

Tooth Whitening – Then and Now

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Everyone wants to have a radiant smile with gleaming pearly whites – and today, practically everyone can! Sales of over-the-counter whitening products have been estimated to approach \$1 billion a year in North America alone.¹ Tooth whitening has become a multi-million dollar industry, and there are literally hundreds of competing products to whiten teeth, be they in-office procedures or take-home systems. The more you know about tooth whitening, the better prepared you'll be to help your patients make informed decisions about what system is right for them.

How it all began

The dental use of hydrogen peroxide, the basic ingredient in all tooth whitening products, has been documented for over 80 years. Initially, hydrogen peroxide was used for periodontal treatment and wound healing, because it was proven to prevent and retard the colonization and multiplication of anaerobic bacteria.^{2,3}

In 1966, Schneider et al.⁴ documented the use of a peroxide-containing gingival strip to apply peroxides in periodontal tissue healing. It wasn't long before an accidental side effect was observed - peroxide actually whitened the teeth.

Later, a pediatric dentist, Dr. Jerry Wagner, used Proxigel in custom-fitted, vacuum-formed trays specifically for whitening teeth. These were FDA-approved oral antiseptics containing 10% carbamide peroxide.¹ The concept of tooth whitening was born.

How it works

Hydrogen peroxide releases the oxygen that breaks down the conjugated bonds in protein chains (stains) into a single bond, which increases the absorption of colour wavelengths resulting in the reflection of little colour (i.e. a whitening effect).⁵

Extrinsic staining, which affects only the enamel surface, can be caused by tea, coffee, nicotine, chewing tobacco, blueberries, wine and natural aging. These stains are all relatively easy to treat with tooth whitening. The intrinsic stains that discolour the internal aspect of the tooth such as fluorosis, tetracycline, trauma, and systemic conditions are infinitely more difficult to treat.

Even though peroxides in whitening materials have been shown to permeate intact enamel in just a few seconds⁶, changing the colour of the dentin requires long exposure to realize positive results.

Is it safe?

The safety of using hydrogen peroxide and carbamide peroxide has been documented in numerous studies. In a retrospective look at two hundred and fifty-six major medical and dental journals Yarborough⁷ states that “the safety and efficacy of hydrogen peroxide is well established.”

Studies on the effect of hydrogen peroxide on the oral hard tissues and pulp have shown that “hydrogen peroxide does not adversely affect enamel morphology or microhardness and hydrogen peroxide is not expected to inhibit pulpal enzymes”⁸ Even when used for extended periods of time when treating tetracycline-stained teeth, no adverse effects have been noted using carbamide peroxide.⁹

Tooth whitening and tooth sensitivity

In some cases, tooth sensitivity may occur as a side effect of tooth whitening. Tooth sensitivity as a result of whitening teeth is dose- and time-related. The higher the dose or concentration of the whitening agent and the longer the teeth are exposed, the greater the risk of tooth sensitivity. If sensitivity occurs, the first and easiest way to address the problem is to decrease the time the patient treats the teeth or decrease the dosage of the peroxide or carbamide peroxide.

Many products contain water to decrease the dehydration effects of whitening, and others have fluoride and potassium nitrate to decrease the incidence of tooth sensitivity. Potassium nitrate penetrates the dentinal tubules and depolarizes the nerves, decreasing the painful stimulus.¹⁰ Potassium nitrate gels, which can be utilized in bleaching type trays for hypersensitive root surfaces, include UltraEZ (UltraDent), Den-Mat Desensitize (Den-Mat) and Relief (Discus). Recently, Amorphous Calcium Phosphate has been added to products like Zoom2 (Discus Dental) to address this issue.

In-office tooth whitening

In-office tooth whitening uses high concentrations of hydrogen peroxide. It is more expensive for the patient than take-home whitening due to the chair time required. In-office tooth whitening is best for those patients who want faster, more immediate results, or patients who need close monitoring for clinical conditions, such as extensive tissue recession or deep unrestored abfraction lesions. It is also necessary for endodontic or internal tooth whitening.

Many current systems employ light-activated bleaching. Some of these include Laser Smile (Biolase Technology) 37% hydrogen peroxide, ArcBrite (Biotrol) 30% hydrogen peroxide, BriteSmile (BriteSmile) 15% hydrogen peroxide, Rembrandt Smile (Den-Mat) 35% hydrogen peroxide, Zoom (Discus Dental) 20% hydrogen peroxide, and LumaWhite Plus (LumaLite) 35% hydrogen peroxide.

