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CLINICAL UPDATE: PROFESSIONALLY-DISPENSED VITAL TOOTH BLEACHING

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COURSE OBJECTIVES

Upon completion of this course, the participant will be able to:

- List the different types of vital tooth bleaching systems that are professionally dispensed
- List the esthetic conditions that can be treated with vital tooth bleaching
- Describe the adverse reactions that have been associated with vital tooth bleaching
- Describe at least three different ways to manage bleaching related tooth hypersensitivity
- Describe how to manage bleaching relapse

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WHO SHOULD TAKE THIS COURSE?

Dentists, Dental Assistants and Dental Hygienists.

INTRODUCTION

Today's patients are better educated than ever before. They understand what dentistry has to offer because the media has educated them. News stories and reality shows have provided our patients with insights on the latest advances and research including periodontal disease and its implications with heart disease, lasers, CAD-CAM, implants, white fillings, porcelain veneers and tooth whitening among others. Also, the internet provides patients with access to information on the advances in dental treatment.

Esthetic dentistry is the major area that our patients are requesting more information about. The types of dental treatments that enhance personal appearances have increased over recent years. With the increase in patient awareness of our ability to improve their smiles, patients have accepted the concept of changing the appearance of their smiles with only a few visits to the dentist.

Esthetic dentistry is elective. Patients no longer need to be dissatisfied with the appearance of their smiles. Esthetic restorative dentistry includes many treatment modalities to change the appearance of teeth. These treatments range from the placement of composite resin restorations, porcelain veneers, tooth whitening, all-ceramic full and partial coverage restorations, porcelain-metal restorations, implants, and removable prosthetic restorations.

ening toothpastes, OTC bleaching products, routine dental prophylaxis, professionally dispensed vital bleaching products, non-vital tooth bleaching and even denture cleaners.

Bleaching can be used as a treatment for teeth that are discolored due to intrinsic and extrinsic staining. Examples of intrinsic staining are endodontic staining and tetracycline induced discoloration. Examples of extrinsic staining of the enamel include fluorosis, yellowing due to aging, hypoplastic enamel, caries demineralization, and staining of teeth due to smoking, ingested food and beverages. (Caries can be both intrinsic and extrinsic staining of tooth structure.)

Professionally dispensed vital tooth bleaching refers to the materials, techniques and devices used for vital bleaching that are dispensed in the dental office. In recent years, patients have shown increased interest in the use of bleaching for treatment of discolored teeth. Bleaching, especially at-home bleaching, has been of interest to dentist and patient alike because it is the most conservative, non-invasive treatment modality currently available to the dental clinician to change the appearance of teeth.

Bleaching is usually used to lighten the shade of teeth that are darkened due to intrinsic and extrinsic discolorations. These techniques can include a variety of concentrations of hydrogen and carbamide peroxide, in-office techniques with and without light or heat enhancement, professionally dispensed whitening strips, and tray bleaching. This article will review the different types of systems, indications and contraindications for vital tooth bleaching and some of the reported adverse effects.

HISTORY & BACKGROUND

The first reports of tooth bleaching occurred as early as 1877.⁽¹⁾ However, the acceptance of tooth bleaching as a non-invasive, conservative treatment for discolored teeth has only gained increasing acceptance during the past 30 years using heated, high concentrations of hydrogen peroxide.^(2,3)

In most cases, the clinical reports describe the use of special heat lamps mounted chairside with the application of the dental dam as a barrier to protect the gingival tissues from the high-concentration, heated hydrogen peroxide. This required the need for multiple office visits (five to seven) and chair time (at least one hour per visit) to attain an acceptable tooth whitening result. Among the adverse reactions reported were tooth hypersensitivity and soft tissue irritation due to the high-concentration hydrogen peroxide seeping under the dental dam.



Fig. 1A



Fig. 1B



Fig. 2

- Fig. 1A The Tray Magic electric soft tray trimmer.
- Fig. 1B Scalloping and trimming the soft vinyl bleaching tray with a Tray Magic handpiece.
- Fig. 2 Bleaching trays without scalloping.

As a result of increased patient awareness, the more conservative technique of tooth whitening with vital bleaching has gained wider acceptance. Tooth whitening refers to any procedure that changes the shade and appearance of teeth without the use of restorative materials. It can include professionally dispensed products and over-the-counter (OTC) patient purchased products. To patients, tooth whitening includes whit-



Fig. 3A



Fig. 3B

- Fig. 3A Preoperative view before bleaching.
- Fig. 3B Postoperative view after two weeks of tray bleaching with take-home whitening.

