

Nightguard Vital Bleaching: Indications and Limitations

a report by

Dr Van B. Haywood, DMD

Professor, Department of Oral Rehabilitation, School of Dentistry, Medical College of Georgia



Van B Haywood, DMD, is Professor in the Department of Oral Rehabilitation, School of Dentistry, Medical College of Georgia (MCG).

He taught at the University of North Carolina School of Dentistry in Operative and Prosthodontics for 12 years before coming to MCG in 1993. He teaches in the Castings course, the Occlusion course and the Esthetics course. He is a member of the American Dental Association, the Georgia Dental Association, the Eastern District Dental Association, and the Augusta Dental Society. He is in the International Association of Dental Research, the Georgia Association of Dental Research, the American Association of Dental Schools, OKU, and the Christian Dental Society. He is a member of the Academy of Operative Dentistry, the American Academy of Restorative Dentistry, and the Academy of Esthetic Dentistry. He is a Fellow in the American College of Dentists and the International College of Dentists.

He is on the editorial board of several peer-reviewed dentistry journals, including the *Journal of Esthetic Dentistry*, and was recently invited to be an Associate Editor of the *Journal of the American Dental Association*. In 1989, he co-authored the first publication in the world on nightguard vital bleaching (NGVB), with Dr Harald Heymann, and in 1997 he co-authored the first article on extended treatment of tetracycline-stained teeth using NGVB. He has completed further research and over 80 publications on the NGVB technique and the topic of bleaching and esthetics. For the last five years, he has been listed in the 'Top Leaders in Continuing Education' by Dental Products Report.

Introduction

The quest for whiter teeth can include a number of treatment options, from bleaching to microabrasion, bonding, veneers or crowns. By far the most conservative treatment, which requires no tooth removal is bleaching. Bleaching can be further divided into three groups: in-office bleaching, nightguard vital bleaching (NGVB), and over-the-counter (OTC) strips and wraps. Nightguard vital bleaching (also known as tray bleaching or at-home bleaching), was formally introduced to the world in the classic 1989 Quintessence article by Haywood and Heymann. Prior to this, essentially the only teeth whitening option that was available was in-office bleaching. Since then, bleaching involving all categories has become a billion dollar industry in the US alone, and is sweeping the world, partially due to the increased awareness of dental esthetics from television and movies. This article will present the indications and limitations for NGVB.

NGVB involves making an alginate impression of the patient's teeth and generating a stone cast. This cast is trimmed such that it has no vestibule and has a hole in the palate or horse-shoe shape (Figure 1). A thin soft tray material is used along with a vacuum-forming machine to fabricate a custom-fitted tray for the patient. The patient applies a bleaching solution (in most cases 10% carbamide peroxide) in the tray nightly, and sleeps with the tray in place for a number of days or weeks, depending on the discoloration.

In comparison, in-office bleaching (also known as chairside teeth whitening), which has existed for over 100 years, involves the isolation of the teeth with a rubber dam or paint-on barrier, and application of 25–38% hydrogen peroxide for up to one hour per appointment. The hydrogen peroxide is activated by heat of light. Over-the-counter products also contain hydrogen peroxide, in a strip or wrap, which is applied for 30 minutes, once or twice a day.

If safety, efficiency and cost to the patient are considered for the three techniques, NGVB is the preferred method. This technique is supported by many safety

and efficacy studies, as well as research on long-term stability, its effects on teeth, and ease of use by the patient. While in-office has a long history of use, it is more expensive and generally requires an average of 3 application visits for maximum whiteness. Although OTC products are less expensive, the patient lacks a proper examination and diagnosis of the cause of discoloration. Moreover, OTC products do not have an ideal barrier such as the custom tray for application, which makes the process take longer than tray bleaching. However, all three techniques will ultimately achieve the same result if used for enough time.

