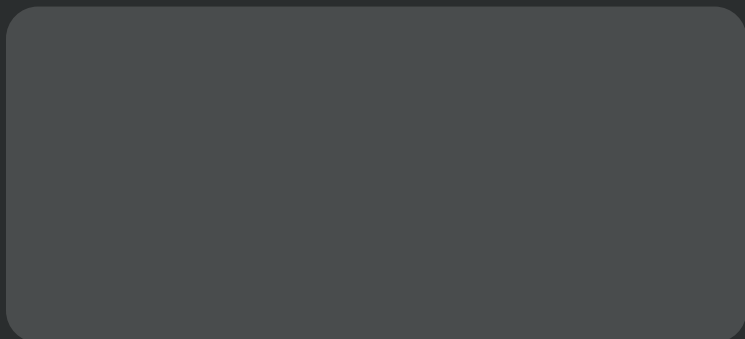




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Teeth whitening: Antiquated to present-day

A peer-reviewed article written by Lacy Walker, RDH, CDA, FAAOSH



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Teeth whitening: Antiquated to present-day

Abstract

For centuries, white teeth have been a sign of wealth, beauty, and privilege. Society has long been obsessed with the esthetics associated with whiter teeth, and the number of products available to achieve this has steadily increased due to popularity and technological advances. Stain, both intrinsic and extrinsic, is multifactorial. There are numerous whitening products on the market, and formulations and ingredients have evolved over the years. This course will help clinicians understand the teeth whitening products and procedures available and will cover the differences between in-office and at-home products, hydrogen peroxide and carbamide peroxide, technological advancements, and the pros and cons of whitening.

Educational objectives

1. Explain the history of teeth whitening.
2. Discuss the etiology of intrinsic and extrinsic stains.
3. Explain the difference between hydrogen peroxide and carbamide peroxide.
4. Describe the difference between in-office whitening, take-home whitening, and laser whitening.
5. Recognize the indications and contraindications for whitening and possible side effects.
6. Select the proper whitening procedure that is best suited for each patient's needs.



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Introduction

Teeth whitening is the most common cosmetic request in almost every dental office. The general population wants whiter teeth and a perfect smile, but there's more to consider than just bleaching or whitening the teeth. Some oral health factors to consider before patients decide to proceed with any whitening procedures are periodontal disease, crowding, medical history, and current restorations (e.g., fillings, crowns, and veneers).

History

Around 5000 BC, ancient Egyptians created a whitening paste composed of ground pumice stone mixed with vinegar. The ancient Romans, who placed great value on having white teeth, used urine as a mouthwash.¹ The ammonia in urine was considered a bleaching agent that lifted stains due to its acidity, and pumice stone mixed with vinegar allowed surface stains to be removed through chemical and mechanical measures.^{1,2} In 3000 BC, people brushed with "chew sticks" made of small twigs to assist in removing particles from teeth.² In the 1700s, barbers filed teeth surfaces and applied nitric acid, and in the 1800s, dentists used oxalic acid, causing extensive tooth damage in the process.³

Nonvital tooth bleaching began in 1848 with the use of chloride of lime, also known as calcium hypochlorite.¹ In 1864, Dr. James Truman introduced the most effective technique for bleaching nonvital teeth, a method that used chlorine from a solution of calcium hypochlorite and acetic acid.^{4,5}

In 1965, a rubber dam was used in combination with hydrogen peroxide and a heat lamp to whiten teeth.⁶ Dr. Van B. Haywood was the first to introduce nightguard vital bleaching (NGVB) in 1989, which involved the application of 10% carbamide peroxide in thin custom-fitted trays.^{6,7} This method uses trays worn at night or at a minimum of two to four hours per day because the material is active for four to 10 hours.^{6,7}

The formulations made in the cosmetic industry have evolved throughout history and have continuously improved with technological advances. There are many beliefs and psychological reasons for whitening teeth as a social prerogative:

confidence, self-esteem, and quality of life. Teeth staining can have negative psychological effects and can take a toll on one's social life. A brighter, whiter smile can also impact one's life, both positively and negatively: positively through increased self-confidence boosting one's quality of life, and negatively if one experiences hypersensitivity.

