

Tooth Bleaching: Types and Procedure with their Contentious Effects A Literature Core

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ABSTRACT

Imitation of smile aesthetics and analysis, is an initial step for dental bleaching, hence it is significant that the dentist/dental hygienist identifies how to analyze the root causes of color change and to specify whitening before suggesting the suitable dental procedure. With the high-tech advancement, dental bleaching techniques have arose to assist its use and provide comfort, safety and reduction in time, in the performance of the technique. The conservative means of external dental whitening is with hydrogen peroxide (photo activated or not) or carbamate. However, dental sensitivity is frequently complained by patients by the home and office whitening procedures. There is an innovative bleaching application in the market without the use of these bleaching gels, as a consequence decreasing post-treatment sensitivity. Such a suggestion elucidates, replacing bleaching agent by ultraviolet light. The object of this literature review is to enlighten the determining factors that affect the final satisfactory results of the different techniques and explains a general overview, permissible to reach a treatment conclusion based on evidence.

Keywords: tooth whitening, tooth bleaching, types of tooth bleaching, procedures of tooth whitening

INTRODUCTION

The depiction of whiter, brighter smiles is getting a lot of recognition in this present era of cosmetics and maquillage.(1) The commencement of Cosmetic Dentistry, which pursue to analyze the issues of the Patient's dignity, self-confidence and standard of living secondarily provides pertinence for the WHO's specification of Health i.e., state of complete physical, mental and social well-being.(2, 3) Tooth discoloration is the reason that causes an unpleasant smile, which in turn grounds the basis of cosmetic dentistry.(4) Types of tooth staining include extrinsic and intrinsic staining. Extrinsic or external staining is the generalized superficial yellowish appearance of the tooth caused by smoking, pigmentation by drinks, medications etc. Meanwhile, intrinsic or internal staining is the localized type of tooth staining, usually small, very dark in color, embedded in deeper tissues of the tooth. Factors affecting intrinsic staining include genetics, aging of tooth (leading to exposure of underlying dentin caused by enamel wear), water fluoridation and high level of fluoride intake, several developmental disorders etc.(5)

Causes of Tooth discoloration

- Poor dental hygiene

Maintaining proper oral hygiene embraces tooth brushing, flossing and regular dental visits for the obstruction of Dental caries, periodontal diseases, tooth staining and most dental problems. (6, 7)

- Tobacco use

Smoking and chewing tobacco causes brown to black discoloration of teeth causing damage to enamel, dentine and sometimes even root of the tooth. (8)

- Environmental Factors:

These include use of either Fluoridated toothpastes or mouthwashes, dietary supplements having fluoride or excessive mineralized water intake. (9)

- Aging

As you age, the outer most layer of a tooth i.e., enamel wears off revealing the dentin i.e., yellowish in color. (10)

- Trauma

Any fall during enamel development can lead to discoloration of milk tooth and it can lead to permanent tooth. (11)

- Medication:

Several medicines such as Doxycycline and tetracycline when given to children in tooth developing age can lead to tooth

discoloration. Other medications include anti-psychotics, anti-hypertensives, anti-histamines etc. (12)

- Restorations:

Certain restorations such as amalgam can cause gray black tooth discoloration. (13)

Working Principle of Tooth Whitening: Tooth whitening can either be done by physical or by chemical means. Physically the stains on a tooth surface can be removed by tooth brushing or scaling.

- Bleaching

Chemically it can be done by deterioration of chromogens (pigments that cause tooth discoloration) which is called bleaching. (14)

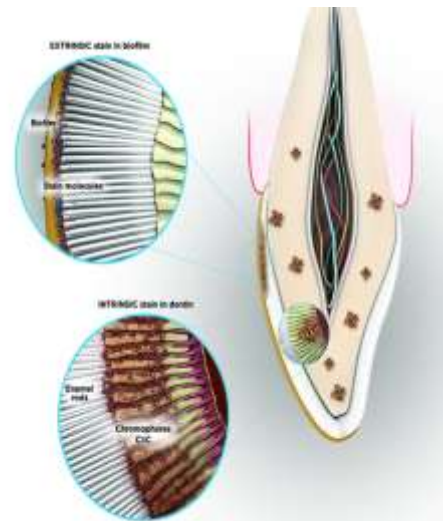


Figure 1:

The active ingredient in most whitening products is Hydrogen per oxide or carbamide peroxide, which break down into per oxide ions (known as whitening molecules). Hydrogen per oxide is mostly used in most of the cases as it is more effective than carbamide peroxide and relatively less time consuming.