Nightguard Vital Bleaching

This author has had the unusual opportunity in dentistry to watch a new technique grow from infancy into the current status, and observe both appropriate and inappropriate comments from research or lack of research. After using virtually every bleaching option available, this author still prefers 10% carbamide peroxide in a custom fitted tray worn overnight for 2–6 weeks. Patients obtain the maximum benefit per application when the tray can be worn overnight. However, if that is not possible, day-wear should be 2–4 hours, due to the extended peroxide release profile of carbamide peroxide. This author also prefers a product that has many research papers supporting its safety and efficacy, preferably with the 'Seal of Acceptance' of the American Dental Association.

Tray Design

There are a variety of tray designs, and the choice depends on the product used, the patient's concerns or habits, their tooth alignment and their gingival status. Tray designs can be scalloped to follow the free gingival margin, and contain reservoirs or spacers to reduce the tightness of the fit of the tray. However, a non-scalloped, no reservoir tray design is the most comfortable to the patient, provides the best seal against the gingival to retain the material, and uses the least material per application for the same result (Figure 2) Generally, reservoirs are not needed to bleach teeth, but their presence will reduce the tightness of the tray and

may reduce sensitivity. However, more material is used per application, and more time is required to fabricate the tray. Scalloped trays are not as important now that the softer tray materials are available, and non-scalloped trays provide a better seal and are more comfortable, as well as being easier to fabricate. However, higher concentrations of peroxide can cause gingival irritation. A single tooth tray consists of a non-scalloped, no reservoir tray design with the tooth mold removed on either side of the tooth desired to be bleached. If a sticky bleaching material is used, a 'temporomandibular disorder' or 'TMD' tray design will only cover the facial surfaces of the teeth and not involve the occlusal contacts of the mouth. Although there are many tray designs, this author prefers the non-scalloped tray with no reservoirs or spacers as first tray of choice.

Indications

Indications for bleaching include a variety of situations. Teeth can be stained from drinks and foodstuff, or be discolored from birth. NGVB is not only removing extrinsic stains that have become intrinsic, but is also changing the genetic color of the tooth. Mild yellow and brown discolorations are most responsive, while darker colors take longer, and gingival discoloration is the most difficult to resolve. In most bleaching situations, the teeth look very natural after bleaching, with the incisal area normally lighter than the gingival. Canines which may be darker than the traditional half-shade from the lateral incisor can be lightened to more closely match the incisor with tray bleaching. This ability to change the color of the canine is a good indication that the bleaching is changing the genetic color of the tooth, rather than merely removing stains. As patients age, the teeth become more yellow, both from secondary dentin and from staining. Bleaching will provide a younger appearance to the teeth for anyone over 45 years old.

The Tooth is a Semi-Permeable Membrane

Current research has demonstrated that the tooth is a semi-permeable membrane, and both hydrogen peroxide and urea (the ingredients of carbamide peroxide) can pass freely through intact enamel to the pulp in five to fifteen minutes. Other research have demonstrated that the passage through the tooth is rapid, with the dentin changing color as fast at the pulpal interface as it does at the dentoenamel junction. Hence bleaching material enter the tooth regardless of whether there are cracks present in the teeth, and will pass under existing restorations to bleach the entire tooth. When the teeth are being bleached, they will get lighter until they reach a "maximum lightness" for that

Figure 1: Cast trimmed such that no vestibule is present and a hole in the center allows for better adaptation of the soft tray material in the vacuum-forming machine.



Figure 2: A non-scalloped, no reservoir tray in the mouth extends 1-2 mm onto the gingival for a seal, but does not engage an undercut, encroach on a frenum, or end on a rugae.



tooth. After that, further treatment will not make them any lighter. Upon termination of bleaching, the tooth color will relapse about one half shade as the optical qualities return to normal from the dissipation of the oxygen from the tooth that was present during bleaching. After this color stabilization, which takes approximately two weeks, the teeth will remain color stable for years.

Carbamide Peroxide vs Hydrogen Peroxide

To be able to compare the various products and treatment times, the dentist must understand the differences between carbamide peroxide (CP) and hydrogen peroxide (HP) and the relative percentages of both. Carbamide peroxide is composed of hydrogen peroxide and urea. The urea stabilizes the CP, elevates

Figures 3: Prior to bleaching, the patient is informed of the defects on the central incisor.



