WHITE PAPER

GLO SCIENCE PRO TEETH WHITENING

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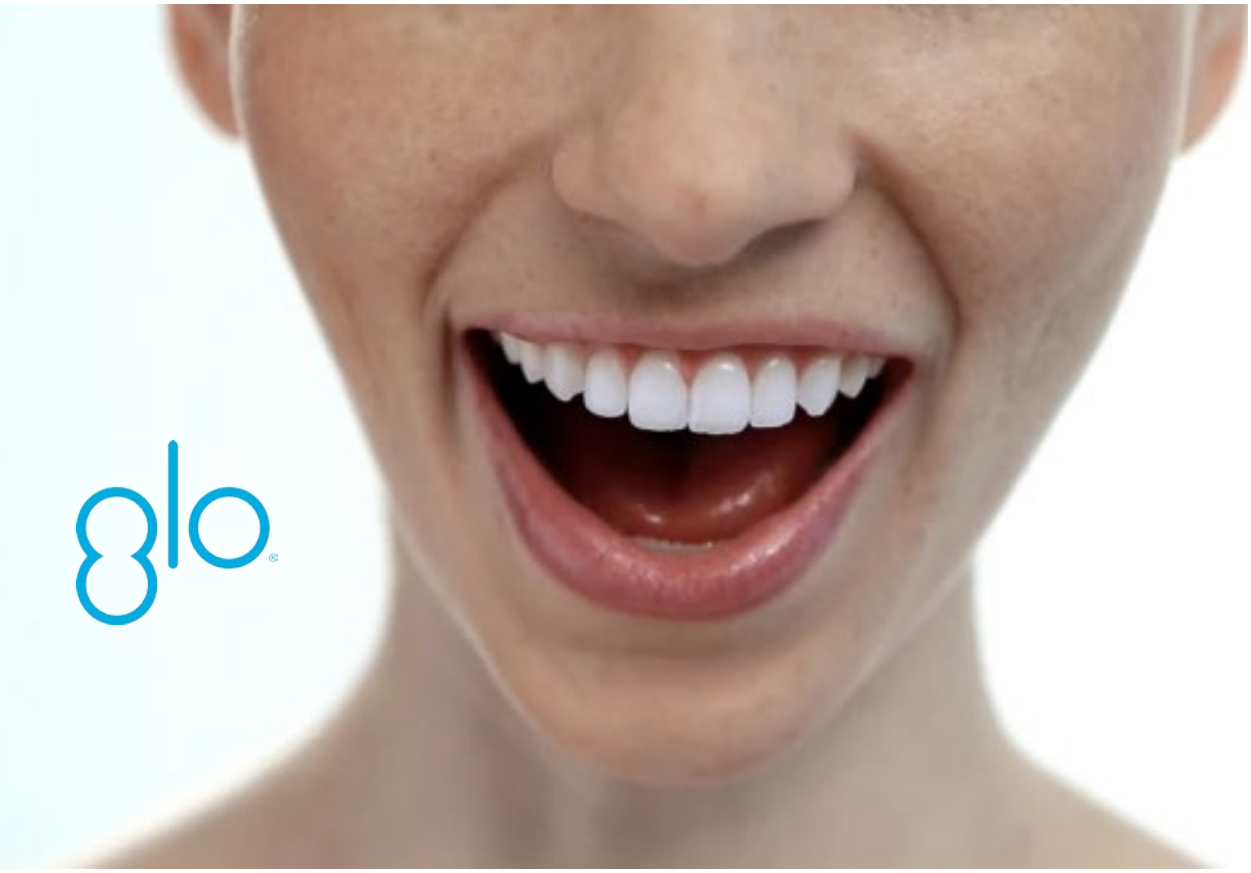

INTRODUCTION

To understand how teeth whitening works, we must first understand not only the anatomy of teeth, but the biology of color as well: how it is determined genetically, the parts of the tooth that are responsible for its color, and the issues of stains, both intrinsic and extrinsic, and how they affect the color of teeth. Furthermore, this whitepaper will discuss how whitening removes both types of stains, covering the role and chemistry of hydrogen peroxide and explaining the factors that influence whitening. Finally, this paper will explain how GLO Science Professional uses those factors in tandem to create the most efficient whitening system on the market, combining years of clinical research with innovative technology.

THE BIOLOGY OF COLOR

Tooth color comes from a convergence of our genetics, environmental factors, and our ability to keep our mouth healthy.

Tooth color is determined by the two outermost layers of the tooth: enamel and dentin. The enamel, as you remember from dental school, is the hardest substance in the body and is translucent in color. About 95% of it consists of calcium phosphate molecules packed together to form highly organized apatite crystals. The tightly packed mass of crystals forms the enamel rods, which are found in rows perpendicular to the underlying dentin.

The dentin is genetically determined and ranges in color from yellowish to grayish white. The underlying dentinal color shines through the enamel surface, which acts like translucent glass.

The dentin is the largest tooth structure, and as a living tissue, it conducts thermal sensitivity and pain from the enamel to the pulp and the nerve fibers. The color in the dentin comes from color pigments known as chromophores, which are organic in nature and have a double carbon bond, or a c=c structure. This is important to remember to understand how whitening really works and how this double bond gets oxidized.

Given that the dentin shines through the translucent enamel, intrinsic and extrinsic stains determine the overall color of the tooth (figure 1).

INTRINSIC STAINS

Because of the location, intrinsic stains are more difficult to remove as they lie within the dentin of the tooth.[1] These stains are caused not by the foods we eat but as a result of genetics, aging, trauma, medications, environment, and systemic conditions.

The most common change in tooth color is a result of aging. As teeth grow older, the pulp shrinks and the dentin becomes thicker, which also causes teeth to yellow, due to increased color from the dentin.[2]

Medications taken during tooth formation can also cause enamel defects, causing teeth to look stained. Tetracycline, used to treat bacterial infections, can cause permanent staining of the teeth, often turning them yellow, brown, or dark gray as the tetracycline molecule is deposited within the dentinal structure.[3] The yellow and dark brown stains of fluorosis are caused by excessive exposure to high concentrations of fluoride during tooth development.

EXTRINSIC STAINS

Extrinsic stains are a result of stain molecules attaching to the sticky layer of the bacterial biofilm on the tooth and are easier to remove since they are on the outside of the tooth. Depending on the level of personal home care, along with lifestyle and diet, visits to a dental professional will determine the degree of extrinsic stains that are allowed to form on the outside of the teeth: the