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The desire for simpler tooth bleaching procedures led to investigations into other types of delivery systems and chemistries to achieve vital bleaching. In 1989, a technique using an at-home mouthguard (tray) with an OTC 10% carbamide peroxide – up to that time used for the treatment of gingivitis – was described as successfully whitening teeth.⁽³⁾ This initial report was followed by the introduction of technique-specific carbamide peroxide gels for vital tooth whitening for use in mouthguards.

As with any new procedure presented to the dental profession, there were concerns about the safety, efficacy and longevity of these bleaching techniques with peroxide materials. Both the United States Food and Drug Administration and the dental profession raised these issues.⁽⁴⁻⁶⁾ Subsequent research has adequately addressed these concerns and demonstrated the safety and effectiveness of tooth whitening with peroxide products.⁽⁷⁻¹⁰⁾ Based on a comprehensive review of the available literature and research, the use of tooth whitening products containing hydrogen peroxide and carbamide peroxide does not appear to pose an increased risk of oral cancer in the general population, including those persons who are alcohol abusers and/or heavy cigarette smokers.⁽¹¹⁾

By 1995, a survey of 8,143 dentists reported that 91% provided vital tooth bleaching in their dental practices.⁽¹²⁾ Seventy-nine percent of these dentists reported success with tooth whitening. Among the side effects reported by the respondents were the following: 62.2% noted tooth sensitivity 10.7% of the time; 45.9% reported soft tissue irritation 5.6% of the time, 2.1% noted systemic effects 0.2% of the time, and 18.8% reported no side effects.

During the early days of tray (mouthguard) vital bleaching with carbamide and hydrogen peroxide bleaching agents, studies demonstrated efficacy and safety with these agents.⁽¹³⁻¹⁹⁾ In all cases, the agents evaluated lightened the color of the teeth safely and effectively with minimal, transient adverse reactions reported. When the bleaching procedure was completed, these adverse reactions that were reported during treatment were no longer present. (Adverse reactions will be covered later in this article.)

With the dental profession's increased acceptance of vital tooth bleaching and tooth whitening with other products, the American Dental Association issued a report in 1994 (revised in 1998) on the guidelines for safety and efficacy criteria for peroxide-containing products to include their use for tooth bleaching. Any product meeting these criteria was eligible for the ADA's Seal of Acceptance. To receive the seal, a company would have to submit safety studies and two clinical trials demonstrating at least two value-oriented shade increments of change when the bleaching recommendations were followed.⁽⁵⁾ To date, the majority of bleaching products that obtained the seal are 10% carbamide peroxide gels designed to be used with a tray delivery.

MODERN DAY BLEACHING

The original concept of professional vital bleaching started with well-fitted, custom-made trays made from patient impressions and casts and used as vehicles to hold a 10% carbamide peroxide gel. Today, the clinician has many choices for providing patients with at-home tooth bleaching materials and techniques. These include a variety of different type tray and trayless systems, each providing for the delivery of either hydrogen or carbamide peroxide in a wide

range of concentrations.

When comparing the chemical concentration of hydrogen peroxide to carbamide peroxide, an approximate formula ratio to use is that 3% hydrogen peroxide is approximately equivalent to 10% carbamide peroxide.

During the past decade, a number of different peroxide bleaching products have been introduced for professional dispensing. There have been modifications in the chemistry to make the available peroxide longer lasting for overnight tray bleaching.^(20,21) The addition of a carbopol to carbamide peroxide vital tooth bleaching gels extend the bleaching potential of the gel over as long as 8 hours.⁽²²⁾ This allows the clinician to make the recommendation to patients that a tray with a carbamide bleaching gel can be worn overnight. This is not true of hydrogen peroxide based vital tooth bleaching products. Hydrogen peroxide will lose more than 50% of its bleaching potential within 30 minutes. This chemical degradation over the course of 30 minutes is responsible for the recommendation that products employing trayless strip technology, e.g., Crest Whitestrips, be worn for only 30 minutes at a time. Also, most manufacturers have made available a range of higher concentrations of peroxides both carbamide peroxide and hydrogen peroxide to decrease the wear time of the tray and/or decrease the time necessary to achieve the final whitening result. Higher concentration hydrogen peroxides (25%-35%) are used for in-office bleaching with and without light and heat enhancement.

BLEACHING "STRIPS"

In recent years, manufacturers have developed novel, trayless methods using plastic strips that release stored hydrogen peroxide for bleaching teeth. The first product introduced in the professional category was Crest Whitestrips (Procter and Gamble), created specifically for in-office dispensing. Later, a version of Whitestrips was made available over-the-counter.

