic potential and may become the final treatment. As many articles have demonstrated,¹⁶⁻¹⁸ bonding should be delayed for 2 weeks postbleaching to allow the tooth shade to stabilize and the bonding to reach its maximum bond strengths. This treatment benefits from the fact that bleaching will occur under existing restorations,¹⁹ so their removal is not required until the bleaching process is completed. Knowledge of esthetic principles of natural teeth is important to harmonize tooth size discrepancies and produce a successful esthetic outcome of any anterior restoration. Bleaching should be attempted on tetracycline-stained teeth because that treatment can be the final solution for the discoloration or can make it easier to achieve an esthetic outcome with subsequent bonding or veneers. ○

DISCLOSURE

Dr. Haywood is a consultant to Ultradent Products Inc, Colgate Oral Pharmaceuticals, Discus Dental, Inc, Block Drug Company, Marion Laboratories, Procter & Gamble, Dental Learning Systems, American

Dental Association, ArchTek, Inc, and GlaxoSmithKline. He has received grant support from Colgate Oral Pharmaceuticals, Ultradent Products Inc, Marion Laboratories, Block Drug Company, and ArchTek Inc. He is a sponsored speaker for Colgate Oral Pharmaceuticals, Ultradent Products Inc, Discus Dental, Inc, Dentsply International, and GlaxoSmithKline. He also received product support from many bleaching companies.

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Product References

Product: Colgate Platinum
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Product: Rembrandt Classic
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Product: Renamel Microfill
Manufacturer: Cosmedent, Inc
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Products: Opalescence Xtra Boost, Sof-Tray,
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1. Some tetracycline-stained teeth may take how long or longer of nightly treatment to achieve a satisfactory result?
 - a. 2 to 6 weeks
 - b. 6 to 8 weeks
 - c. 2 to 6 months
 - d. 2 to 6 years
2. Which discolorations are most difficult?
 - a. Yellow
 - b. Brown
 - c. Gray
 - d. Red
3. Banded discolorations are more difficult than uniform discolorations, especially if the center band is:

- a. yellow.
 - b. brown.
 - c. gray.
 - d. red.
4. Minocycline is the most commonly prescribed and safest drug used in young adults for treatment of:
 - a. facial acne.
 - b. tonsillitis.
 - c. asthma.
 - d. allergies.
 5. For extended bleaching treatment, 7^{1/2}-year follow-up studies have demonstrated no detrimental effects on the:
 - a. tooth.
 - b. pulp.
 - c. patient.
 - d. All of the above.
 6. A log form was used to:
 - a. gather data as to when color change was noticeable.
 - b. note the presence of sensitivity.
 - c. count the number of syringes used with this tray design and arch size.
 - d. All of the above.

7. Options for diagnostic evaluations are:
 - a. using the bleaching casts for a diagnostic wax-up.
 - b. using scotch tape on a photograph to color in the teeth.
 - c. employing computer simulation.
 - d. All of the above.
8. What was used in-office to "jump-start" or shorten the treatment time but did not alter the outcome?
 - a. 10% hydrogen peroxide
 - b. 35% hydrogen peroxide
 - c. 10% carbamide peroxide
 - d. 35% carbamide peroxide
9. Higher concentrations of carbamide peroxide may invite:
 - a. increased sensitivity.
 - b. increased erosion.
 - c. decreased abfraction.
 - d. periodontal-endodontic complications.
10. Bonding should be delayed for how long postbleaching?
 - a. 1 hour
 - b. 1 day
 - c. 1 week
 - d. 2 weeks

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CIRCLE ANSWERS

- | | | | | |
|-----|---|---|---|---|
| 1. | a | b | c | d |
| 2. | a | b | c | d |
| 3. | a | b | c | d |
| 4. | a | b | c | d |
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| 6. | a | b | c | d |
| 7. | a | b | c | d |
| 8. | a | b | c | d |
| 9. | a | b | c | d |
| 10. | a | b | c | d |

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SIGNATURE _____

DATE _____

PROGRAM EVALUATION

Please evaluate this issue's programs by responding to the following statements, using the scale of: (3 = Excellent to 1 = Poor.)

- | | | | |
|---|----------------------|----------------------|----------------------|
| • Clarity of objectives | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| • Usefulness of the content | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| • Benefit to your clinical practice | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| • Usefulness of the references | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| • Quality of the written presentation | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| • Quality of the illustrations | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| • Clarity of review questions | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| • Relevance of review questions | <input type="text"/> | <input type="text"/> | <input type="text"/> |

Please list future CE topic preferences: _____

- Did the lessons achieve their educational objectives? Yes No
- Did the articles present new information? Yes No
- How much time did it take you to complete the CE? _____ min

PRACTICE INFORMATION

- DDS/DMD Full-time registered Hygienist
 Dental Asst. Part-time registered Hygienist
- General Prac. Periodontist
 Oral Surgeon Prosthodontist
 Endodontist Other (includes dentists with
 Pedodontist (nonspecified ADA specialty)

DEADLINE FOR SUBMISSION OF ANSWERS IS 12 MONTHS AFTER THE DATE OF PUBLICATION.

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