Review Article

# At Home and In-Office Bleaching Techniques – A Literature Review

**Shilpa Ajai, K. Mahalakshmi[1]**

Dental Practitioner, Modern Dentistry Dental Clinic, Chetpet, [1]Public Health Dentistry, Meenakshi Ammal Dental College, Chennai, Tamil Nadu, India

## Abstract

Hydrogen and carbamide peroxides have been successfully used for many years; in the past century, the dental bleaching technique suffered several changes and almost 10 years before new millennium, the technique was finally recognized by the international agencies of regulation. It is important that dentists handle the peroxides with the essential knowledge because it is demonstrated that satisfactory final results of this technique depend on the correct diagnosis of stains, management of the substrates (enamel and dentin) and as well sensitivity. Dentists are exposed to several dental bleaching techniques, products, and brands, and in the last 2 decades, the devices for light activation of the peroxides have become an extensive catalog. Today, the technique is also suffering changes based on the effectiveness of the different light sources for peroxide activation and its relation to satisfactory final results of the technique. The purpose of this literature review is to explain the determinant factors that influence satisfactory final results of the techniques and provide a general overview, to achieve a treatment decision based on evidence.

**Keywords:** At home bleaching, bleaching, in-office bleaching

## Introduction

Tooth whitening can be considered as one of the simplest, quickest, and minimally invasive treatments for the esthetic improvement of darkened teeth, in addition to presenting a low cost when compared to other restorative aesthetic alternatives. Thus, it has become much sought after by patients in search of a better smile appearance.[1] The change in the color of the teeth can occur due to intrinsic and extrinsic factors. Intrinsic factors can result from dental trauma, mistaken endodontic treatments, intrapulpal hemorrhage, pulp necrosis, and certain dental diseases or defects.[2,3] Extrinsic factors, on the other hand, result from the accumulation of chromophoric substances resulting from foods and beverages such as coffee, red wines, teas and spices, the use of tobacco, and some medicines.[4,5] There is a treatment protocol for each change. Therefore, the correct diagnosis of the causal agent is essential to establish the best treatment plan and thus obtain the appropriate prognosis.[6,7,8] Among the different whitening techniques, we have homemade tooth whitening and office dental whitening. We can also have an association between both techniques. Homemade tooth whitening consists of the patient applying the whitening gel in personalized trays for a certain time, under the supervision of the dentist. It stands out for the use of low concentration bleaching agents. Dental whitening in the office consists of applying gels based on carbamide peroxide above 20% and hydrogen peroxide in the dental office.[9,10] This technique has the advantage of being directly controlled and supervised by the professional, so that there is no contact with soft tissues and gel ingestion, does not depend on the collaboration of the patient and exhibits immediate results, and can be performed in just one clinical session.[11]

## Types of Stains

The apparent color of a tooth is a combination of its innate color along with the stains present within and on the tooth surface. The chromogens when deposited on the surface of the tooth or within the pellicle layer discolor the tooth and are termed extrinsic stains. Extrinsic stains occur when chromogens such

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**Address for correspondence:** Dr. Shilpa Ajai, Department of Public Health Dentistry, Meenakshi Ammal Dental College, Chennai, Tamil Nadu, India.
E-mail: shilpaajai1208@gmail.com



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as tobacco, tea, coffee, red wine, medicines, spices, and plaque attach directly to the tooth.[12] Chromogens such as polyvalent metal salts such as iron supplements and cation antiseptics such as chlorhexidine may combine with tea and attach to the tooth indirectly, creating black or brown characteristic stains. Prophylactic procedures may remove extrinsic stains; however, the more persistent stains respond successfully to bleaching.

## Mechanism of Bleaching

Bleaching is a decolorization or whitening process that can occur in solution or on a surface. The color-producing materials in solution or on a surface are typically organic compounds that possess extended conjugated chains of alternating single or double bonds and often include heteroatoms, carbonyl, and phenyl rings in the conjugated system and are often referred to as a chromophore. Bleaching and decolorization of the chromophore can occur by destroying one or more of the double bonds in the conjugated chain, by cleaving the conjugated chain, or by oxidation of other chemical moieties in the conjugated chain.[13] Hydrogen peroxide oxidizes a wide variety of organic and inorganic compounds. The mechanisms of these reactions are varied and dependent on the substrate, the reaction environment, and catalysis. In general, the mechanism of bleaching by hydrogen peroxide is not well understood and it can form a number of different active oxygen species depending on reaction conditions, including temperature, pH, light, and presence of transition metals. Under alkaline conditions, hydrogen peroxide bleaching generally proceeds through the perhydroxyl anion (HO2). Other conditions can give rise to free radical formation, for example, by homolytic cleavage of either an O–H bond or the O–O bond in hydrogen peroxide to give H + OOH and 2 OH (hydroxyl radical), respectively. Under photochemically initiated reactions using light or lasers, the formation of hydroxyl radicals from hydrogen peroxide has been shown to increase. As peroxide diffuses into the tooth, it can react with organic coloured materials found within the tooth structures leading to a reduction in color.[10]