Strips for whitening teeth usually extend from canine to canine the maxillary and mandibular arches. They also work best when the teeth are well-aligned. Professionally dispensed Whitestrips are a higher concentration than OTC Whitestrips. There are many OTC products for whitening teeth. This article will be limited to in-office treatment.

PATIENT SELECTION

When treatment planning for successful esthetic treatment of tooth discolorations, it is important to select patients with conditions that have the best prognosis for success. Key factors that have an effect on the final result include (a) concentration of the bleaching agent, (b) duration of use of the bleaching agent,



Fig. 4A



Fig. 4B

Fig. 4A Preoperative view before bleaching.

Fig. 4B Postoperative view after six weeks of tray bleaching with GC TION take home (GC America).

(c) type of tooth discoloration, (d) color of the teeth and (e) the patient's age.⁽⁸⁾ It has been reported that tooth discolorations with the best prognosis for whitening are:

1. Yellowing of the teeth without any systemic or developmental cause (food, smoking, aging staining);
2. Mild fluorosis staining;
3. Mild tooth darkening due to trauma;
4. Mild tetracycline staining^(17,18)

Regarding #4, it has been reported that moderate to severe tetracycline discoloration can be lightened in shade with overnight use of a vital mouthguard bleaching over a period of 6 months.⁽²³⁾ Many dentists are using vital tooth bleaching as an adjunct to their esthetic bonding procedures. For patients dissatisfied with tooth



Fig. 5



Fig. 6



Fig. 7

Fig. 5 In-office, one-hour whitening using 35% hydrogen peroxide bleaching system.

Fig. 6 Preoperative view before one-hour professional tooth whitening.

Fig. 7 Cleaning the teeth with TiON non-fluoridated prophylaxis paste.

malposition and shape combined with discolorations, lightening the shade of teeth first with bleaching makes masking tooth discolorations less difficult. It is important before any bonding procedure that bleaching be discontinued for at least one week prior to the restorative treatment to prevent interference with bonding adhesion and material setting.⁽²⁴⁻²⁷⁾

AT-HOME TRAY BLEACHING

When professional vital tooth bleaching using trays for at-home use was first introduced to the profession, there were concerns over adverse reactions and patient complaints. The adverse reactions and patient complaints included the taste of the bleaching gel itself, gingival irritation, uneven tooth bleaching, a splotchy appearance of the teeth during the initial stages of bleaching and tooth

hypersensitivity while bleaching. These issues have been investigated and research has provided a better understanding. In response, manufacturers of tooth bleaching products have made changes in technique recommendations and product components to address these issues.

Clinician and patient complaints concerning issues of taste have been addressed with an expanded selection of better flavors for improved patient acceptance. Gingival irritation has been seen with trays that were poorly fabricated either due to inaccuracy of casts or due to the need for scalloping the tray for higher concentrations of hydrogen and carbamide peroxide bleaching gels.⁽²⁸⁾ During the initial bleaching, especially with higher concentrations of tray bleaching gels, the reported splotchy or uneven appearance of the teeth disappears after the first week of bleaching.

Tooth sensitivity during bleaching is the most often reported adverse reaction. In clinical research studies, tooth sensitivity during bleaching—either with at-home tray delivery and in-office procedures—has been reported in the range of 18%-78% of patients.⁽²⁹⁻³¹⁾ The sensitivity due to tooth bleaching in clinical observations suggest that it is transient with no long term effects.⁽³²⁾ Some clinicians initially believed that this transient sensitivity was due to gingival recession; it has since been shown that gingival recession is not a factor in the occurrence of tooth hypersensitivity when bleaching.⁽³³⁾ There was no significant difference in reported sensitivity while bleaching based upon the presence or absence of gingival recession.

To minimize tooth sensitivity during vital tooth bleaching, the clinician can recommend a decrease in wearing time for the first week: not more than one hour per day for carbamide peroxide products or, for higher concentration hydrogen peroxides, as little as 15 minutes. As an alternative to shorter wearing times, lower concentrations of peroxide may be used instead.