Etiology of intrinsic and extrinsic stains

Enamel, the hardest substance in the body, is composed mainly of inorganic material: calcium and phosphate ions that make up hydroxyapatite crystals. Hydroxyapatite is a naturally occurring mineral and accounts for up to 97% of enamel and approximately 70% of dentin.⁸ Since teeth are mainly composed of this compound, they easily absorb hydroxyapatite to enhance remineralization. It has been postulated that hydroxyapatite fills in the enamel, giving teeth a whiter appearance.

Teeth whitening, also known as teeth bleaching, is defined as the chemical degradation of chromogens.⁹ Chromogens are compounds accumulated in the teeth that give the teeth their color and are referred to as either intrinsic or extrinsic stains.⁹ To remove the discoloration from a tooth's structure, one must first identify the type of stain: intrinsic or extrinsic. Intrinsic staining, sometimes called internal staining, can be attributed to genetics, age (enamel wear over time exposing yellow dentin), antibiotics, high levels of fluoride, and developmental disorders that can start before the tooth has erupted.¹

Intrinsic staining, which affects the dentinal layer of the tooth, can appear in shades from yellow to brown to gray. Intrinsic stains, caused by certain foods and beverages such as coffee, tea, wine, and tobacco products, are absorbed into the dental pellicle. This type of staining can also be caused by medications such as tetracycline. Tetracycline is an antibiotic that can permanently affect the color of teeth if given to pregnant women during the last half of pregnancy. Clinical use of tetracycline in children under the age of 8 is not recommended due to the potential for tooth staining. However, doxycycline,

a second-generation tetracycline, has not been shown to cause tooth staining in young children.¹⁰

Tetracycline-stained teeth are more difficult to whiten, since the tetracycline color molecules cannot be removed entirely.¹¹ Teeth that have been stained from the use of tetracycline are nonporous, and the discoloration changes from a fluorescent yellow to a nonfluorescent brown over time.¹¹ Tooth shade depends on the type of tetracycline, dosage, duration of intake, and patient's age at the time of administration.¹¹ The discoloration usually affects teeth on both arches. There are two approaches to whitening teeth that have been affected by this medication: intentional root canals with intracoronary bleaching and external whitening, which can be complicated in achieving optimal results.¹¹

Extrinsic stain, also known as external staining, develops on the tooth's surface and is caused by multiple environmental factors such as coffee, tea, wine, certain foods such as dark berries, and tobacco products. Medications such as chlorhexidine and doxycycline can also cause extrinsic staining. Stain removal involves either physical or chemical removal or a combination of the two. Colored compounds from these sources are adsorbed into acquired dental pellicle or directly onto the surface of the tooth, causing a stain to appear.³ Removal of plaque and calculus from the surface of the teeth prior to bleaching is necessary to achieve positive esthetic results.

In-office formulations

There are many standard formulations among teeth whitening products, including hydrogen peroxide (H₂O₂), carbamide peroxide (CH₆N₂O₃), and sodium chlorite (NaClO₂). In the late 1980s, several companies introduced both home-based products and professionally applied tooth whitening products into the US marketplace.³

Hydrogen peroxide, a compound consisting of hydrogen and oxygen, is the most common active ingredient in teeth whitening products. Carbamide peroxide, also known as percarbamide or urea peroxide, is another popular whitening agent used

in many in-office and at-home whitening products. Sodium hypochlorite has been used in nonvital teeth whitening, mainly on teeth in which the nerve has become necrotic due to trauma, necessitating endodontic treatment. Hydrogen peroxide breaks down faster than carbamide peroxide because it releases most of its whitening potential in the first 30 to 60 minutes. Hydrogen peroxide produces free radicals and breaks down the molecules and chromophore bonds, resulting in changes in tooth color.¹²