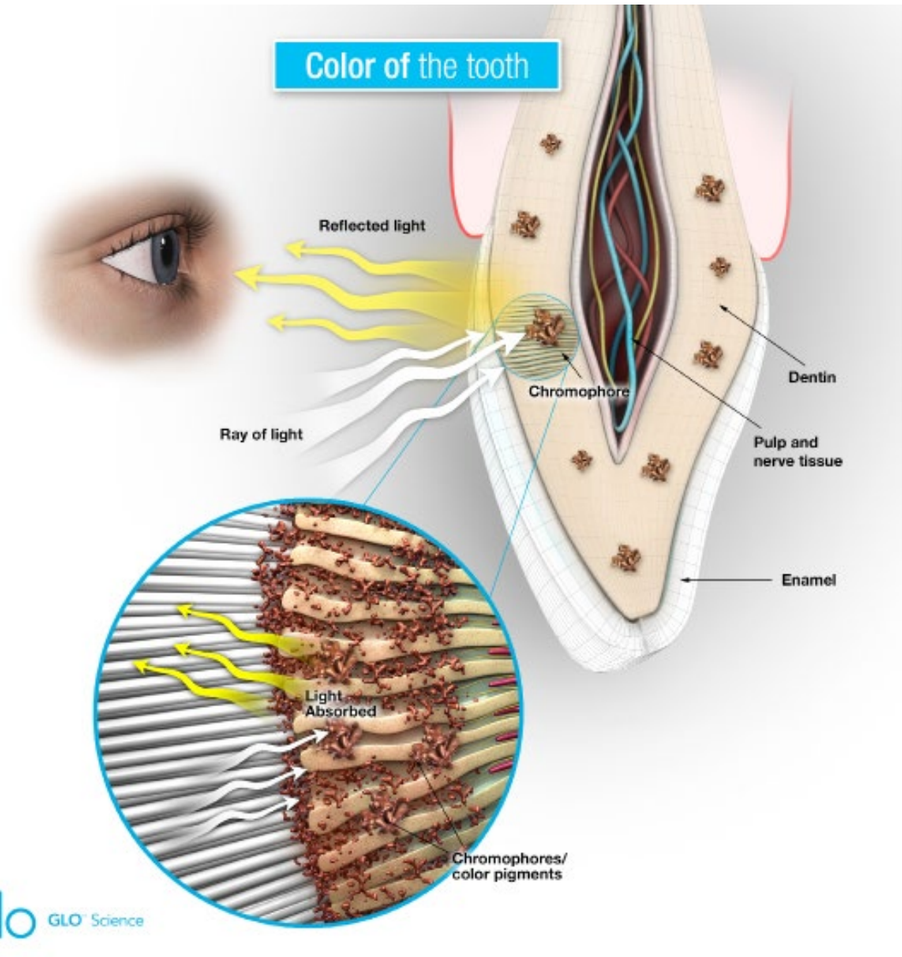

FIGURE 1 The color of the tooth arises when the chromophore molecules absorb and reflect certain wavelength of visible light, transmitting the darker color to our eyes.

hygienist can scrape away the calculus and plaque that the toothbrush can't remove and teach proper home care and its importance, eliminating the basis of stains.

These discolorations are caused when stains on the enamel penetrate into the enamel matrix. Certain foods and drinks can lead to staining when left on the teeth for a lengthy period of time, as any smoker or coffee, tea, red wine, or soda drinker demonstrates.[4] Anything that stains a white shirt is a culprit to stain the teeth (figure 2).

EXTRINSIC & INTRINSIC STAINS

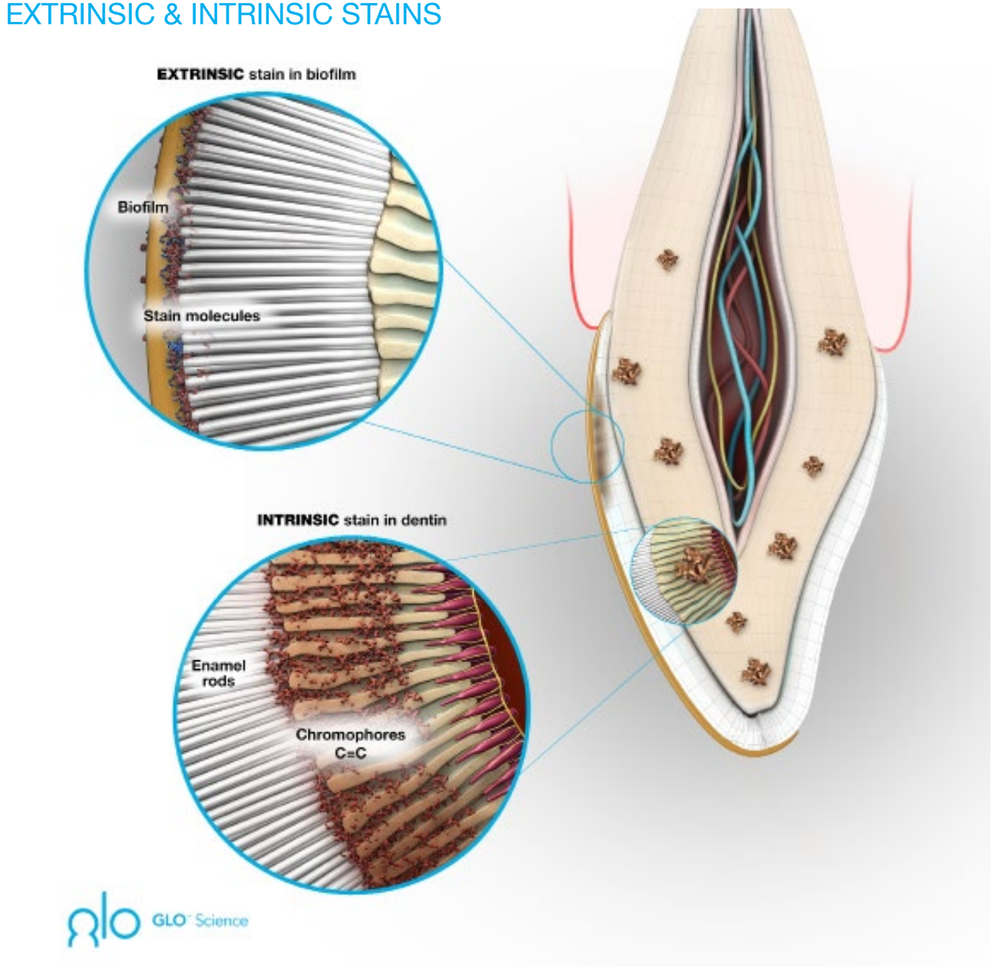

FIGURE 2 Color molecules called chromophores join together, increasing the chromophore bonds and causing the tooth to look darker and darker. The color molecules collect on the surface of the teeth (extrinsic stains) and the inside of the teeth (intrinsic stains).

WHITENING WITH HYDROGEN PEROXIDE

A tooth is a semi-permeable membrane, allowing bleaching agents like peroxide to penetrate to the dentinal structures within 15 minutes.[5] Hydrogen peroxide breaks down into water and peroxide radicals (oxygen ions) as it is absorbed into the tooth, also known as whitening molecules. These radicals have unstable electrons, which seek something to bond to, specifically unsaturated double bonds, which usually have a yellow pigment. Free radicals react with the double carbon bonds that hold chromophores in stain molecules, breaking them down into single carbon bonds. While double carbon bonds are responsible for the yellow color in stains by absorbing light, single carbon bonds reflect light, making the teeth appear whiter and brighter as the stain molecules become vaporized. At this point, the double bonds are converted into hydroxyl groups, similar to alcohol and usually colorless (figure 3).

Because of hydrogen peroxide's instability, it can break down over time from when it is manufactured to when it is transported and then used on the patient, both in the office and during take-home use. Hydrogen peroxide needs to be manufactured in a stable formula and/or kept in a hermetically sealed system to prevent decomposition.

In transportation, there is an obvious decomposition of hydrogen peroxide due to heat in warm climates, decreasing its efficacy.[6] Rather than keep the compound refrigerated during transport, which is costly, one way to help stabilize the hydrogen peroxide compound is to build a stable formula using a lower pH environment, which prevents decomposition. The dual barrel syringe used in professional whitening allows for the reactive substance (hydrogen peroxide) and a pH raiser to be delivered at the time of extrusion, thus raising the pH and ensuring that the higher pH will activate the whitening molecules for even more effective whitening. The whitening molecules created in a higher pH environment yield the very active perhydroxyl molecule and fewer of the less active negative oxygen ions.[7] Hermetically sealed delivery systems are also critical in creating a sealed environment to maintain efficacy for the take-home whitening products.