A 5% potassium nitrate (KNO₃) formulation has been shown to be an effective desensitizer in toothpastes.^(34, 35) Noting this, a number of manufacturers have added 5% KNO₃ desensitizing agents to their bleaching gels. The addition of KNO₃ to a bleaching gel fails to account for the fact that the desensitizing effect of KNO₃ is due to extended use.^(29, 36) Two effective strategies using a KNO₃ desensitizing toothpaste that have been clinically evaluated are brushing with the desensitizing toothpaste for two weeks prior to initiating bleaching⁽²⁴⁾ and having the patient place a sensitivity toothpaste containing a 5% KNO₃ one week prior to the initiation of bleaching in the tray that will be used for bleaching for 30 minutes a day.⁽³⁷⁾ Both of these strategies take into account the mechanism for desensitizing that KNO₃ provides. Another strategy is to have a patient use a professionally dispensed desensitizing gel with 5% KNO₃ for use with bleaching.⁽³⁸⁾

Amorphous calcium phosphate (ACP) has also been shown to be an effective desensitizer.^(39,40) Recent research has shown that a paste (MI Paste, GC America) containing Recaldent, a casein phosphopeptide-amorphous calcium phosphate (CPP-A CP), has been effective in reducing tooth sensitivity due to bleaching.^(37,41) One manufacturer has introduced bleaching products that contain ACP. A research study evaluating these ACP-containing bleaching gels demonstrated that ACP could be added to a 16% carbamide peroxide bleaching gel with significant reduction in clinical measures of dentinal hypersensitivity both during and after treatment.⁽⁴²⁾

Over the years, there has been controversy over which tray is best. When tray bleaching was introduced, the trays were fabricated from thin and thick flexible vacuum forming materials and thin, rigid plastic materials. Some manufacturers created a foam lined tray, believing it would hold the bleach on the teeth more effectively. One can conclude the following from the current research that has evaluated a wide variety of tray configurations and types, and duration of wearing the tray:

- Thin, flexible, vacuum-formed materials are the standard;
- The use of spacers on the stone model to create reservoirs is not necessary, but the use of reservoirs will lead to the patient swallowing less of the bleaching gel;^(43, 44)
- Scalloping the tray to follow the gingival contours is not nec-

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essary when using a 10% carbamide peroxide, but should be done for higher concentrations of carbamide peroxide or hydrogen peroxide equivalents. Over-trimming the tray, leaving a portion of the tooth uncovered, is not a problem because the bleach will penetrate beyond the tray;⁽⁴⁵⁾

- Custom fitted trays provide improved bleaching gel-tooth contact;⁽⁴⁴⁾
- Most companies provide bleaching gel for a two-week time of application;
- Higher concentrations of carbamide peroxide bleach worn in a tray show faster initial improvements, but over a six-week period of time comparing 10% carbamide peroxide to higher concentrations, there is no difference in the final result;^(46,47)
- The concept of teeth lightening to a final certain level has been termed the “inherent lightness potential” of a tooth; there is an endpoint to how much lighter teeth will get;⁽⁴⁷⁾
- In most cases, moderate and dark tetracycline staining can be treated with bleaching over an extended time of 3-6 months;^(48,49)
- Concern over the effectiveness and bleaching potential with overnight tray wearing has been addressed. A degradation in peroxide concentration occurs over time when a tray is worn overnight but the bleaching agent is still effective. Hydrogen peroxide has a greater than 50% degradation within 30 minutes, while carbamide peroxide bleaching gels can be used overnight;⁽²²⁾
- 10% at-home carbamide peroxide bleaching gels are clinically safe when exposed to enamel, dentin, root surfaces, ceramics, cast metal and composite resins.⁽¹⁰⁾ There is one case report of greening of amalgam during bleaching.

At-home tray bleaching requires a number of steps for success including accurate study casts, trimmed to allow for a vacuum down, thin, flexible mouthguard to be fabricated. When doing tray bleaching, it is important that the casts be inspected to be certain there are no irregularities, bubbles, or distortions. For tray fabrication, stone casts should be trimmed, leaving a minimal base to ensure an accurate adaptation of the thin, soft vinyl mouthguard/tray material. Using a vacuum unit, the bleaching tray can be fabricated using 0.040-inch thick, 5” X 5” clear ethyl vinyl acetate sheets. One excellent vacuum unit is the Sta-Vac II unit (Buffalo Dental). It is a workhorse vacuum unit to fabricate bleaching trays, athletic mouthguards, templates for implants, orthodontic retainers, among others.

Once the tray is vacuumed on the cast, it can be easily trimmed on the cast using a Tray Magic (Premier) electric, soft tray trimmer to leave a scalloped tray that follows the free margin of the gingival on both the facial and lingual surfaces, leaving all of the gingival tissues uncovered by the tray. (Fig. 1) By trimming the tray on the cast, there is less concern about distortion that occurs when trimming with a scissor. The trays should be free of loose plastic tags. Scalloping of the tray is especially important with any of the higher concentration bleaching gels.^(39,43) When using concentrations of 10% carbamide peroxide, the tray can be trimmed, leaving a 0.5 – 1.0 mm extension from the free gingival margin.(Fig. 2)

The patient should be instructed on the how to place the bleaching gel in the trays and how to remove any excess gel after insertion. Although the duration for wearing the tray will vary, at least one

hour of wear time a day for two weeks will provide up to 90% of the whitening effect for most patients. (Fig. 3) Research has shown that a bleaching endpoint will be reached at six weeks independent of the concentration and type of peroxide used. (Fig. 4) Table 1 contains a partial listing of at-home, professionally dispensed bleaching products.