Figure 4: After tray bleaching, the defect remains, and would need composite bonding to complete the treatment.



the pH during treatment and gives the CP a longer release of peroxide. A 10% CP solution is equivalent to 3.5% HP and 6.5% urea. All components are naturally occurring in the body, and can be easily handled by the body mechanisms in low doses. The more basic difference is that HP releases all its peroxide in 30–60 minutes, hence wear times and application times for HP are in this time range. CP releases 50% of its peroxide in the first two hours, and can take up to 6 additional hours to release the remaining peroxide for bleaching. Hence, CP is a time-release approach to bleaching. This is very important because the tooth can apparently only change color at a certain rate, which differs between patients. Higher concentrations of HP or CP, thought to shorten time, can only do so to the point at which the rate of tooth color changes. After that point is reached, the tooth color cannot change any faster, regardless of the concentration or material. More specifically, the higher concentrations of CP do not markedly alter the rate of tooth color change in a linear fashion. In other words, a 20% CP solution will not bleach the teeth twice as fast as a 10% solution. Moreover, the higher the concentration of peroxide, the greater the chance of sensitivity. Sensitivity is the

primary deterrent to bleaching, and occurs with all products. There is a greater rebound after bleaching with higher concentrations, and there is very little research on the safety and effects on the tooth. Generally, higher concentrations should only be used at the request of the patient, when they have been informed of the side effects and cautions. Regardless of the concentration or product, all bleaching will eventually reach the same color outcome.

Most of the research on safety and efficacy has been conducted on 10% CP. Stability up to 10 years has been reported, and no pulpal or tooth damage was reported. Effects on the teeth are minimal with a neutral pH material, and appear no worse than normally ingested foods and cola or fruit drinks.

The Importance of the Dental Examination

Since discolored teeth can indicate the presence of several pathological conditions, the most important component of the bleaching process is the dental examination. These conditions include abscessed teeth, caries and internal resorption. Bleaching can also mask the indication of other problems, allowing them to progress without treatment. The dental examination is essential to properly diagnosis the cause of the discolorations and prevent improper treatment. The examination should include a screening radiograph of the anterior teeth to evaluate for non-painful abscessed teeth, internal resorption, dissimilar pulp sizes, and other problems. All single discolored teeth should receive a radiograph. Vitality testing may be appropriate, although a tooth with no radiographic evidence of an abscess and no symptoms can be bleached without endodontic therapy with no risk. Once the other pathological conditions are eliminated, the examination also determine appropriate bleaching treatment time for the type discoloration, and identifies existing restorations or defects that will not be affected by bleaching (Figures 3 & 4). The patient often expects bleaching to correct all problems, and must be informed of the additional restorative treatment that may be necessary to harmonize mis-matched restorations or tooth shapes after bleaching.

The examination should also evaluate the translucency of the anterior teeth. Often gray areas are discoloration inside the tooth, but occasionally they can be the dark interior of the mouth showing through a translucent tooth. In this case, the tooth may become more translucent with bleaching, and hence appear darker rather than lighter after treatment. A simple application of the finger to the lingual of the tooth will reveal whether the dark discoloration is translucency or

inherited. If the teeth remain translucent after bleaching, treatment options include bonding composite to the lingual to block the light if the occlusion allows, or facial composites or veneers. Patients should be fully informed of the cost of the potential additional restorations prior to bleaching.

Gray discolorations could also be a result of the patient taking minocycline, a commonly prescribed tetracycline antibiotic for facial skin conditions. There are several reports in the literature of adult teeth staining from minocycline ingestion in their adult years. While these teeth will also bleach, the treatment time is much longer. Additionally, gray discoloration can be caused by lingual or occlusal amalgams showing through the enamel to the facial. The decision should be made as to whether to replace those amalgams prior to bleaching. In some instances the gray discoloration could not be removed after bleaching, and bleaching resulted in the tooth having a greater mismatch of color with the adjacent teeth. When removing the amalgam, all the gray should be eliminated, and the tooth restored with a very light-colored composite. After bleaching, this restoration will blend in with the color of the tooth. Generally, it is preferred to replace composite restorations after bleaching for the best color match. However, the concern for remaining gray discoloration, or extensive decay close to the pulp with sensitivity indicates a pre-bleaching restoration should be placed. If the color does not match after bleaching, often the surface of the composite can be replaced without replacing the entire restoration.