The degree of penetration of the highly reactive oxygen molecules is directly related to the following factors: how long the whitening gel is on the teeth, the concentration of the whitening gel, and other secondary factors that impact efficacy and stability of the whitening

Manufacturers of whitening products stabilize hydrogen peroxide in two ways: either from a hermetically sealed delivery system or through a stabilized hydrogen peroxide formulation (i.e. vial, strip, ampoule). The traditional method, a stabilized formulation, uses carbamide peroxide ($CH_6N_2O_3$), also known as urea peroxide.

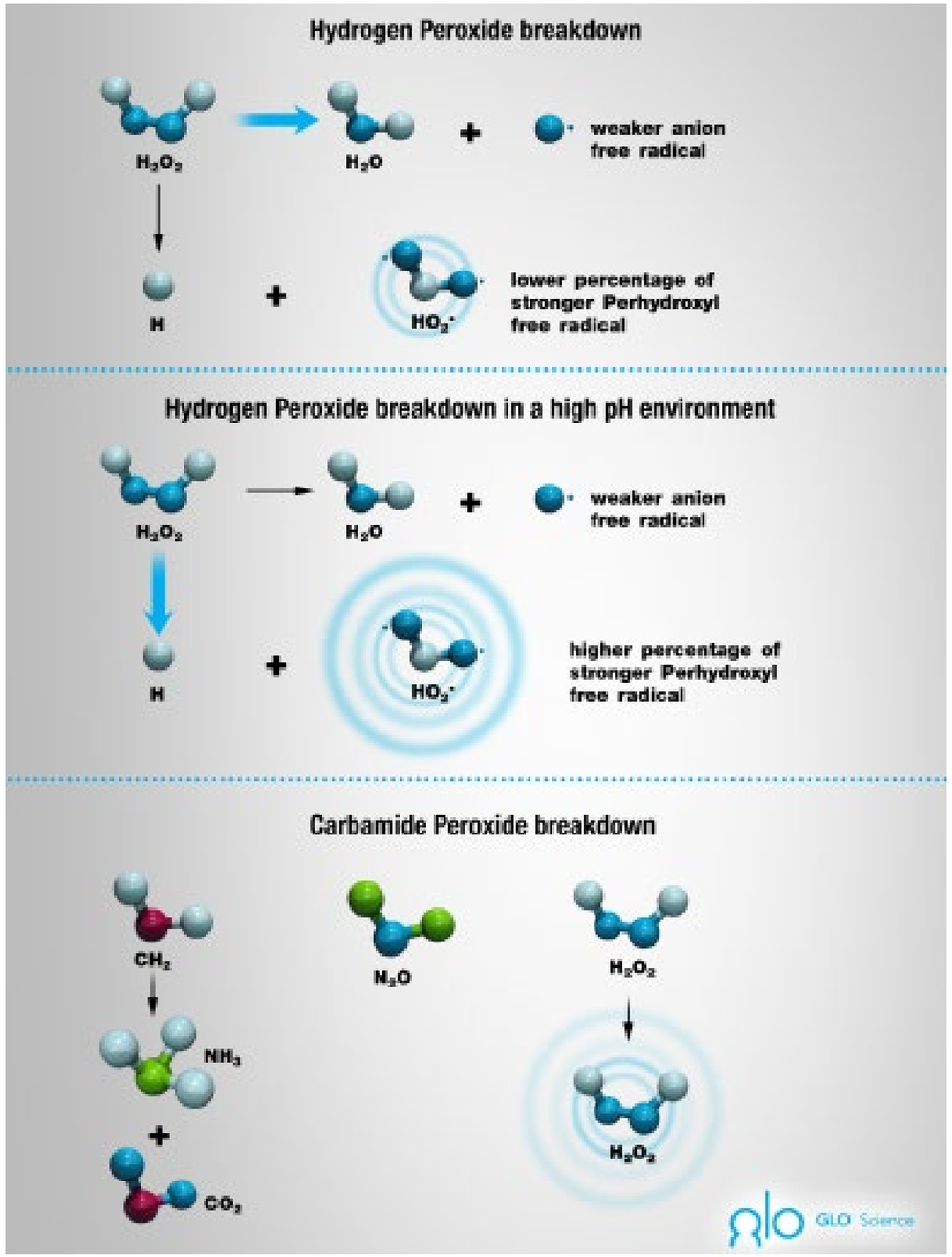

FIGURE 3 A greater amount of highly reactive perhydroxyl molecules form when the pH is greater than 9.5. This is called the ionization of buffered hydrogen peroxide.

WHITENING WITH CARBAMIDE PEROXIDE

Carbamide peroxide is less effective than hydrogen peroxide because it breaks down slower and has a lower concentration of peroxide.[8,9] When carbamide peroxide breaks down, it results in hydrogen peroxide and urea, in addition to other byproducts, such as ammonia (NH_3).

Urea slows down the decomposition of hydrogen peroxide, lengthening the whitening process, and the byproducts have an unintended consequence of causing soft tissue irritation, as the gels are on the gums for extended periods of time (tray and gel delivery system).[10,11] Because hydrogen peroxide gels are aqueous, while carbamide peroxide gels are anhydrous, the glycerine and the ammonia breakdown byproduct can dehydrate the pulp of the tooth and irritate the soft tissue in at-home use. Innovative manufacturers have moved away from these carbamide peroxide formulations and are focusing on building stable hydrogen peroxide systems with hermitically sealed delivery systems.

The slower decomposition rate of carbamide peroxide requires longer exposure time of teeth to the gel in order to achieve efficacy, resulting in sensitivity seen in both over-the-counter and dentist-administered take-home tray and gel systems.

To compare the whitening strength of carbamide peroxide and hydrogen peroxide, we must find the equivalent concentration of each. To do that, you must divide carbamide peroxide by about three, meaning products like Zoom NiteWhite, which has carbamide peroxide concentrations of 10%, 16%, and 22% has the equivalent hydrogen peroxide concentration of about 3%, 5%, and 7%, respectively.[12]

In the same way, hydrogen peroxide concentrations must be multiplied three times (2.765 to be exact) to find their equivalent in carbamide peroxide. GLO Science Professional, a dual in-office and take-home whitening kit, contains 9% hydrogen peroxide in the take-home kit, equating to a little over 27% of carbamide peroxide concentration.

The two agents break down at different rates as well. While hydrogen peroxide releases all of its peroxide in 20 to 30 minutes, carbamide peroxide releases about 50% of its peroxide in two to four hours before it experiences a slow decline.

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Too high a concentration of hydrogen peroxide, along with too much exposure under high heat, will cause extreme sensitivity, as the intrapulpal pressure inside the tooth increases. The resulting pain is commonly referred to as a "zinger."

FACTORS THAT INFLUENCE WHITENING

Understanding the primary and secondary factors of whitening will help build effective whitening results without sensitivity.

The two primary factors that influence whitening are contact time and the concentration of hydrogen peroxide. The effect of the whitening gel is directly related to the amount of exposure time. The longer the teeth are exposed to the solution and the higher the concentration of the whitening gel, the greater the change in the color of the tooth. Of course, this is a double-edged sword: too high a concentration of hydrogen peroxide, along with too much exposure under high heat will cause extreme sensitivity, as the intrapulpal pressure inside the tooth increases. The pain felt as a result is commonly referred to as a "zinger."