Because of media coverage about light-activated bleaching, patient demand for this process is increasing. However, CRA clinical trials repeatedly show that light and heat do

not increase tooth lightening and are not necessary for vital tooth bleaching. Contact time and concentration of active ingredients are the critical factors.¹¹ The use of lights may impress patients, but they add cost, occupy operatory space, can cause soft tissue burning and can increase operatory temperature.¹³ All systems recommend a take-home tray as an adjunct, so the question is whether any observed benefit is due to the light or the tray.¹³

Before utilizing a light-activated bleaching system, ask the patient if he/she is on any medication. Some medications can cause minor to extreme photosensitivity. These include acne medications, anti-cancer drugs, antidepressants, antihistamines, antimicrobials, antiparasitic drugs, antipsychotic drugs, diuretics, hypoglycemics and non-steroidal anti-inflammatory drugs.

In-office whitening systems not using light or heat include Illumine (Dentsply Professional) 15% hydrogen peroxide, Office White (Life-Like Cosmetic Solutions) 40% hydrogen peroxide, Perfecta White (Premier Dental Products) 35% hydrogen peroxide, Niveous (Shofu Dental) 25% hydrogen peroxide and Opalescence Xtra Boost (UltraDent) 38% hydrogen peroxide.

Due to the negative effects on gingival tissue of these high concentrations of hydrogen peroxide, many of these systems utilize various forms of tissue protection to minimize the potential for gingival damage. The application times and number of applications vary by product.

Take-home tooth whitening

In March of 1989, Dr. Harald Heymann and Van Haywood introduced the concept of tooth whitening using a nightguard with a viscous gel containing a thickening agent (Carbopol), which allowed for longer bleach activation and increased retention in the tray.¹⁴

In 1989, Dr. Dan Fischer, who created Opalescence carbamide peroxide (UltraDent), received a patent for creating the thick and sticky whitening gel formulation that is still the basis for most nighttime gels marketed today. This was the first ADA-approved system for whitening.¹ This product was developed with a high water content to minimize tooth sensitivity, a neutral pH, and a thixotropic viscosity to stay in the tray. It was designed for sustained release of the hydrogen peroxide.

The degradation over time of carbamide peroxide shows that after two hours, more than 50 percent of the active ingredient is available and 10 percent is available after 10 hours.¹⁵ Therefore, for nighttime wear, the maximum whitening effect occurs in the first two hours.

Whitening agents that are recommended for nighttime use by their manufacturers include: Opalescence (UltraDent) 10%, 15%, 20%, Nupro White Gold (Dentsply Professional) 10% and 15% carbamide peroxide, Nite White Turbo (Discus Dental) 6% hydrogen peroxide, Gentle White (IMDS) 35% hydrogen peroxide, and Pola Night (Southern Dental Industries) 10%, 16% and 22% carbamide peroxide.

For daytime use, both carbamide peroxide and hydrogen peroxide are effective at-home bleaching agents.¹⁶ Products that are indicated for daytime use by their manufacturers include: Opalescence (UltraDent) 10%, 15%, 20% carbamide peroxide, Rembrandt XTRA-Comfort (Den-Mat) 16%, 22%, 30% carbamide peroxide, Natural Elegance (Henry Schein) 10%, 15%, 22% carbamide peroxide, JustSmile (JustSmile Whitening Systems) 2-10% hydrogen peroxide, Perfecta Bravo (Premier Dental Products) 9% hydrogen peroxide, and Pola Day (Southern Dental Industries) 3%, 7.5%, and 9.5% hydrogen peroxide.

An innovative new product by UltraDent Products is Treswhite, the first pre-molded, pre-filled, disposable tooth whitening tray. The tray contains 9% hydrogen peroxide gel along with a gingival barrier protector gel around the sides. The thixotropic nature of the gel ensures that it stays in contact with the teeth.

When it comes to tooth whitening utilizing a tray, the use of reservoirs is still an issue of debate. The reservoir technique creates a little bubble of space on the inside surface of the tray immediately adjacent to the buccal surface of the tooth. This space will trap a greater quantity of bleach than a non-reservoir technique. The increased bleach quantity will release more oxygen ions over a longer period of time in the vicinity of the tooth, creating a greater early whitening effect.¹⁷

In a study by Matis, he states that “there is no clinical difference in tooth whitening after two hours of tray use whether or not reservoirs are present”, yet in his conclusions he states that “bleaching with tray reservoirs produced significantly greater tooth lightening than bleaching without reservoirs”.¹⁸ The author prefers using trays with reservoirs.

Companies like Proctor and Gamble and Colgate offer non-tray whitening products that have been well researched and documented.^{19,20} These include Crest Whitestrips, containing a 6.5% hydrogen peroxide, many different versions of Colgate Platinum whitening toothpaste, and Colgate Simply-White Whitening Gel, a paint-on gel containing 5.9% hydrogen peroxide.²¹

As a valued member of the dental team, you are in a unique position to play an active role in encouraging and educating your patient about the choices available for tooth whitening. If you have utilized a tooth whitening system yourself, don't be afraid to talk to your patient about your experience, and proudly show them your pearly whites!

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