Hydrogen peroxide breaks down into peroxide (penetrates dentinal structures within 15 minutes of duration) and water, while carbamide peroxide breaks down into hydrogen peroxide, urea and ammonia. Urea slows down the decomposition of hydrogen peroxide, thereby prolonging the process of whitening and causing irritation of soft tissues. (15, 16)

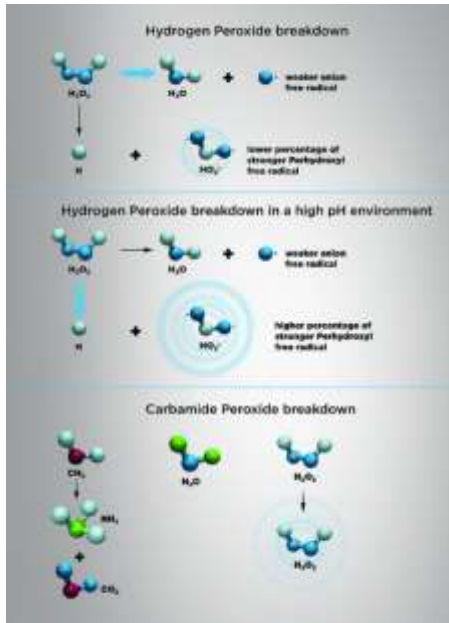


Figure 2: Piezo catalysis or mechano-catalysis

The Piezo catalytic effect is the activation of the electrical charges in response to mechanical stimuli (either by tooth brushing, flow of water, respiration or muscle movement). The process is similar to photo-catalysis, but the only difference is the use of light-induced charges instead of mechanical ones. (17, 18) ZnO, BaTiO₃, and BiFeO₃ are considered to be efficient Piezo electric catalysis. (19, 20)

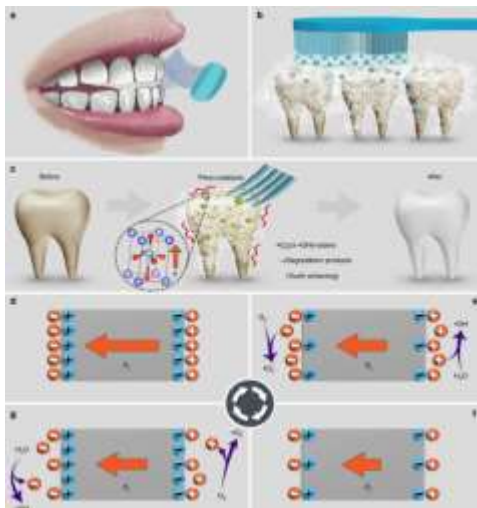


Figure 3: Factors affecting Tooth whitening

Contact Time: The greater the exposure of Hydrogen peroxide, the whiter the tooth. But too much exposure under high heat can increase the intrapulpal pressure inside the tooth causing severe tooth sensitivity and the pain felt by the patient is known to be Zinger. (15)

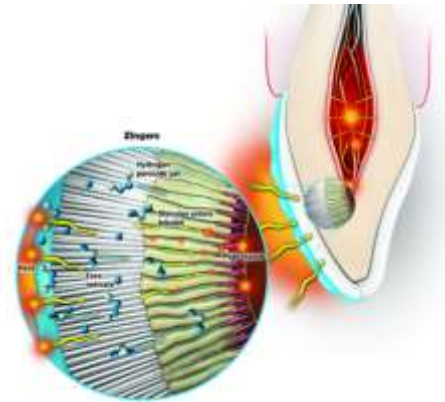


Figure 4: Concentration of the bleaching agent

The higher the concentration of whitening gels, the higher the tooth whitens but penetrates dentinal tubules causing sensitivity in teeth mentioned above. (21)