## Vital Teeth Bleaching

There are three fundamental approaches for bleaching vital teeth: in-office or power bleaching, at-home or dentist-supervised night-guard bleaching, and bleaching with over-the-counter (OTC) products. First, in-office bleaching utilizes a high concentration of tooth-whitening agents (25%–40% hydrogen peroxide). Here, the dentist has complete control throughout the procedure and has the ability to stop it when the desired shade/effect is achieved. In this procedure, the whitening gel is applied to the teeth after protection of the soft tissues by rubber dam or alternatives (Powell and Bales, 1991), and the peroxide will further be activated (or not) by heat or light for around 1 h in the dental office (Sulieman, 2004). Different types of curing lights including halogen curing lights, Plasma arc lamp, Xe–halogen light (Luma Arch), Diode lasers (both 830 and 980 nm wavelength diode lasers), or Metal halide (Zoom) light can be used to activate the bleaching gel or accelerate the whitening effect. The in-office treatment can result in significant whitening after only one treatment, but many more may be needed to achieve an optimum result (Sulieman, 2005b).[12]

Second, at-home or dentist-supervised night-guard bleaching basically involves the use of a low concentration of whitening agent (10%–20% carbamide peroxide, which equals 3.5%–6.5% hydrogen peroxide). In general, it is recommended that the 10% carbamide peroxide be used 8 h per day and the 15%–20% carbamide peroxide 3–4 h per day. This treatment is carried out by the patients themselves, but it should be supervised by dentists during recall visits. The bleaching gel is applied to the teeth through a custom-fabricated mouth guard worn at night for at least 2 weeks. This technique has been used for many decades and is probably the most widely used (Sulieman, 2005a). The at-home technique offers many advantages: selfadministration by the patient, less chair-side time, high degree of safety, fewer adverse effects, and low cost.[14] Despite the fact that patients are able to bleach at their own pace, this at-home bleaching technique, with its various concentrations of bleaching materials and regimens, has become the gold standard by which other techniques are judged. However, it is by no means without disadvantages since active patient compliance is mandatory and the technique suffers from high dropout rates (Leonard *et al*., 2003). In addition, color change is dependent on diligence of use, and the results are sometimes less than ideal since some patients do not remember to wear the trays every day. In contrast, excessive use by overzealous patients is also possible, which frequently causes thermal sensitivity, reported to be as high as 67% (Haywood, 1992). A 35% concentration of hydrogen peroxide is recommended by some clinicians for in-office dental bleaching, followed by at-home bleaching with gels containing 10%, 15%, or 20% carbamide peroxide (Langsten *et al*., 2002). Bailey and Swift (1992) showed that higher-concentration bleaching agents can produce more peroxide radicals for bleaching, resulting in a faster whitening process. However, this rapid process of bleaching may increase the side effects of tooth sensitivity, gingival irritation, throat irritation, and nausea (Broome, 1998). Finally, OTC bleaching products have increased in popularity in recent years. These products are composed of a low concentration of whitening agent (3%–6% hydrogen peroxide) and are self-applied to the teeth through gum shields, strips, or paint-on product formats. They are also available as whitening dentifrices, prefabricated trays, whitening strips, and toothpastes (Zantner *et al*., 2007). They should be applied twice per day for up to 2 weeks. OTC products are considered to be the fastest-growing sector of the dental market (Kugel, 2003). However, these bleaching agents may be of highly questionable safety because some are not regulated by the Food and Drug Administration.

### Nonvital tooth bleaching

There are numerous nonvital bleaching techniques used today, for example, walking bleach and modified walking bleach, nonvital power bleaching, and inside/outside bleaching.

The walking bleach technique involves sealing a mixture of sodium perborate with water into the pulp chamber of the affected tooth, a procedure that is repeated at intervals until the desired bleaching result is achieved. This technique is modified with a combination of 30% hydrogen peroxide and sodium perborate sealed into the pulp chamber for 1 week; this is known as modified walking bleach.[3] In internal nonvital power bleaching, hydrogen peroxide gel (30%–35%) is placed in the pulp chamber and activated either by light or heat, and the 36 M. Q. Alqahtani temperature is usually between 50 and 60 C maintained for 5 min before the tooth is allowed to cool for a further 5 min. Then, the gel is removed, the tooth is dried, and the "walking bleach technique" is used between visits until the tooth is reviewed 2 weeks later to assess if further treatment is needed. Finally, the inside/outside bleaching technique is a combination of internal bleaching of nonvital teeth with the home bleaching technique.

## Acid or Neutral Hydrogen Peroxide

Sun *et al*. evaluated what the effects of 30% neutral and acid hydrogen peroxide would be on human dental enamel, checking its chemical structure, mechanical properties, surface morphology, and tooth staining. In the experiment, 27 premolars were selected, randomly divided into 3 experimental groups: acid group, where the samples were immersed in 4 mL of 30% hydrogen peroxide solution and pH 3.6; neutral group, where the samples were immersed in a mixture of 4 ml of 30% hydrogen peroxide solution and pH 7.0 and 5 ml of saturated NaOH solution; and the control group, where the samples were immersed in 4 mL of distilled water with pH 6.8. Attenuated Total Reflection Fourier Transform Infrared spectroscopic analysis, Raman spectroscopy, atomic force microscopy, microhardness test, and color measurements were performed before and after treatments to perform the evaluations.[9] After the analysis, it was concluded that major changes were found in the acid group after treatment, while small changes were detected in the neutral and control groups. Thus, it was found that hydrogen peroxide at 30% in neutral concentration had the same efficacy in tooth whitening and caused less deleterious effects on the enamel than hydrogen peroxide at 30% in acid concentration.