Carbamide peroxide is a water-soluble compound that consists of hydrogen peroxide and urea and can be found in commercial and household disinfecting products and teeth whitening products.¹³ Carbamide peroxide does have adverse effects such as dentinal hypersensitivity and gingival irritation, as do many of the other whitening products on the market. A product with 30% carbamide peroxide is about 10% hydrogen peroxide. Carbamide peroxide releases about half of its whitening power in the first two hours and can remain active for up to an additional six hours.^{4,8} The recommendation is for no more than 22% carbamide peroxide for at-home use. A concentration of 10% carbamide peroxide is equal to a concentration of about 3.5% hydrogen peroxide when in the mouth.⁸ Carbamide peroxide is more stable than hydrogen peroxide and has a longer shelf life.

Carbamide peroxide eventually breaks down into hydrogen peroxide and urea, which further breaks down into water and ammonia. This last reaction increases the pH of the solution, reducing the enamel demineralization, and the proteolytic activity of urea can improve the bleaching effectiveness.¹⁴ Twenty-one years ago, the American Dental Association (ADA) approved six 10% carbamide peroxide products: Rembrandt Classic, Opalescence, Nite White Classic, Platinum and Platinum Overnight, and Patterson Tooth Whitening Gel.⁷ However, some of these products have been discontinued or their formulation has changed.

Technology

Bill Dorfman, DDS, developed and marketed the first in-office whitening system,

ZOOM!, in 1989, bringing cosmetic dentistry within reach for the public.³ An in-office whitening procedure such as ZOOM! involves multiple steps to prevent sensitivity and gingival irritation. Other in-office whitening systems include Opalescence from Ultradent and Pola Office from Southern Dental Industries (SDI). The ZOOM! whitening system uses a dental dam that isolates and protects the gingival tissue to prevent burning, irritation, and saliva from compromising the working area. The recommendation is to inform the patient that their cheek and tongue will be retracted during the procedure to avoid salivary contamination. It has been suggested that a patient interested in teeth whitening be well informed of the side effects and potential outcomes as people are affected differently.

Several approaches have been used to reduce the effects associated with teeth whitening, including desensitizers or anti-inflammatory medications. Another recommendation is for patients to be evaluated to ensure they are good candidates for this type of whitening procedure. Patients with anterior composites, crowns, veneers, receding gums, or active periodontal disease may not be viable candidates. If a patient has active periodontal disease, isolation for any in-office whitening system will be challenging to achieve due to the amount of inflammation and bleeding present. Receding gums are a concern due to the exposed cervical portion of a tooth being more sensitive to external stimuli, and composite restorations and crowns do not change color when whitening material is applied. Some in-office systems use light activation. For example, ZOOM! uses a blue LED (light-emitting diode) technology to deliver a spectrum of light energy that activates the in-office whitening gel to achieve optimal results. Research has presented conflicting results on whether light activation improves the effectiveness of whitening agents.⁹

Custom whitening trays are an option for at-home use; however, it's a longer process and requires multiple applications. Custom whitening trays require the fabrication of a translucent tray using a vacuum former in conjunction with a model

of the patient's teeth. Most custom whitening trays are made from ethyl vinyl acetate, a flexible material that most patients confirm is easy to wear. Occasionally offices will paint on the dental impression or model to allow a reservoir for the whitening gel to cover more surface area.

Over-the-counter (OTC) whitening trays are another option, but not all trays fit and there are some differences. Some trays are bulkier than others and require more gel to cover the tooth surface, resulting in an increase in the cost of whitening gel.