- PH

For the extension of the shelf life of the whitening product, acidic pH should be maintained. PH should be increased to produce a greater whitening effect in less span of time. Higher pH yields the most active per hydroxyl molecule and fewer negative oxygen ions that are less active. (22)

- Environment

The efficiency of the process of tooth whitening can be increased by prevention of oxygen ions to escape in the air. This is the case with dentist-administered whitening products, preventing infiltration of the enzymes in saliva known as peroxidases into the whitening gels, thereby preventing escape of the free oxygen ions into the atmosphere. (23)

- Temperature

The basic kinetics of a chemical reaction includes every 10 degrees Celsius of rise in temperature doubling the rate of reaction. Temperature higher than 53 degrees Celsius or 128 degrees Fahrenheit can cause reversible pulpitis and intense sensitivity of teeth in patient undergoing tooth whitening. Below this temperature is a safe and serene zone for patients. (24)

Pros and cons of Dental Bleaching: Patient's belief regarding their dental esthetics and relief of pain are the most important concerns for a dental practitioner as dentistry is all about patient's satisfaction and fulfilment of trust, they do on you being a Dental Professional. (25) In order to satisfy a patient's demand for perfect bright smile with no pain in any of the tooth is a cosmetic and restorative based concern. Whitening procedures can either be performed in a clinic or at home by the patient himself. The advantages for in-office bleaching include brighter white smile in less period of time, of course under a professional assistance with no or less damage to soft tissues of the teeth. (26, 27) The disadvantages are basically the duration and cost of the treatment along with minor sensitivity issues patient experience for some first days of the tooth whitening procedure. (28) The benefits of home bleaching are the simplest easiest application of the material with no chair-side appointment and lower concentration of the bleaching agent. (29) The drawback for home bleaching is the prolonged usage of whitening kit resulting in changes of soft tissues such as irritation of pulpal tissues. (30)

Although bleaching agents provides visible outstanding changes in the dental esthetics of a patient but the ramifications the bleaching materials abandon on the surface of the enamel cannot be either neglected or nullified. (31) Increased porosity of the enamel surface results in the morphological changes and chemical deterioration of the organic and inorganic structures of enamel, thereby causing sensitivity and minor pain in some patients as a side effect. (32)

If a patient undergoes tooth filling with Glass ionomer cement or any other resin-based cement, tooth whitening should be avoided for a whole day because of the increased solubility and decrease bond strength between the tooth and resin-based cement for the first 24 hours of duration. (33)

Internal bleaching can result in severe periapical tissue damage and cervical root resorption, when the tooth is not properly obturated after Root Canal Treatment is done, preventing flow of the bleaching agent into the periapical tissues. (34) No such case of cervical root resorption is reported in case of a vital tooth. However, the flow of the bleaching agent into the periapical tissues can be reduced by using radical scavenger such as thiocarbamide. (35)

Occasionally patients undergoing tooth whitening complain of minor gastro intestinal issues such as burning palate and throat. Stomach upsets are also reported in some of the cases. (36)

Effects on dentin because of the whitening agents are not as much described as enamel but micro hardness of dentin is observed as compared to enamel. (37) Furthermore, Dentin abrasive wear is observed in a study on the effects of erosion, dentifrice abrasion and bleaching on the enamel and dentin wear. It was concluded that enamel abrasion and erosion cannot be seen with a bleaching agent (10% carbamide peroxide) but might cause dentinal abrasion wear in some cases. (38)

Marginal leakage was observed in a study in which a penetrated dye was used on an extracted tooth with composite resin filling. (39) However, another study showed relatively showed no marginal leaking of a composite resin filled tooth (40) regarding staining of bleached composite resin tooth, it was observed that early staining of bleached composite resin occurs than the bleached tooth. (41) This could be the result of surface roughness and alteration in the surfaces of restorations. Further studies were done regarding the same concern of staining of composite filled teeth and two studies showed that bleaching is beneficial for composite restorations. One suggested that bleaching can remove staining from the external surfaces of a composite based resin filled tooth. Meanwhile, another suggested that bleaching removes stains better than polishing thereby resulting in original Chroma of the tooth. (41)