## Temperature Influenced by Tooth Bleaching

Loretto *et al*.[14] evaluated the increase in the temperature of the pulp chamber influenced by three bleaching agents, using the photoactivated tooth whitening technique performed in a dental office. For this, a healthy and extracted human upper central incisor was selected. The remaining pulp that was in the pulp chamber was removed and the root canal was enlarged, allowing the introduction of the thermometer sensor. The pulp chamber was filled with thermal paste, which allowed heat transfer from the dental walls to the thermocouple sensor during the bleaching treatment. To whiten teeth, three photosensitive whitening agents (35% hydrogen peroxide) were used: Whiteness HP (FGM Produtos Odontológicas, Joinville, SC, Brazil), Whiteness HP Maxx (FGM Produtos Odontológicas, Joinville, SC, Brazil), and Lase Peroxide Sensy (DMC, São Carlos), SP, Brazil); and for the activation of the bleaching gels, a high-intensity light-emitting diode source, Flash Lite 1401 (Discus Dental Inc., Culver City, CA, USA) was used. From the results, it was found that exposure to light raised the temperature in the different groups studied, however, the application of bleaching gels potentiated the absorption of the heat emitted by the light source, except in the group in which the Lase Peroxide Sensy (DMC) was used. The different increases in the temperature of the pulp chamber for the different groups studied can be explained by differences in the composition of the bleaching gels.

## Associated or Clinical Bleaching

Rezende *et al*.[7] evaluated effectiveness, tooth sensitivity, and color recurrence in two different tooth whitening techniques: the technique performed in the dental office and the associated technique, which associates the whitening treatment from the office to the home. For this, 30 patients were selected, randomly divided into two groups: the associated whitening group and the office whitening group. No dental bleaching group in the office was used 35% hydrogen peroxide (Mix One Supreme, Villevie, Joinville, Santa Catarina, Brazil). For the associated bleaching group, dental bleaching was also performed with 35% hydrogen peroxide following the same protocol as the dental bleaching group, but from the following day, a home whitening technician started using hydrogen peroxide a 6% (Mix Day, Villevie, Joinville, Santa Catarina, Brazil). Both treatments have similar tooth sensitivity and intensity. It was concluded that both techniques are effective, generate similar results regarding the intensity of tooth sensitivity, an associated tooth whitening technique generates greater color stability, however, the office whitening technique shows immediate results. Thus, we must indicate each technique according to the patient's need and preference.

## Patient Selection for Vital Tooth Bleaching

Bleaching, though promising, may not guarantee success in all cases or may fail to satisfy patient's high expectations. The indications and contraindications are basically the same for both in-office and home bleaching. Patient's lifestyle, current levels of tooth sensitivity, the type of discoloration, baseline shade of the teeth, and time available for bleaching are important factors to be contemplated while selecting the bleaching technique. Patients with decay, periapical lesion, and sensitivity should seek treatment for the same before bleaching. Bleaching is contraindicated in pregnant women as the effects of bleaching materials on fetus are yet to be investigated. Erasing stains is not time-specific as some stains are more responsive to bleaching than others. Analysis of reports, studies, cases, and personal experiences has correlated stains and their response to bleaching with functions as a guideline to assist the clinician in predicting success.[4,8] It has been demonstrated that teeth with yellow hue with no

or developmental pathologies are bleached more efficiently. Younger patients experience a greater magnitude of whitening. Gender had no significant influence in the whitening response of the tooth. Tobacco stains and other brown stains respond to longer bleaching regimens, as they are not easy to bleach. There is a correlation of the sclera of the eye and tooth to be bleached. If the discolored teeth were lighter than the sclera, the probability of success would be lesser.[12,13]

## Conclusion

The importance of tooth whitening for patients and consumers has seen a dramatic rise in the number of tooth whitening products and procedures. Concomitantly, there has been a rapid increase of published *in vivo* and *in vitro* tooth whitening studies. Indeed, it is clearly evident that there is an extensive literature describing their efficacy and safety. However, some of this literature is conflicting, and these topics warrant further careful evaluation as they were outside the scope of the current review. A number of approaches to measuring tooth color changes following tooth whitening exist, each with their own advantages and disadvantages, and this topic is likely to be an area commanding further research in the future. With the continued interest in tooth whitening amongst basic and clinical researchers, the further mechanistic understanding and optimization of the factors controlling the tooth whitening process will continue to expand. This will give further improvements to the tooth whitening products and procedures and give significant benefits to the field of aesthetic dentistry. This will ultimately lead to the enhancement of patient compliance and satisfaction with the whitening outcome.

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### Conflicts of interest

There are no conflicts of interest.

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