IN-OFFICE, ONE-HOUR WHITENING

The first bleaching of teeth to change color was done using an in-office procedure. Currently, the most popular systems for in-office bleaching use high-concentration hydrogen peroxides that provide what is often referred to as “one-hour bleaching.” These high-concentration hydrogen peroxides range from 25%-35%. In-office bleaching can be provided to patients as either a single-visit 1-1 ½ hour treatment or a multiple visit procedure.⁽⁵⁰⁻⁵³⁾ One can use one of the light-enhanced bleaching techniques, a laser activated bleach or merely a paint-on bleaching gel or solution.

For the in-office light enhanced systems, usually the light can only be used for bleaching (BriteSmile, Discus Dental; LumaArch, LumiLite; Zoom 2, Discus Dental). One light system is based upon a plasma arc high intensity photopolymerization device (Sapphire PAC Light, DenMat) that can be used for in-office whitening and for resin photopolymerization.

In-office professional whitening can be a perfect complement to the at-home whitening system you are using. There are many patients who cannot find the time to apply trays or strips in their busy lives. In-office whitening offers them the convenience of whitening their teeth in one or more dental appointments.

How effective is in-office bleaching? Studies have been done to compare in-office bleaching to at-home tray bleaching.^(54,55) At-home tray bleaching usually gives the best final result. The results of in-office bleaching with light enhancements have been controversial. Within the dental literature, there are conflicting studies as to whether or not high-concentration hydrogen peroxide bleaching compounds are ef-



Fig. 8A



Fig. 8B



Fig. 9A



Fig. 9B

- Fig. 8** Gingival Protector gingival mask being applied.
- Fig. 9A** Application of a thin coating of Reactor with V-CAT photo-catalyst.
- Fig. 9B** Use of the air syringe to remove excess Reactor from the tooth.



Fig. 10



Fig. 11



Fig. 12



Fig. 13

- Fig. 10** The Whitening Gel syringe and Whitening Liquid syringes are joined together for mixing and activating the bleaching gel.
- Fig. 11** Application of the Bleaching Gel to the teeth in a thickness of 0.5-1.0 mm.
- Fig. 12** Light activation of the bleach.
- Fig. 13** Removal of the bleaching gel with a cotton gauze.

(similar to flowable composite resin) that is painted over the gingival tissues and light cured.

Concerns have been expressed that one-hour whitening with light enhancement is not different from whitening without the light: multiple visits are needed, one week at-home tray whitening is recommended after the in-office procedure and sensitivity remains an issue during this chairside procedure.^(52, 54, 55, 62, 63) If this is the case, why use a light?

effective.^(56, 57) Some studies have shown that the use of a light-activated/enhanced bleaching product provides better whitening^(50, 51, 58) while other studies demonstrate that there is no benefit to using an accessory light.⁽⁵⁸⁻⁶⁰⁾

There are a variety of one-hour whitening systems and products available. The techniques for one-hour whitening vary from product to product. In most cases, the in-office vital tooth bleaching products are 25-35% hydrogen peroxide gels. The use of high-concentration hydrogen peroxide gels intra-orally requires that specific safety protocols be used. First, the patient must be wearing eye protection and the gingival soft tissue adjacent to the procedure must have a barrier placed. (Fig. 5) Some lights generate heat and/or UV rays, so a rubber dam napkin can be used to shield the face from the light source. In some cases, the manufacturers provide moisturizers for the lips or sunscreen as protection from the UV rays. While a dental dam would be ideal, as was seen with earlier bleaching techniques, the placement of a dental dam will inhibit the bleaching of the cervical areas of the teeth and patients may therefore be dissatisfied since they naturally want their entire visible tooth surface to get whiter. Manufacturers have responded by providing barrier protection in the form of a light-cured resin

The use of a light to enhance vital tooth bleaching is important in the dental practice because the patient expects to see the light. Our patients do not live in closets. They have seen articles in the newspapers and magazines and watched the extreme makeover television shows where the light is being used. Even though the research on light-enhanced bleaching is not definitive, patients expect its use. Without the light, they will wonder if they are getting the proper care. There is no harm in using the light and many look upon light enhanced bleaching to be important for patient satisfaction and marketing.