A case report using a KTP (potassium titanyl phosphate) laser showed promising results against a tetracycline stain. A KTP laser is a type of Nd:YAG laser that has become more prevalent in Europe and Japan and has been used to remove tattoos, hemangiomas, and melanomas.^{11,15} This type of laser uses a potassium titanyl phosphate crystal as its frequency doubling device. The KTP laser has been used in case studies to understand its effects on bleaching tetracycline-stained teeth and on traumatized tooth enamel.^{11,15} The KTP laser tends to penetrate dentin with less damage and has been shown to be significantly more effective than an LED or diode laser.¹¹

Toothpaste

The efficacy of whitening toothpaste has been controversial due to lower-than-expected outcomes. Patients expect immediate results and are disappointed if the advertised results are not achieved. However, patients are not always aware of the type of stain they have. Toothpastes have a lower concentration of whitening ingredients since they are sold over the counter and adverse side effects need to be minimized if misused.

Numerous older products on the market claimed to whiten. Toothpaste ingredients that claimed to whiten include activated charcoal, blue covarine, hydrogen peroxide, carbamide peroxide, and microbeads such as those found in Oral-B 3D White Perfection.¹⁶ A clinical study that tested different kinds of toothpaste containing these ingredients showed that the toothpaste with microbead abrasives and blue covarine presented the best

global tooth whitening performance.¹⁶ The Microbead-Free Waters Act of 2015 banned microbeads due to environmental concerns.¹⁷ It's essential to know a product's ingredients and which formulation would be most effective for each patient. The use of abrasives such as calcium carbonate, sodium bicarbonate, and hydrated silica gels reduce the adhesion of biofilm to the tooth surface but are not abrasive enough to damage tooth enamel.¹⁶

Activated charcoal has become popular through social media trends, but its effectiveness hasn't been studied. Activated charcoal/carbon has attracted interest because it acts in a high surface area and consequently has the capacity of adsorbing pigments, chromophores, and stains responsible for the color change of teeth.¹⁶ According to table 1, Black & White by Curaprox uses activated charcoal, including enzymes and optical pigment. Closeup White Attraction also uses optical pigment (blue covarine). Blue covarine acts to shift the apparent color of teeth by depositing a thin, semitransparent film of bluish pigment on the dental surface, resulting in brighter and whiter teeth.¹⁶

color changes of all the samples treated with mouthwash were significantly lower than those samples treated with 10% carbamide peroxide at all of the evaluated time intervals, but they were significantly higher than those of the negative control group.¹²

Safety/risk factors

All whitening options have the potential to cause irritation, dentinal hypersensitivity, and long-term damage if the manufacturer's protocols aren't followed properly. The temporary nature of OTC whitening products can lead to overuse. Patients and clinicians need to consider restorative procedures such as anterior fillings, crowns, or veneers because these restorations are unlikely to whiten.

Studies of different whitening procedures concluded that there could be changes in tooth surface structure and increased tooth sensitivity, especially if highly concentrated hydrogen peroxide solutions are applied.⁸ The etiology of dentinal hypersensitivity is multifactorial, as it could arise from various types of external stimuli such as thermal,

theory, also known as the fluid movement theory, was first proposed by Brännström.¹⁸ This theory explains the fluid movement in the dentinal tubules. If the tubules are widened, fluid movement occurs at a higher rate, allowing more stimuli to reach the nerve endings in the pulp. The number of tubules in sensitive dentin is eight times more than the number of tubules in nonsensitive dentin.¹⁸

Dental offices offer a wide variety of whitening products, and many dental companies incorporate common ingredients into their products in different concentrations depending on the products or regimens used. Manufacturers go through a rigorous amount of testing to determine what is the safest and most effective way to whiten teeth naturally without adding harsh chemicals. One study mentions companies adding particulate hydroxyapatite, a biomimetic agent, to their preventive oral care products.⁸ The mineral phase of human teeth consists of calcium phosphate in the form of hydroxyapatite.⁸ The term "biomimetic" was coined by biophysicist/biomedical engineer Otto Schmitt in the 1950s and refers to the study of multidisciplinary mechanisms and biologically produced materials to design novel products that mimic nature.¹⁹ Particulate hydroxyapatite, a biomimetic agent, is used in preventive oral care.⁸ The inner part of a tooth, dentin, is a protein-rich, bonelike biocomposite containing about 70% hydroxyapatite with proteins (mainly collagen) and water forming the rest.⁸ Enamel, the outer part of a tooth, is a highly mineralized tissue containing about 97% hydroxyapatite in the form of micrometer-long needles that form a complex hierarchically organized microstructure.⁸