To avoid tooth sensitivity, the goal is to have high frequency (whitening days in a row), not high intensity of contact time in one sitting at high temperatures, i.e. professional whitening with hot lamps. In the same way, the higher the concentration of hydrogen peroxide (or carbamide peroxide), the greater the effect of the oxidation process. The highest concentration generally used is 35% hydrogen peroxide for chairside whitening, however when gelling agents are used, the concentration is then reduced to 25 - 30%, as studies have shown that lower levels of hydrogen peroxide in gel form are just as effective as higher levels in liquid form.[8]

Secondary factors that impact speed and efficacy for the whitening process without sensitivity are the pH level of hydrogen peroxide, the temperature at which the process takes place, the environment in which the process takes place, i.e. open or closed. and the method of delivery of the hydrogen peroxide.[7]

pH

When hydrogen peroxide is stored and shipped, an acidic pH must be maintained to extend shelf life, but the optimum pH for hydrogen peroxide to have its oxidation effect is 9.5 to 10.8. This range produces a 50% greater result in the same amount of time as at a lower pH, so it's best to raise the pH from the ideal storage and shipping range to the ideal whitening range (as is done with the dual barrel syringe for in-office whitening with a pH raiser on one side).

PRIMARY & SECONDARY FACTORS OF WHITENING

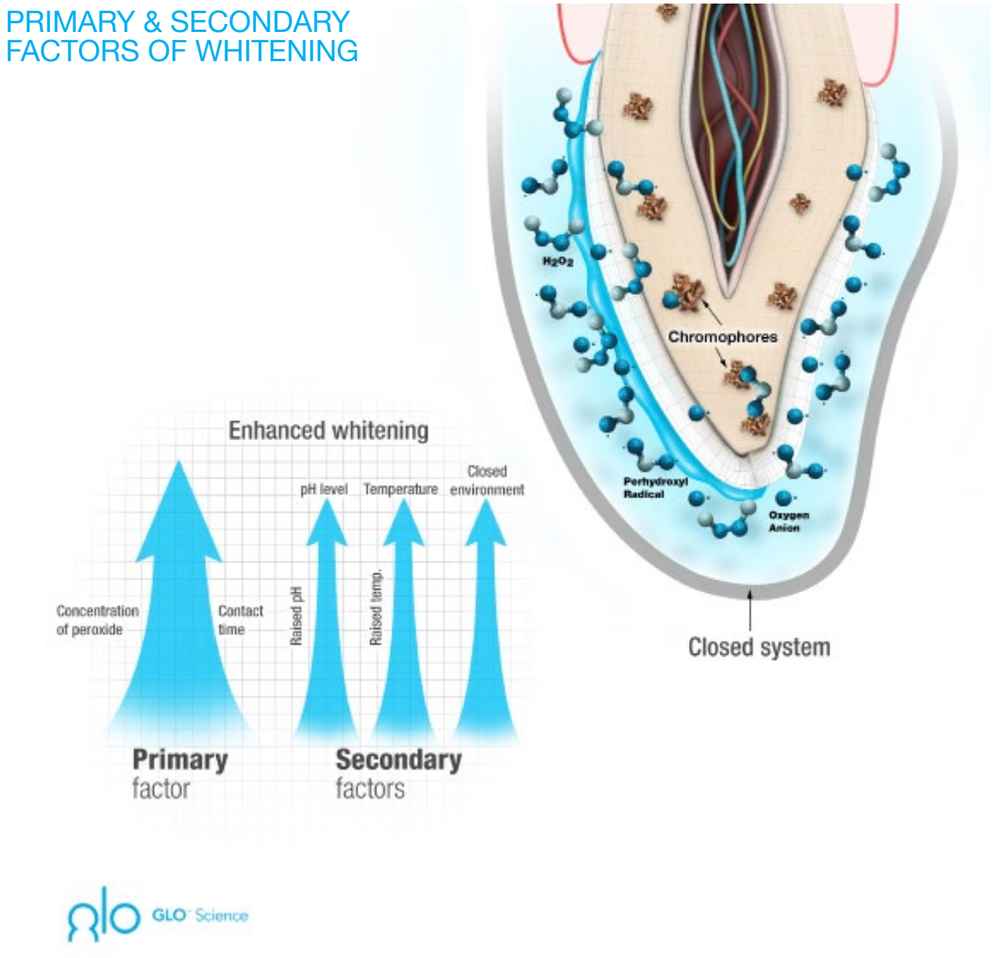

FIGURE 4 The primary factors of whitening are the concentration of the peroxide and the amount of time it is on the teeth for absorption and breaking down the stain. The secondary factors increase the efficacy of the whitening oxygens with pH, temperature increase, and preventing the escape of the whitening oxygens with a closed environment.

TEMPERATURE

Temperature accelerates the reaction rate, leading to a quicker whitening session.[13] For every 10°C the temperature increases, the rate of the chemical reaction is doubled. This is the basic kinetics of a reaction rate. The temperature can also cause sensitivity and a reversible pulpitis in patients if it is too high (over 53°C or 128°F). If the exposure time is short and below this temperature and the patient is comfortable, then it is at a safe range.[14,15]

ENVIRONMENT

When oxidation takes place within a sealed environment, as in dentist-administered tray and gels (figure 5), the efficacy of bleaching is increased by preventing the oxygen ions from escaping from the tooth surface and into the atmosphere.[16] This is called a closed system or a sealed environment. This closed system keeps the peroxidases (the enzymes in our saliva that break down free radicals) from getting into the whitening gel and reacting with the free radical whitening molecules, preventing the whitening oxygens from escaping into the open air. The better the seal, the more effective the whitening.

FIGURE 5 Shown here is a patient using tray and gels. Although the closed system is effective, the gums are bathed in hydrogen peroxide gel, causing pain and sensitivity.

METHOD OF DELIVERY

Finally, new hydrogen peroxide formulations have a more stable chemistry, known as peroxydone, and have improved the adhesive qualities of gels, which bind the hydrogen peroxide to the surface of the tooth. This improves the contact time of the active ingredients and lowers the likelihood of sensitivity, as the gel stays on the tooth and away from the soft tissue. For at-home whitening, the peroxydone allows the user to place the whitening gel directly to the teeth without drying out and irritating the soft tissue. The polyethylene strips utilize this chemistry, although the strips may sit on the gums, if not used carefully by the user. The vial, pen and ampoule delivery method offers an improvement to the strip technology by allowing the user to target the whitening gel to the tooth.

SENSITIVITY

Everyone wants to have whiter teeth, but nobody wants to go through the pain. Dental professionals need to offer patients a safe, effective way to whiten their teeth without sensitivity.

Many times the sensitivity is a general discomfort, which can be caused by a number of factors, such as using classic trays and gels (which bathe the soft tissue for hours at a time), aggressive oxidation from whitening under the high heat of whitening lights, and the low pH compounds, glycerin and the ammonia by-product of the carbamide peroxide gels.