CASE REPORT

A 25-year-old patient desired tooth whitening. She had just completed orthodontic treatment and felt that her teeth had gotten darker. (Fig. 6) After a complete oral examination and evaluation, the patient was determined to be a good candidate for vital tooth bleaching. The patient was presented with different treatment options including tray whitening and in-office vital bleaching. For this patient, at-home tray bleaching did not fit her busy schedule. While there are many options for one-hour tooth whitening for this case, it was decided to use a new in-office bleaching agent, TiON (GC America).

TiON uses the photo-catalyst "V-CAT" to enhance bleaching effectiveness.⁽⁴¹⁾ V-CAT is a nitrogen-doped, titanium dioxide that was developed by Toyota Central R&D Laboratories and is more effective than standard titanium dioxide photo-catalysts used in the past. V-CAT has a high photo-catalytic activity under both UV and visible light irradiation. When used according to the manufacturer's directions, the V-CAT technology produces color changes (whitening) of the teeth when the bleaching agent is exposed to a dental curing light or a bleaching light system. The V-CAT chemistry is activated by UV and visible light irradiation, and the hydrogen peroxide contained in the whitening gel is rapidly converted to OH and O radicals by the V-CAT.

The TiON system involves the following steps: (1) cleaning the teeth with the TiON prophylaxis paste, (2) applying a lip balm to the patient's lip, (3) isolating with cotton rolls or using a lip retractor and then create a gingival mask with the Gingival Protector, (4) dispensing the Reactor in a dispensing dish, (5) applying the Reactor to the tooth surfaces, (6) connecting the Whitening Gel syringe to the Whitening Liquid Syringe and mixing the two together, (7) applying the Whitening Gel to the teeth, (8) irradiating the teeth and (9) removing the Bleaching Gel.

Before starting treatment, all extrinsic stain was removed from the teeth with a dental oral prophylaxis using the non-fluoridated prophylaxis paste provided in the TiON kit. (Fig. 7) The teeth were rinsed and dried. A lip balm was applied to the patient's lips. To protect the gingival during the tooth whitening procedure, the Gingival Protector (GC Dental), a light-activated flowable resin, was applied from second premolar to second premolar on both the maxillary and mandibular arches and light cured. (Fig. 8) For ease of application, no more than two teeth were isolated at a time and light cured until all of the teeth being bleached were isolated at the attached gingival tissues before initiating the bleaching procedure.

The teeth were now ready for the bleaching procedure. Five drops of Reactor were applied to the dispensing dish. Reactor is the innovative photo-catalyst V-CAT, which provides enhanced whitening power to the TiON bleaching system. Each tooth was painted with a thin

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layer of the Reactor with a disposable brush. (Fig. 9A) Using dried forced air from an air syringe, all excess Reactor agent was removed from the tooth surfaces. (Fig. 9B) The Whitening Gel syringe and Whitening Liquid syringe from the kit were screwed together using their bayonet mount and connected together. (Fig. 10) The two reagents were combined by injecting all of the gel into the liquid syringe. Then, to mix the two reagents, the liquid was injected into the gel syringe and the mixing process was repeated twenty times for a thorough mixing of the bleaching agents. At the final mix, all the bleaching agent was in the gel syringe.

With mixing complete, the special syringe tip was placed onto the Whitening Gel syringe. Using the special tip the Whitening Gel was applied onto the teeth to be whitened to a thickness of 0.5-1.0 mm. (Fig. 11) Light activation can be done with either a curing light (LED, halogen, plasma arc) or a bleaching light (metal halide). Place the light source as close to the tooth/teeth as possible and irradiate the teeth with a curing light for one minute per tooth or a bleaching light for twenty minutes for both arches simultaneously. For this treatment, the Bleaching Gel was activated with a halogen curing light, one minute for each tooth. (Fig. 12) After light activation, the bleaching gel was removed from the teeth by wiping the gel from the teeth from cervical area to incisal edge. (Fig. 13)

As part of the procedure and to assure no tooth sensitivity due to the whitening process, MI Paste (GC America), a casein phosphopeptide- amorphous calcium phosphate (CPP-ACP), was applied to the teeth using a gloved finger and rubbed into the facial tooth enamel surfaces. (Fig. 14) MI Paste can also be applied with a prophylaxis cup or using a tray. The MI Paste was left on the teeth for five minutes and then rinsed off. Recent research⁽³⁶⁾ has shown that the use of MI Paste almost eliminates tooth sensitivity and there is evidence that it will minimize shade relapse after whitening.

After completion of the TiON treatment, it was noted that the patient had lightened her teeth by six shades. She was happy with her new smile. (Fig. 15) Since she was wearing a clear, hard, custom-made orthodontic tray-retainer, it was decided to continue whitening with the GC TiON Whitening System Take Home kit used her orthodontic retainer.