Additionally, companies have also added potassium nitrate, an inorganic nitrate salt of potassium, to prevent dentinal hypersensitivity. Potassium nitrate is a water-soluble crystalline solid that occurs in nature.²⁰ Potassium nitrate interferes with the nerve pulse and is commonly found in desensitizing toothpaste. Potassium salts move along the dentinal tubules, and by blocking the axonic action of the intradental nerve fibers, they decrease the excitability of the tooth.¹⁸

TABLE 1: Whitening toothpastes and the technology behind them.¹⁶

Experimental group	Manufacturer	Whitening technology
B&W	Black & White, Curaprox, Switzerland	Activated charcoal, enzymes, and optical pigment
WAD	Closeup White Attraction Diamond, Unilever	Optical pigment (blue covarine)
LWA	Colgate Luminous White Advance, Colgate, Brazil	Hydrogen peroxide
TA (control)	Colgate Tripla Ação, Colgate, Brazil	Traditional abrasive
3DW	Oral-B 3D White Perfection, Procter & Gamble, Brazil	Microbead abrasives
XW4D	Sorriso Xtreme White 4D, Colgate, Brazil	Optimized abrasives

Mouthwashes

Mouthwashes are popular OTC oral hygiene products, and each is formulated for a specific purpose. Mouthwashes can prevent halitosis, xerostomia, carious lesions, and whiten teeth while reducing the bacterial load in the oral cavity. The efficacy of whitening mouthwash depends on contact time and the constituents of the product. In one study, the

chemical, tactile, or through evaporation, which is part of the whitening process. Receding gingival tissue can also be a source of sensitivity that needs to be considered if a patient is interested in teeth whitening. Dentinal hypersensitivity has several names, such as root hypersensitivity, dentin hypersensitivity, cervical hypersensitivity, and cementum hypersensitivity. The hydrodynamic

Conclusion

Teeth whitening has long been seen as a privilege, a sign of beauty and wealth, and a desired esthetic procedure. Technological advances throughout history have made desired results more accessible for consumers. Having a clear understanding of the etiology of stains, a product's constituents, how each whitening process functions, and the side effects of each procedure will help dental professionals select the specific whitening procedure that is best suited for each patient's needs.