More often, dentists hear about patients experiencing “zingers,” which are temporary but extremely painful. They have been compared to electric shocks of the teeth that rapidly shoot down the length of anterior teeth, lasting for a brief moment before being alleviated. Zingers are caused by overheating the teeth or allowing excessive exposure to hydrogen peroxide (or both) (figure 6).[17,18]

These shocks are the unintended consequence of the prolonged high heat from LEDs and lasers that sit just outside the mouth. The intention of the heat is to impact the hydrogen peroxide breakdown with high intensity light energy (though the cause and effect behind this has not been proven). The high heat of the super bright LEDs is over 152°F. If you point a laser thermometer at the surface of the tooth while one of the whitening lights is on for 16- to 20-minute intervals, you have high intensity exposure and the cause of “zingers.”[19]

In take-home kits, the lengthy exposure of the soft tissue to the hydrogen peroxide gel causes irritation and pain. From the most recent studies, up to 40% of all people who use the professionally administered take-home tray and gels report some level of sensitivity.[20] Many manufacturers use fluoride and potassium nitrate, in addition to ibuprofen, to alleviate the pain from tooth whitening for their patients. It would be optimal to have tooth whitening without sensitivity.[10]

Whitening gels bathe the roots and supporting structures of the teeth for weeks on end, and too few scientific studies have outlined the long-term effects of soft tissue’s extended exposure to carbamide peroxide and hydrogen peroxide gels, but longer exposure time needs to be avoided at all costs.[21]

WHITENING OPTIONS

The American Dental Association (ADA) has identified four types of teeth whitening treatments: in-office, take-home, over-the-counter, and other. Both in-office and take-home treatments are professionally backed, with a dentist conducting an in-office exam and performing a chairside whitening treatment before dispensing the take-home kit to the patient.

In-office whitening usually offers hydrogen peroxide at a higher concentration (up to 35%) and activates the solution by heat from laser or light energy. The process requires tissue isolation by barrier: usually gauze for the lips and upper gums and a cured gingival barrier. It offers the quickest results, with several shade changes within the hour.

The professional whitening lights that sit outside the mouth usually require three or four 16-minute sessions, creating a high degree of heat (over 67°C), causing a quick increase of intrapulpal pressure, i.e. the zingers. The energy from lights has never been shown to create increased free radical production and greater uptake, and it is the heat that accelerates the reaction rate of hydrogen peroxide.

The other technique for the in-office whitening is for the patient to sit with higher concentration gels plus custom whitening trays with no light or heat. The hydrogen peroxide or carbamide peroxide gels have higher concentration in the office compared to the take home, with hopes of jumpstarting the whitening process. However, there is no acceleration to the breakdown of hydrogen peroxide so it is less efficient whitening.

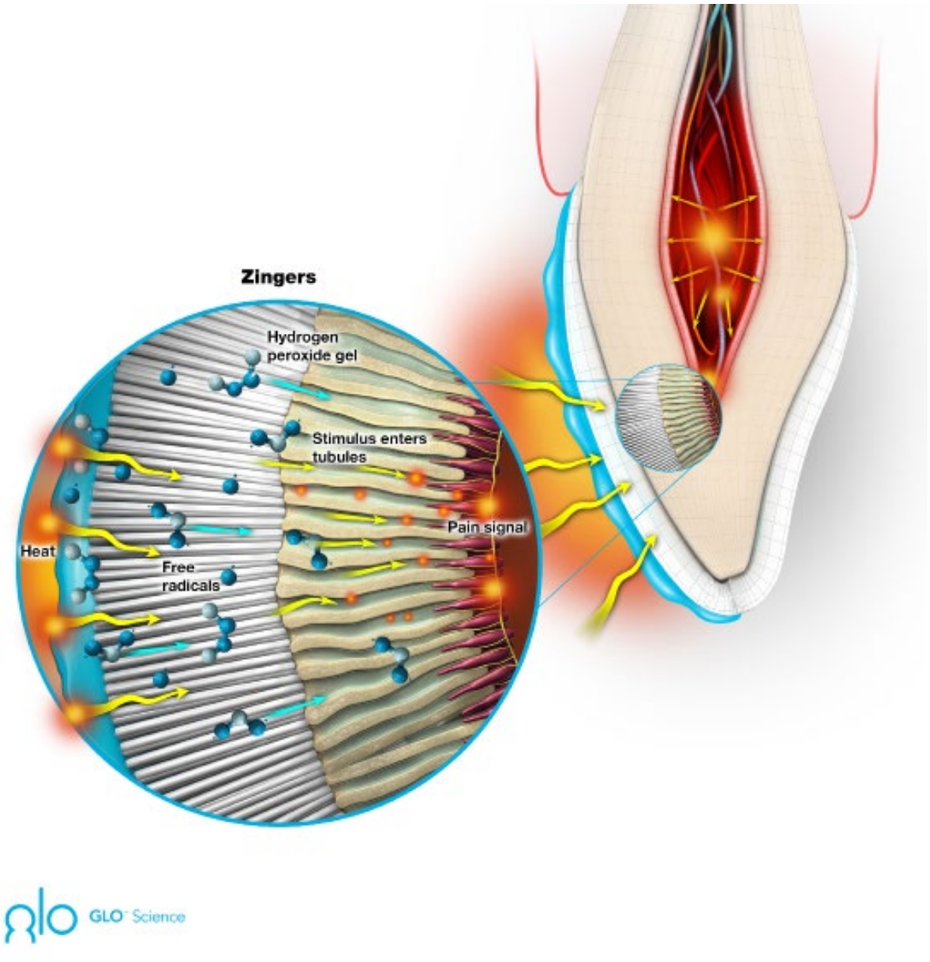

FIGURE 6 Zingers are caused by overexposure to heat from the professional whitening lamps that do not control temperature, causing a rise in the intrapulpal temperature.

The professional take-home kits with custom whitening trays (25-year-old technology) have a lower chemical concentration of either carbamide peroxide or hydrogen peroxide gel, which is placed into custom-fitting trays and worn at night (for a longer wear time) or during the day (for a shorter wear time). Take-home kits may yield the same results as in-office treatment, but over a longer period of time, greatly increasing exposure time to the teeth, as well as the soft tissue. This causes greater sensitivity due to prolonged exposure.

Used together, in-office and take-home kits are called "dual whitening," and the combination is the most effective way to whiten.[22] Done alone, the effects of in-office whitening will regress

in as few as seven days, while at-home kits provide no jumpstart to the whitening process. In addition, the teeth and gums are exposed to the carbamide or combination hydrogen peroxide gel for long periods with stand-alone take-home kits, increasing the likelihood of sensitivity.

Over-the-counter whitening treatments are available nearly everywhere: malls, spas, cruise ships, even Walmart, and over-the-counter whitening kits can be purchased by the consumer without a dental exam, meaning there is no professional oversight (plus, extrinsic stains are not professionally removed beforehand). They come in strips, wraps, boil-and-bite trays, and paint-on form and are inconsistent, with no customization of the whitening regimen. Because many products have not gone through the rigorous testing seen with professionally dispensed products, some don't work and overstate their effectiveness, and many are under scrutiny in several state jurisdictions for their lack of safety, supervision, and training.

Despite all of the various whitening methods available, dentist-prescribed dual whitening is still the quickest, safest, and most effective method available.

The answer was GLO Science Professional whitening: a system that combines the technology of light and heat in a closed system mouthpiece with hermetically sealed, take-home hydrogen peroxide gels, resulting in a dual whitening experience that optimizes contact time without long exposure times.

GLO: A BREAKTHROUGH IN TECHNOLOGY AND DESIGN

What would it look like if we combined all of the positive factors of whitening, eliminated all of the compromises that caused sensitivity, and synergized a dual whitening experience for our patients?