The TiON in-office bleaching process can be repeated at



Fig. 14 Application of the MI Paste to minimize tooth sensitivity and prevent bleaching relapse.

the same appointment or during another appointment using the mixed bleaching gel if desired. For darker discolored teeth, a dentist may desire repeating the procedure up to three times in a single visit. If the procedure will be repeated during another dental visit, the bleaching gel should be stored in a refrigerator between uses.

BLEACHING RELAPSE

From all clinical and research accounts, tooth whitening with the latest generation of vital bleaching products is effective and safe^(13-19, 21, 50, 51, 59, 60, 64, 65) also relatively long lasting. Still, bleaching relapse has been reported. With in-office bleaching, CRA reported relapse rates of 41% at one year.⁽⁶⁰⁾ For tray bleaching, Haywood reports 26% at 18 months.⁽⁶⁶⁾ Others have reported varying degrees of bleaching relapse over time.⁽⁶⁷⁻⁶⁹⁾ To prevent bleaching relapse, a patient would have better success with a power toothbrush and whitening toothpaste instead of manual tooth brushing.⁽⁶⁷⁾ Bleaching can be maintained through the use of whitening toothpastes and bleaching toothpastes with yearly touch-up bleaching using a peroxide bleaching agent in the patient's custom fitted tray.

BLEACHING SHADES FOR RESTORATIVE DENTISTRY

As more patients seek bleaching as their tooth whitening solution, there will be new challenges for matching shades with porcelain and composite resin. Many of the composite resin systems now have bleaching shades for better color matching. Also, the Classical Vita Shade Guide had its lightest shade B-1 which in many cases was not light enough to match bleached teeth. Vident has introduced its new Bleachedguide to meet this challenge.

For indirect restorations, patients should be instructed to discontinue bleaching to stabilize the shade of their teeth after the impression is sent to the laboratory with a chosen shade. Also, as part of the bleaching procedure, the patient needs to understand that while the teeth may lighten, the materials in the restored teeth will not.

CONCLUSION

Vital tooth bleaching is an effective treatment modality that can change the appearance of teeth. Patient satisfaction has been demonstrated after use of both professionally-dispensed bleaching treatments and OTC products. Based upon the clinical results reported with professional vital tooth bleaching, it is a viable, esthetic treatment for the discolored dentition.⁽⁶⁸⁾ Its conservative nature and little if any risk make it an important part of an esthetic dentistry treatment plan.



Fig. 15 Postoperative view at the completion of bleaching demonstrating a shade change of six shades.

CUT ON DOTTED LINE

MAINTAINING WHITENED TEETH:

MINIMIZING BLEACHING RELAPSE

- Use a whitening toothpaste to remove surface stains and prevent yellowing with a power toothbrush
- Brush or rinse immediately after consuming stain-causing beverages or foods
- Use a straw to drink beverages that stain, such as coffee, tea, colas and red wine
- For woman, wear a bright shade of lipstick – blue or pink based – to make teeth appear whiter. Avoid orange or brown shades
- Check whether you need a touch up. Depending upon the whitening method used, you may need a touch up in six months or after a year or two. If you smoke or drink coffee, you may need a touch up more often.

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SELF-TEST

1. **Professionally dispensed vital tooth bleaching refers to:**
 - A. materials used for bleaching that can be bought in the oral care section of pharmacies
 - B. materials used for bleaching that can be purchased over the internet at special web sites
 - C. any bleaching service that can be purchased in drive-in centers
 - D. materials used for vital bleaching that are given to the patient after an evaluation and diagnosis in the dental office
2. **According to this article, tooth whitening refers to:**
 - A. placing porcelain veneers
 - B. placing composite resin restorations
 - C. any procedure that changes the shade and appearance of teeth without restorative materials
 - D. adhesive bonded restorations that change a tooth's appearance
3. **The most conservative treatment for tooth discoloration is:**
 - A. porcelain veneers
 - B. bleaching
 - C. composite resin veneering
 - D. ceramic crowns
4. **Bleaching is a technique to lighten the color of teeth darkened by:**
 - A. intrinsic staining
 - B. extrinsic staining
 - C. entopic staining
 - D. a and b
5. **All of the following are examples of tooth discolorations due to intrinsic staining EXCEPT:**
 - A. Tetracycline induced staining
 - B. endodontic staining
 - C. enamel hypoplasia
 - D. caries
6. **Tooth bleaching was reported as early as:**
 - A. 1877
 - B. 1905
 - C. 1935
 - D. 1973
7. **Early bleaching techniques used heated, high concentrations of hydrogen peroxide. Clinical problems and adverse reactions with this technique included:**
 1. multiple office visits (five to seven)
 2. allergic reactions
 3. soft tissue irritation due to the high concentration of bleach
 4. tooth hypersensitivity
 5. caries formation
 - A. 2, 4 and 5
 - B. 1, 3 and 4
 - C. 2, 3 and 5
 - D. 1, 2, 4 and 5
 - E. 1, 2, 3, 4, and 5
8. **With vital tooth bleaching, adverse reactions were reported by patients. The highest reported adverse reaction during tooth whitening with bleaching was:**
 - A. gingival irritation
 - B. tooth sensitivity during bleaching
 - C. trays are difficult to insert
 - D. bad taste of bleach
9. **Vital tooth bleaching using a tray and low-concentration peroxide was first described in the dental literature of what year?**
 - A. 1877
 - B. 1935
 - C. 1989
 - D. 1995
10. **The American Dental Association has issued guidelines for vital tooth bleaching and whitening products. To receive the American Dental Association seal of acceptance for a whitening**