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QUESTIONS

1. Around 5000 BC, who created a whitening paste composed of ground pumice stone mixed with vinegar?
 - A. Romans
 - B. Chinese
 - C. Egyptians
 - D. Greeks
2. Who placed great value on having whiter teeth and used urine as a mouthwash?
 - A. Catholics
 - B. Romans
 - C. Greeks
 - D. Egyptians
3. In what year did people brush with something called chew sticks made of small twigs to assist in removing particles from teeth?
 - A. 4000 BC
 - B. 600 BC
 - C. 3000 BC
 - D. 1000 BC
4. In the 1700s, barbers filed teeth surfaces and applied what type of acid to remove stains from the dentition?
 - A. Nitric acid
 - B. Oxalic acid
 - C. Sulfuric acid
 - D. Acetic acid
5. In the 1800s, what acid did dentists use that caused extensive tooth damage in the process?
 - A. Nitric acid
 - B. Phosphoric acid
 - C. Hydrochloric acid
 - D. Oxalic acid
6. In what year was a rubber dam used in combination with hydrogen peroxide and a heat lamp to whiten teeth?
 - A. 1965
 - B. 1989
 - C. 1943
 - D. 1981
7. Who introduced nightguard vital bleaching (NGVB) in 1989, involving the application of 10% carbamide peroxide in thin custom-fitted trays?
 - A. Dr. Bill Klusmeier
 - B. Dr. Aminah El-Mourad
 - C. Dr. Van B. Haywood
 - D. Dr. Bill Dorfman
8. In 1864, Dr. James Truman introduced the most effective technique for bleaching nonvital teeth, a method that used chlorine from a solution of what two chemical compounds?
 - A. Calcium hydrochloride and acetic acid
 - B. Ammonia and nitric acid
 - C. Calcium carbonate and sulfuric acid
 - D. Potassium hydroxide and carbonic acid
9. Hydroxyapatite is a naturally occurring mineral that accounts for up to what percentage of enamel and approximately 70% of dentin?
 - A. 65%
 - B. 43%
 - C. 97%
 - D. 88%
10. What are the compounds accumulated in the teeth that give the teeth their color and are chemically degraded during the whitening process?
 - A. Acerogenins
 - B. Chromogens
 - C. Amelogenins
 - D. Procollagen
11. What is the name of the antibiotic that, if given to pregnant women during the last half of pregnancy, can permanently affect the color of a baby's teeth later in life?
 - A. Metronidazole
 - B. Levofloxacin
 - C. Trimethoprim
 - D. Tetracycline
12. Which of the following is not considered a standard formulation in teeth whitening?
 - A. Hydrogen peroxide (H_2O_2)
 - B. Barium peroxide (BaO_2)
 - C. Carbamide peroxide ($CH_6N_2O_3$)
 - D. Sodium chlorite ($NaClO_2$)
13. What chemical compound produces free radicals and breaks down the molecules and chromophore bonds, resulting in changes in tooth color?
 - A. Carbamide peroxide
 - B. Sodium hypochlorite
 - C. Potassium nitrate
 - D. Hydrogen peroxide
14. What is a water-soluble compound that consists of hydrogen peroxide and urea and can be found in commercial and household disinfecting products and teeth whitening products?
 - A. Carbamide peroxide
 - B. Sodium peroxide
 - C. Barium peroxide
 - D. Organic peroxide
15. Which substance has been used in nonvital endodontically treated teeth whitening?
 - A. Hydrogen peroxide
 - B. Carbamide peroxide
 - C. Sodium hypochlorite
 - D. Sodium peroxide
16. A concentration of 10% carbamide peroxide is equal to a concentration of about what percentage of hydrogen peroxide when in the mouth?
 - A. 2.8%
 - B. 3.5%
 - C. 7.9%
 - D. 6.3%