That's what I asked myself, working with other dental professionals and a team of engineers and product developers, we came up with a solution. The answer was GLO Science Pro teeth whitening: a system that combines the technology of light and heat in a closed system mouthpiece with hermetically sealed, take-home hydrogen peroxide gels, resulting in a dual whitening experience that optimizes contact time without long exposure times.

It's been clinically proven that the professional combination of in-office and take-home whitening kits, known as dual whitening, is the quickest, safest, and most effective method to achieve a brighter smile. My team of oral health professionals experienced the compromises that exist in professional whitening and I came up with the dual whitening answer: an innovative

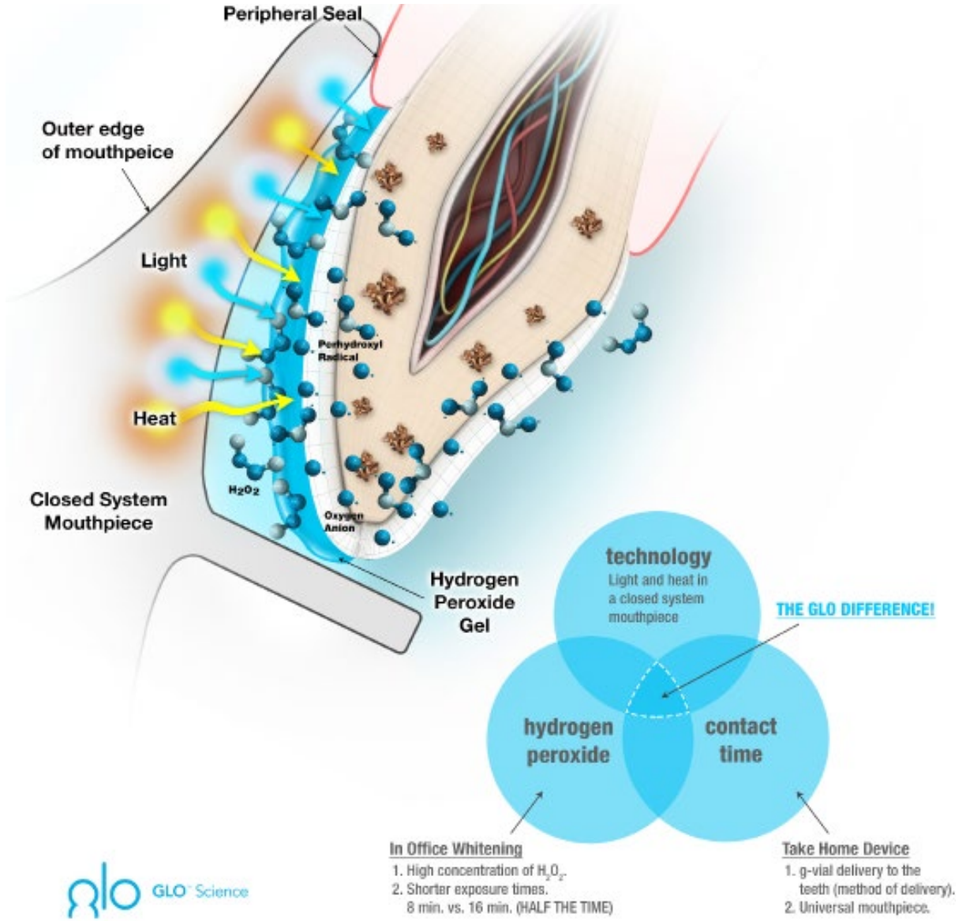

FIGURE 7 GLO Science Professional developed a way to improve the efficiency of hydrogen peroxide by controlling the form in which it is applied, the environment in which it works, and the temperature and light used to accelerate the process.

procedure that combines light and heat in a closed system to accelerate the whitening process, in combination with a unique whitening gel delivery system.

HOW GLO SCIENCE USES HEAT AND LIGHT

In in-office procedures, light and heat usually sit outside of the mouth, where the oxygen ions escape off the surface of the teeth behind the leading edge of the gel that sits on the tooth surface.[23] GLO Science Professional puts the light and heat inside the mouth and uses the closed system of a universal mouthpiece (no impressions needed), along with a unique delivery system, to apply the whitening gel directly to the surface of the teeth.

HOW GLO SCIENCE DELIVERS HYDROGEN PEROXIDE

By putting the LED lights and heat resistors in a closed system mouthpiece, the controlled warming heat accelerates the formation of the highly reactive oxygen ions. This breakthrough is the closed system mouthpiece that prevents the whitening oxygens from escaping into the atmosphere (figure 8). Instead, they bombard the surface of the tooth, resulting in shorter exposure times to the hydrogen peroxide gels and, therefore, less sensitivity. The warming heat is modulated to the critical temperature, preventing the pulpal response that happens with other professional whitening lights,[11] resulting in shorter wear times. No zingers and a take-home mouthpiece that doesn't require impressions or laboratory time. The GLO Professional dual whitening uses all of the elements for optimizing whitening without the sensitivity.

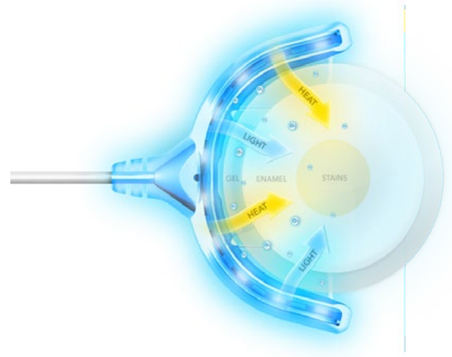

FIGURE 8 GLO Science mouthpiece - the universal sized mouthpiece combines light and heat in a closed system to deliver whitening and other formulations. The closed system prevents whitening oxygens and other formulations from escaping the teeth and gum area, which allows for quicker, more effective treatment.

GLO Science technology is backed by 10 patents, with 16 patents pending.

FIGURE 9 GLO Science G-Vial, features an anotomically designed tip using biomimicry. The "O" shape tip allows the user to target the gel towards the teeth, away from the sensitive gum tissue.

HOW GLO SCIENCE USES H_20_2

GLO Science Professional, under the dual whitening approach, uses a hydrogen peroxide gel delivered in a dual-barrel syringe for chair side whitening. The formulation uses a safe level of hydrogen peroxide in-office (24% and 30%, including a pH raiser in the dual barrel syringe in order to increase efficacy). The 24% hydrogen peroxide gel for the in-office whitening is designed for the younger patients and people with dentinal sensitivity, recession, and abfractions at the CEJ. The take-home device uses the innovative g-vial technology to deliver hydrogen peroxide, a targeted delivery system with highly adhesive 9% gel (figure 9).

G.L.O. (Guided Light Optic) technology has revolutionized whitening by addressing the compromises of other in-office whitening systems on the market, eliminating large harmful lights that cause high sensitivity, and replacing messy trays that place the whitening gels all over soft tissues and roots of the teeth for hours at a time. The results are faster, more efficient, and long lasting whitening without the sensitivity.

CONTACT TIME WITH GLO

Because of the short wear time (four 8-minute applications—half the time of other at-home kits), and a temperature regulator that does not exceed 52°C on the surface of the tooth, along with the automatic timer with the GLO Control, teeth are not overheated or excessively exposed to hydrogen peroxide. The take-home gels are composed of purified hydrogen peroxide in an adhesive form (peroxydone). There is no carbamide peroxide and thus no breakdown byproducts (ammonia, alcohol) that can cause irritation to the teeth and gums.