Other Indications and Limitations

Making your patient aware of your ability to bleach their teeth without insulting their current appearance is a delicate procedure. Having questions on the medical history about tooth color happiness, posters in the hygiene room where the teeth are cleaned, or asking the patient if they are happy with their smile are ways to introduce the subject. Patients often ask if they would look better from bleaching. The photographic norm is that when the white color of the teeth matches the white sclera of the eyes, the patient looks very normal. Evaluate the sclera of the eyes relative to tooth color, and use that match as the measure for success rather than the number of shade tab changes (Figures 5 & 6). However, when the patients desire whiter teeth, they should be informed that the root dentin does not bleach well. Patients with exposed root surfaces will still have yellow roots after bleaching. Restorations do not change color from bleaching, nor are they detrimentally affected.

Brown and white discolorations are often caused by

Figure 5: Prior to bleaching, the color of the teeth is darker than the sclera of the eye.



excessive fluoride, either in the naturally occurring water, or from topical application. Brown discolorations can be removed over 80% of the time, so bleaching should be the first choice for brown stains. White discolorations cannot be removed, but the background color of the tooth, upon lightening, will make the white spots less noticeable. White discolorations often go through a 'splotchy stage' during bleaching, where they become more noticeable. However, bleaching should be continued to lighten the remainder of the tooth, and upon termination, the white spots will revert to their original color. Should the white spot be too stark, then either abrasion to remove it, with or without composite bonding to hide it, will be required. Generally, bleaching should be done prior to abrasion, so that if a composite is needed after bleaching, the color has stabilized for two weeks and the bond strengths are back to normal. The only exception to this rule is when the surface is rough and pitted, or it is obvious the stark white discoloration is contained on the surface only.

Single arch bleaching is the preferred treatment approach, since this gives the patient a less-expensive way to initiate the procedure, and provides a good comparison for the progress. Also, since sensitivity often

Figure 6: After bleaching, there is a better color match between the teeth and the sclera of the eye.



This is a reasonable goal to which the patient can better relate than to shade tabs.

Figure 7: Tetracycline-stained teeth do not always get very white, but can improve enough to satisfy the patient's esthetic needs.



involves the smaller teeth, there are less chances of sensitivity on the maxillary arch. Surprisingly, a significant number of patients chose not to bleach the opposite arch, since it does not show during their smiling, even when financial constraints do not exist. Each practice should have a single arch fee for entry level patients. I always start with one arch unless there is

a time constraint for an upcoming event, since some patients cannot remember or easily see an obvious color change. Digital photographs are essential to esthetic dental treatment.

Nicotine stains are much more stubborn to bleach, and generally require 1–3 months of nightly treatment. Tetracycline-stained teeth can require from 1–12 months of nightly treatment, with an average of 3–4 months for most discolorations. The blue-gray discolorations, especially when located at the gingival third, are least responsive. However, research has shown that 6 months of nightly bleaching is not detrimental to the tooth or pulp in 7.5 year recalls, and will provide some color improvement in almost every patient. Since it is impossible to predict the time required, and hence the appropriate fee, a ‘pay-as-you-go’ approach is very successful in treating tetracycline-stained teeth. The patient will pay the initial fee for bleaching of normal teeth for their tetracycline-stained teeth. One bleaching kit in a non-scalloped, no reservoir tray design will afford about one month’s treatment of one arch. The patient records the amount of material used daily, and can determine the monthly need of bleaching material from that record. After the initial dental fee, the monthly fee will only be the material needed and the office visit. The patient continues until their teeth cease to change color, they have reached the desired color, or they are no longer interested in pursuing this option (Figure 7). This approach is both fair to the dentist and to the patient, as predictions for time of treatment for tetracycline staining are very difficult. There are several analogues of tetracycline that can be administered, and each gives a different color to the tooth at the time of administration. Brown and yellow, especially in the incisal or the tooth or uniform discoloration throughout the tooth, are most responsive; gray and blue at the gingival are least responsive. Banded teeth have mixed responses, and may require some composite bonding to cover a particularly unresponsive gray band.