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QUESTIONS

17. Who developed and marketed the first in-office whitening system, ZOOM!, in 1989, bringing cosmetic dentistry within reach for the public?
- Dr. Bill Dorfman
 - Dr. Rick Workman
 - Dr. Howard Farran
 - Dr. Martha Somerman
18. Most custom whitening trays are made from what flexible material?
- Polyvinyl chloride
 - Ethyl vinyl acetate
 - Low-density polyethylene
 - Polyethylene terephthalate
19. Which type of laser has become more prevalent in Europe and Japan and has been used to remove tattoos, hemangiomas, and melanomas?
- Ruby laser
 - Alexandrite laser
 - Nd:YAG laser
 - Neatcell Picosecond
20. According to Figure 1, which toothpaste used the optimized abrasives whitening technology?
- Closeup White Attraction Diamond
 - Colgate Luminous White Advance
 - Oral-B 3D White Perfection
 - Sorriso Xtreme White 4D
21. According to a clinical study, what other ingredient in combination with microbeads presented the best global tooth whitening performance before microbeads were banned?
- Blue covarine
 - Phosphate salts
 - Hydrated aluminum oxides
 - Dehydrated silica gels
22. Which of the following abrasives mentioned in this article does not reduce the adhesion of biofilm to the tooth surface and is not abrasive enough to damage tooth enamel?
- Calcium carbonate
 - Sodium bicarbonate
 - Hydrated silica gels
 - Magnesium carbonate
23. What ingredient has attracted interest because it acts in a high surface area and consequently has the capacity of adsorbing pigments, chromophores, and stains responsible for the color change of teeth?
- Stabilized chlorine dioxide
 - Activated charcoal
 - Titanium dioxide
 - Hydrogen peroxide
24. The Microbead-Free Waters Act banned microbeads due to environmental concerns in which year?
- 2005
 - 2010
 - 2015
 - 2020
25. Which part of the tooth is composed of 70% hydroxyapatite?
- Enamel
 - Dentin
 - Cementum
 - Pulp
26. In one study, the color changes of all samples treated with mouthwash were significantly lower than those of samples treated with ___ at all evaluated time intervals, but they were significantly higher than those of the negative control group.
- 10% hydrogen peroxide
 - 3.5% hydrogen peroxide
 - 30% carbamide peroxide
 - 10% carbamide peroxide
27. Who first proposed the hydrodynamic theory, also known as the fluid movement theory?
- Brännström
 - Dorfman
 - van Leeuwenhoek
 - Willoughby Miller
28. Sensitive dentin has ___ times more tubules than nonsensitive dentin.
- 6
 - 8
 - 2
 - 10
29. The phrase “biomimetic” was coined by what biophysicist/biomedical engineer in the 1950s and refers to the study of multidisciplinary mechanisms and biologically produced materials to design novel products that mimic nature?
- Otto Schmitt
 - Jacques Dubochet
 - Joachim Frank
 - Francis Crick
30. Which common ingredient found in toothpastes interferes with the nerve pulse by blocking the axonic action of the intradental nerve fibers?
- Sodium lauryl sulfate
 - Diethylene glycol
 - Xylitol
 - Potassium nitrate

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EXPIRATION DATE:	JANUARY 2025

ANSWER SHEET

Teeth whitening: Antiquated to present-day

NAME: _____ TITLE: _____ SPECIALTY: _____

ADDRESS: _____ EMAIL: _____ AGD MEMBER ID (IF APPLIES): _____

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Educational Objectives

1. Explain the history of teeth whitening
2. Discuss the etiology of intrinsic and extrinsic stains
3. Explain the difference between hydrogen peroxide and carbamide peroxide
4. Describe the difference between in-office whitening, take-home whitening, and laser whitening
5. Recognize the indications and contraindications for whitening and possible side effects
6. Select the proper whitening procedure that is best suited for each patient's needs

Course Evaluation

1. Were the individual course objectives met?

Objective #1: Yes No	Objective #3: Yes No	Objective #5: Yes No
Objective #2: Yes No	Objective #4: Yes No	Objective #6: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

- | | | | | | | |
|--|-----|----|---|---|---|---|
| 2. To what extent were the course objectives accomplished overall? | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Please rate your personal mastery of the course objectives. | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. How would you rate the objectives and educational methods? | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. How do you rate the author's grasp of the topic? | 5 | 4 | 3 | 2 | 1 | 0 |
| 6. Please rate the author's effectiveness. | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Was the overall administration of the course effective? | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Please rate the usefulness and clinical applicability of this course. | 5 | 4 | 3 | 2 | 1 | 0 |
| 9. Please rate the usefulness of the references. | 5 | 4 | 3 | 2 | 1 | 0 |
| 10. Do you feel that the references were adequate? | Yes | No | | | | |
| 11. Would you take a similar course on a different topic? | Yes | No | | | | |

12. If any of the continuing education questions were unclear or ambiguous, please list them.

13. Was there any subject matter you found confusing? Please describe.

14. How long did it take you to complete this course?

15. What additional dental continuing education topics would you like to see?

Mail/fax completed answer sheet to:

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| 4. (A) (B) (C) (D) | 19. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D) | 20. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D) | 21. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D) | 22. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D) | 23. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D) | 24. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 25. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 26. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 27. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 28. (A) (B) (C) (D) |
| 14. (A) (B) (C) (D) | 29. (A) (B) (C) (D) |
| 15. (A) (B) (C) (D) | 30. (A) (B) (C) (D) |

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