SELF-TEST (cont'd)

- product, a manufacturer must submit:
- two clinical trials demonstrating at least two value oriented shade increments of change
 - safety studies
 - a and b
 - none of the above
- 11. Trays fabricated from thin, flexible vinyl materials are the standard for vital tooth bleaching. Scalping of trays:**
- is done to provide the patient a more visually appealing tray
 - is not necessary when bleaching, regardless of concentration
 - is done only in conjunction with in-office, light enhanced bleaching
 - is done for at-home tray bleaching with higher concentrations of carbamide peroxide and hydrogen peroxide gels
- 12. A number of trayless systems for professional dispensing have been introduced. One of the most popular is Crest Whitestrips. Drawbacks to bleaching with strip-type systems are that they:**
- are difficult to apply when there is anterior tooth misalignment
 - don't work as effectively as tray vital bleaching
 - can only whiten the six anterior teeth in the maxillary and mandibular arches
 - A and B
 - A and C
- 13. In-office bleaching with TiON in-office (GC America) uses as its active bleaching agent:**
- 10% sodium hypochlorite
 - 45% carbamide peroxide
 - 25% hydrogen peroxide
 - 15% carbamide peroxide
- 14. TiON in-office bleaching uses a unique photo-catalyst, "V-CAT," that is activated by a light source. V-CAT is:**
- a vitriolic catalyst
 - a nitrogen-doped titanium dioxide
 - a light and heat sensitive catalyst that contains tertiary amines
 - a vernolium photoinitiator sensitive to UV, IR and visible light
- 15. In the TiON in-office bleaching system, the Reactor refers to:**
- The oxidizing agent for the bleaching procedure
 - The reducing agent for the bleaching procedure
 - The V-CAT photo-catalyst
 - The paint-on, soft-tissue protector
- 16. In-office bleaching typically use as the bleaching agent a:**
- calcium peroxide
 - hydrogen peroxide
 - sodium perborate
 - sodium hypochlorite
- 17. Tooth hypersensitivity is an adverse reaction reported by patients during tray-based, vital tooth bleaching. Tooth hypersensitivity:**
- will increase and continue after treatment
 - may cause the need for endodontic treatment
 - is transient and is no longer present when the treatment is completed
 - is directly related to gingival recession
- 18. To minimize tooth sensitivity during vital tooth bleaching for patients with sensitivity, a clinician can recommend that the patient:**
- decrease the time the tray is worn the first week
 - use lower concentrations of peroxide bleaching gels with a desensitizing agent
 - use a desensitizing toothpaste 30 minutes per day, beginning one week before starting bleaching
 - use a professionally dispensed desensitizing gel for use with bleaching
 - all the above
- 19. Patients who have the best prognosis with vital bleaching include those with all the following diagnoses EXCEPT:**
- Yellowing of the teeth with a systemic or developmental cause
 - Mild tetracycline staining
 - Mild fluorosis staining
 - Discolored porcelain
- 20. Bleaching relapse has been reported in the literature. According to the references in this article, the expectation of relapse is:**
- 15% with one-hour whitening at one year; 8% with at-home whitening at 18 months
 - 23% with one-hour whitening at one year; 12% with at-home whitening at 18 months
 - 41% with one-hour whitening at one year; 26% with at-home whitening at 18 months
 - 55% with one-hour whitening at one year; 43% with at-home whitening at 18 months

Clinical Update: Professionally-Dispensed Vital Tooth Bleaching

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19. (A) (B) (C) (D)

20. (A) (B) (C) (D)

CUT ON DOTTED LINE