THE INNOVATIVE METHODS OF GLO

The heat and light in the GLO universal mouthpiece activates the whitening gel, accelerating the oxidation process. The closed mouthpiece with a peripheral seal creates a sealed environment in the mouth, preventing the oxygen ions from escaping the tooth surface into the atmosphere, causing maximum efficiency and effectiveness in short exposure times. There is no need to take impressions or send the patient home with custom-made trays. The GLO universal mouthpiece is built on a flexible circuit, making the fit universal.

It's understood that the longer hydrogen peroxide is on the teeth, the whiter the results. Overexposure of carbamide peroxide and hydrogen peroxide will cause irreversible changes to the teeth and sensitivity. People do not need to sleep in whitening trays or use a system for weeks on end. There is a faster and safer way, and dental professionals as the expert can share the facts with their patients. Patients don't want to experience sensitivity by exposing their teeth to peroxide and high heat for too long.

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PATIENT EXPECTATIONS

WHITENING ENDPOINT

Regardless of the type of stain, all patients will reach a point at which teeth may not lighten further. This stage is called the whitening endpoint.

The whitening endpoint is based on individual tooth structure, the thickness of the enamel or calcified dentin. To whiten teeth after the endpoint results in tooth breakdown and loss of enamel. Therefore, it is critical for dental professionals to know that bleaching must be stopped at or before the saturation point. This saturation point, well defined by Frysh,[8] shows how the enamel matrix will break down as the dentinal structure and enamel is exposed to highly reactive oxygen ions for too long.

RESTORATIONS

The color of porcelain crowns, bridges, ceramic veneers, implants, composite, bonding, inlays/overlays, or areas of gingival recession where there is root exposure cannot be changed internally, only lifting extrinsic stains can have some whitening effect. Whitening occurs only on the natural enamel surface of the tooth, from the incisal edge to the CEJ.

COLOR STABILITY AND MAINTENANCE WITH GLO PROFESSIONAL

Patients should be reminded to avoid staining foods and drinks for up to 48 hours after whitening (that includes coffee, tea, tobacco, mustard, and ketchup). Patients should understand that the habits that led to their tooth stains will help to re-stain them in the future, so it's important to develop a whitening maintenance regimen for patients.[24]

The take-home GLO Professional device allows our patients to re-whiten and maintain the whitening results they achieved in the office. The basic rule of thumb is for the patients to use one G-Vial a month for maintenance and use the take-home device for two whitening sessions a year at home. Of course, our patients aren't always diligent and all whitening patients continue to schedule touch-ups. It's important for hygiene schedulers to ask all whitening patients if they would want a touch-up whitening at their routine hygiene appointment, which is only an extra 15 minutes for two 8-minute applications in addition to the hygiene appointment. This is a terrific add-on to the hygiene appointment.

Patients should also maintain standard oral healthcare protocol and return to the dentist's office every four to six months to monitor and maintain a bright, healthy smile.

BEFORE AND AFTER

Case 1

A 40-year-old female presents with A2 shade whitened to an 0M3 with the in-office GLO Professional whitening 30% H_2O_2 gels. Her take-home regimen was five days in a row with four 8-minute applications per day.

BEFORE AFTER

Case 2

A 32-year old female presents with A3 shade whitened to an 1M1 with the in-office GLO Professional whitening 30% H_2O_2 gels. Her take-home regimen was five days in a row with four 8-minute applications per day.

BEFORE AFTER

BEFORE AND AFTER: TETRACYCLINE CASE

Case 3

A 28-year-old male patient presented with a class 1 tetracycline case - *the most difficult teeth whitening scenario.* Patient was treated with an aggressive GLO Science Professional regimen due to the severity of the tetracycline staining.

BEFORE AFTER

REGIMEN

1. In-Office: Four 8-minute passes of GLO Science Professional chairside whitening using 30% H_2O_2
2. Take-Home: 14 days of GLO Science Professional take-home whitening treatments (four 8-minute applications per day)
3. In-Office: Four 8-minute passes of GLO Science Professional chairside whitening using 30% H_2O_2.
4. Take-Home: 14 days of GLO Science Professional take-home whitening treatments (four 8-minute applications per day)

RESULTS

After two in-office GLO Science Professional whitening treatments using 30% hydrogen peroxide, each followed by 14 days of GLO Science Professional take-home whitening using the professional strength G-Vial whitening gel, the patient moved 16 shades on the VITA shade guide, starting at C4 and ending at 1M1.

COMMENTS

The maintenance of whiter teeth is based on the patient's wants, needs, and lifestyle, so adjust patient instructions accordingly.

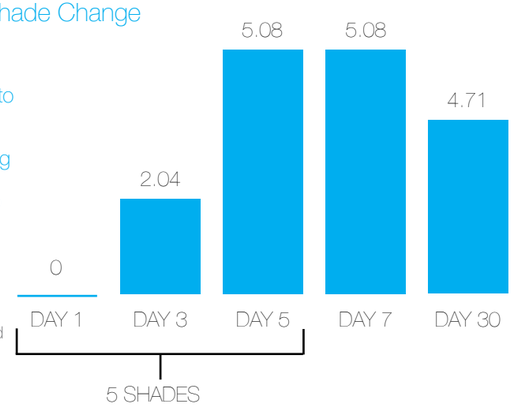
The 30% concentration formula is used on all adults, unless there is a high level of sensitivity from recession and root exposure. For patients with more stubborn intrinsic stains, such as tetracycline stains and older patients who have more dentinal deposition and thus more yellow teeth, a more aggressive whitening regimen needs to be employed. Patients with yellow and grey teeth require the longest contact time. Great results are achieved by jumpstarting the process with in-office whitening and combining that with a high number of days of take-home treatment (10 to 20 days, depending on the severity of the tetracycline stain cases).

CLINICAL STUDIES

GLO Science Professional Take-Home Shade Change on Maxillary Teeth

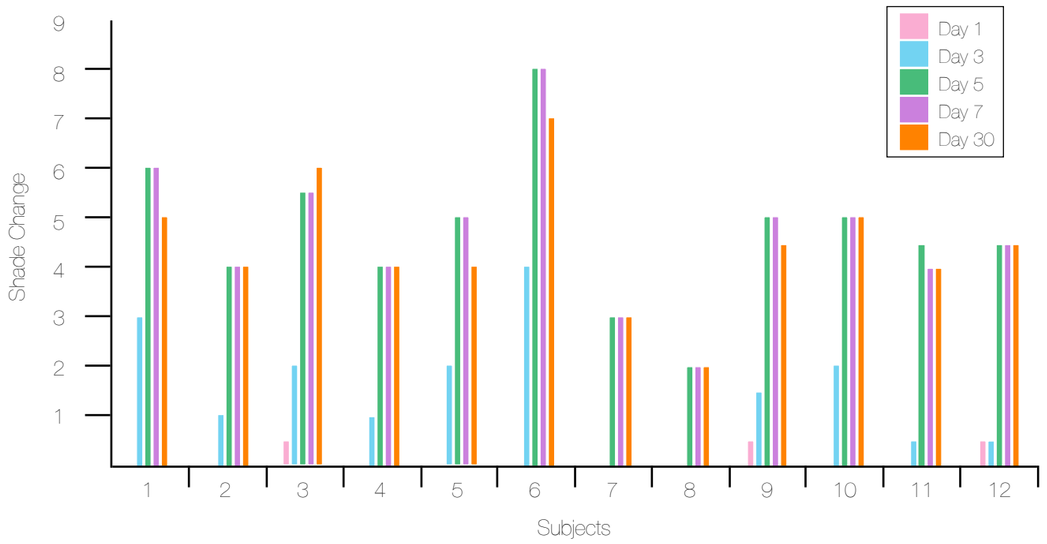
RESULT:
Average of 5 tooth shades lighter in 5 days - up to 7 shade changes (chart 1).