Whether or not the color change in tetracycline-stained teeth or normally discolored teeth will satisfy the patient’s esthetic demands is another question. However, that cannot be determined pre-operatively, so bleaching is the first consideration prior to any additional restorative treatment. Even if veneers are later indicated, placement of veneers is both easier and have a more natural appearance when the veneers can be placed over lighter teeth. Any improvement from bleaching will enhance the appearance of the veneers, especially when uneven reductions are required in malpositioned teeth. Even if veneers have been placed on unbleached teeth, the tooth color can be changed from the lingual, which sometimes gives the veneers a lighter appearance. Over time, veneers may acquire stains at the

margins. Bleaching can also be used to remove these stains prior to resealing the margins with a dentin bonding agent.

Bleaching and Bonding

Bleaching and bonding offers a very conservative approach to management of discolored and mal-formed teeth. Often the bleaching makes the teeth light enough that conservative composite restorations can hide the remaining discoloration or complete the tooth shape successfully. If more aggressive restorations are needed, the patient can now see the benefits to their smile from the initial treatment, and is more willing to continue with other treatments. Bleaching often allows the patient to visualize the additional treatment that is indicated but not readily apparent to the untrained eye (Figures 8 & 9). A combination of conservative treatments is most cost-effective and preserves the natural enamel of the tooth. All other options are still available should bleaching, esthetic recontouring, and bonding not provide the desired esthetic outcome.

Sensitivity

Patients should be informed that 9 out of 10 patients successfully bleach, with the color duration 1–3 years, or even permanent, and up to 2/3 patients may experience some sensitivity. Sensitivity is mainly involved with the tooth, but could be gingival. Treatment of sensitivity may involve reducing the wear time, but more effective results have been obtained with the placement of potassium nitrate in the tray or in the bleaching material. Additionally, pre-brushing for two weeks with a potassium-nitrate containing toothpaste can be even more beneficial. Newer products like amorphous calcium phosphate show promise in sensitivity treatment and restoring gloss to enamel. All side effects cease upon termination of bleaching treatment, with no re-occurrence or additional side effects.

Overall limitations with bleaching are moderate to severe tetracycline staining, especially the dark blue or gray, and when the gingival area is discolored. With white spot fluorosis, only the background will be lightened and the tooth may go through a splotchy stage in treatment. Often extensively restored teeth are a contraindication due to the cost and risk of replacement restorations.

Summary

A guarded prognosis for bleaching involves the following:

Figure 8: Before bleaching, the patient has an unattractive smile, but does not see the problems.



Figure 9: After bleaching, the patient is now interested in closing the diastema for a more attractive smile.



Bleaching is often the gateway to other restorative treatment needs.

- History or presence of sensitive teeth
- Extremely dark gingival third of tooth visible during smile
- Extensive white spots which are very visible
- TMJ dysfunction or bruxism habits
- Translucent teeth or exposed root surfaces

The only contraindications to NGVB are as follows:

- Unrealistic expectations by the patients
- Unwilling to comply with at-home treatment
- Excessive existing restorations not requiring replacement
- Patient will not tolerate taste of product
- Pregnant or nursing mother (for psychological reasons, not physical concerns).

In closing, bleaching or whitening is best performed in a professionally-supervised manner, with a proper examination and diagnosis, using appropriate materials for the patient and situation, with a fair fee for service. Ten per cent carbamide peroxide in a custom-fitted tray is generally the safest, most cost-effective whitening treatment available. Other bleaching treatments may be

indicated based on patient preference, lifestyle, finances, or other limitations, but require informed consent after presenting cost/benefit and risk/benefit ratio. ■