- 100% of GLO users stated that the bleaching device and system was very easy to use
- 100% of GLO users reported they started to see a difference after day 3 of treatment
- Subject satisfaction was extremely high



Clinical Study performed by Hatice Hasturk, DDS, Ph.D., and Thomas Van Dyke, DDS, PhD, Boston University.

CHART 1 - SHADE CHANGE AT DAY 1, 3, 5, 7, 30



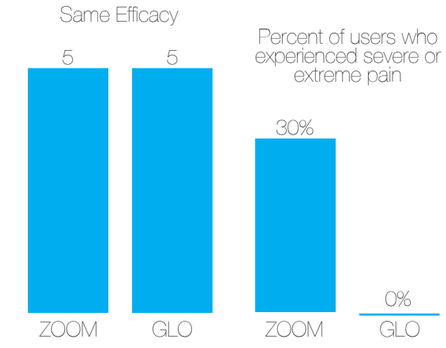
*The whitening treatment ended at day 5.
**Shade stability was checked on days 7 and 30.

CLINICAL STUDIES

CLINICAL STUDY:
GLO Brilliant Personal Teeth Whitening Device vs. Zoom Professional Whitening

RESULT:
GLO Brilliant has equal efficacy without severe/ extreme pain

- 0% of GLO users experienced extreme to severe pain after using the product
- 30% of Zoom uses experienced extreme to severe pain after using the product
- GLO users own the device; therefore, regression or fallback from the original shade is not seen due to maintenance

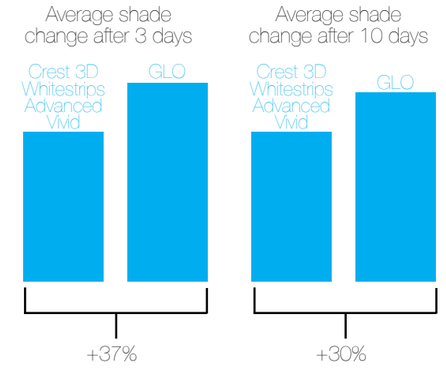


Clinical Study performed by Dr. Sushma Nachnani, University

CLINICAL STUDY:
GLO Brilliant Personal Teeth Whitening Device vs. Crest 3D Whitestrips Advanced Vivid

RESULT:
GLO users whitened by 4.8/5 shades
Whitestrips users whitened by 3.7 shades

- 100% of GLO users were satisfied with the product after 10 days
- 0% of GLO users reported any pain or cold sensitivity in the teeth after using the product
- 86% said they would recommend GLO to a friend



Clinical Study performed by Dr. Sushma Nachnani, University Health Resources

REFERENCES

1. Watts A, Addy M. Tooth discolouration and staining: A review of the literature. Br Dent J. 2001;190:309-316.
2. Fasanaro TS. Bleaching teeth: History, chemicals, and methods used for common tooth discolorations. J Esthet Restor Dent. 1992;4(3)71-78.
3. Kugel G, Aboushala A, Zhou X, Gerlach RW. Daily use of whitening strips on tetracycline-stained teeth: Comparative results after two months. Compend Contin Educ Dent. 2002;23:29-34.
4. Gerlach RW, Zhou X. Vital bleaching with whitening strips: Summary of clinical research on effectiveness and tolerability. J Contemp Dent Pract. 2001;2:1-16.
5. Palo RM, Bonetti-Filho I, Valera MC, Camargo CH, Camargo S, Moura-Netto C, Pameijer C. Quantification of peroxide ion passage in dentin, enamel, and cementum after internal bleaching with hydrogen peroxide. Oper Dent. 2012;37(6):660-664.
6. Chen J, Xu J, Shing C. Decomposition rate of hydrogen peroxide bleaching agents under various chemical and physical conditions. J Prosthet Dent. 1993;69(1)46-48.
7. Browning WD, Blalock JS, Frazier KB, Downey MC, Myers ML. Duration and timing of sensitivity related to bleaching. J Esthet Restor Dent. 2007;19(5)256-264.
8. Frysh H. Chemistry of bleaching. In: Goldstein RE. Complete Dental Bleaching. 1st ed. Hanover Park, IL: Quintessence Publishing; 1995:25-32.
9. Gerlach RW, Gibb RD, Sagel PA. A randomized clinical trial comparing a novel 5.3% hydrogen peroxide whitening strip to 10%, 15%, and 20% carbamide peroxide tray-based bleaching systems. Compend Contin Educ Dent. 2000;29:S22-S28.
10. Haywood VB, Caughman WF, Frazier KB, Myers ML. Tray delivery of potassium nitrate-fluoride to reduce bleaching sensitivity. Quintessence Int. 2001;32(2)105-109.
11. Yarborough DK. The safety and efficacy of tooth bleaching: a review of the literature 1988-1990. Compendium. 1991;12(3):191-196.
12. Gerlach RW, Zhou X. Comparative clinical efficacy of two professional bleaching systems. Compend Contin Educ Dent 2002;23:35-41.
13. Davidi MP, Hadad A, Weiss EI, Domb A, Mizrahi B, Sterer N. The effect of a mild increase in temperature on tooth bleaching. Quintessence Int. 2008;39(9)771-775.
14. Cohen SC. Human pulpal response to bleaching procedures on vital teeth. J Endod. 1979;5(5)134-138.
15. Robertson WD, Melfi RC. Pulpal response to vital bleaching procedures. J Endod. 1980;6(7)645-648.
16. Gibson-Howell J. Review of: Tooth Whitening: Indications and Outcomes of Nightguard Vital Bleaching. J Dent Hyg. 2008;82(5).
17. Brannstrom M. The Hydrodynamic Theory of Dentinal Pain: Sensation in Preparations, Caries, and the Dentinal Crack Syndrome. J Endod. 1986;12(10):453-457.
18. Narhi M.V.O. Dentin sensitivity: A review. Jour Biol Buccale. 1985;13:75-96.
19. Brannstrom M, Astrom A. A Study on the Mechanism of Pain Elicited from the Dentin. J Dent Res. 1964:619-625.
20. Karpinia KA, Magnusson I, Sagel PA, Zhou X, Gerlach RW. Vital bleaching with two at-home professional systems. Am J Dent. 2002 Sep;15 Spec No:13A-18A.

REFERENCES

21. Burningham AR, Davidson BJ, Malekzadeh S, Dasgupta R, Yoder BE, Newkirk KA. Tooth whiteners as a risk factor for oral cavity squamous cell carcinoma: A report of cases. Paper presented at: 6th International Conference on Head and Neck Cancer; August 7-11, 2004; Washington, D.C.
22. Deliperi S, Bardwell DN, Papathanasiou A. Clinical evaluation of a combined in-office and take-home bleaching system. J Am Dent Assoc. 2004;135(5)628-634.
23. Matis BA. Degradation of gel in tray whitening. Compend Contin Educ Dent. 2000;28:S28, S31-S35.
24. Odioso LL, Gibb RD, Gerlach RW. Impact of demographic, behavioral, and dental care utilization parameters on tooth color and personal satisfaction. Compend Contin Educ Dent. 2000;29:S35-S41.