Types of Bleaching: Bleaching can be broadly classified as bleaching on vital and non-vital teeth. Vital tooth bleaching can be done in clinics or at home both are carried under dentist's supervision. Another type of contemporary bleaching method known as bleaching with over-the-counter (OTC) products is also gaining popularity these days. (42)

Vital tooth bleaching: In-office bleaching: In-office Bleaching is done in multiple visits where the dentist applies the whitening gel on the tooth surface in passes of 10 minutes each time, ensuring safety of surrounding soft tissues. Usually 25%-50%hydrogen peroxide (HP) is used which is then activated by heat, lasers or LED lights to activate the bleaching agent and speedup the whole process. (43) The whole process is under the control of the dentist and can be halted upon achieving the desired result. This process eliminates the issues of patient's compliance and manual dexterity. This mode of bleaching is ideal for patients with gag reflex who cannot opt for at-home bleaching, also this process can be used as a kick start for at-home bleaching regimen to obtain optimum results. Multiple visits may be required to achieve the preferred result. (43) To give a fine lustrous finish to the whole process the teeth are generally polished with diamond polishing pastes along with the application of neutral fluoride gels to stabilize sensitivity. The downside of this quick process involves increased tooth sensitivity, throat sensitivity, gingival sensitivity nausea and a costly procedure. (44)

Vital tooth bleaching: At home bleaching: At home Bleaching is a long and slow process carried by the patient as instructed by the dentist. It basically involves use of low concentration of whitening agents (10%-20%carbamide peroxide, CP) as it's a long, slow process and higher concentration of whitening agents is reported to have caused increased tooth sensitivity. (45)Whitening gel is

loaded into a custom made mouth guard and is worn by the patient usually during the night or during the day as well depending upon patient's availability of time and sensitivity. The process is carried out over the period of 2 weeks or as directed by the dentist during the recall visits. This mode is more cost effective, safe and requires less chair-side time. However patient compliance counts more for its success rates. The difference between at office and at home bleaching differs in the concentration of the whitening gel used, they type of bleaching agent used and the bleaching time. There is a difference in opinion to the end result produced by the two modes of bleaching. Many suggest at-home bleaching to be the gold standard against all other techniques however others suggest there is not much difference in the end result between the two modes of bleaching. (46)

Finally with the increase in demand for bleaching teeth these days Over the Counter bleaching has gained much popularity. The increase interest in aesthetics these days and heavy marketing of these whitening products have led to the blast of products marketed directly to the public claiming to address the tooth coloration. The main difference between this technique and the former two techniques is mainly dentist supervision. Here the patient makes his own diagnosis, buys the OTC whitening agent commercially available and applies it independently. (47) These products are available as whitening toothpastes, strips, gels, whitening dentifrices, prefabricated trays, mouth rinses, whitening dental floss and toothbrushes etc. The composition of these products, the mode and frequency of application varies from product to product. The most common among them like whitening dentifrices are composed of abrasives along with low quantities of hydrogen peroxide and carbamide peroxide. (48) The whitening gels and strips are composed of a very low quantity of hydrogen peroxide(6%-10%) applied for 20-30 minutes twice daily for 14 days and finally whitening mouth rinses that are typically composed of very low concentration of hydrogen peroxide(HP 1.5%) used for around 3 months daily for 60 seconds each time. The result of these commercially available product is debatable and is also much relatable to patient's compliance and how effectively the manufacturer's protocols are followed. However, studies have proven these products to lighten the tooth by 1-2 shades. (43)

Non-vital tooth bleaching: Non-vital Tooth Bleaching is basically a conservative approach to have an aesthetically pleasing look for endodontically treated teeth. Crowns, veneers and other restorative procedures are also used as an alternative but these techniques are neither minimally invasive nor pocket friendly when compared to non-vital bleaching. (49) The procedure involves placement of an oxidizing agent within the cavity chamber to remove discoloration. For non-vital bleaching different concentrations of hydrogen peroxide and carbamide peroxide are usually used. The mechanism of action of different whitening agents remains the same and the process is activated and accelerated using light or heat. The main difference between the vital and non-vital bleaching is the type of stains being addressed, vital bleaching targets mostly extrinsic stains and non-vital intrinsic stains. There are numerous non-vital bleaching techniques available such as in-office technique, inside/outside technique, and walking and modified walking bleach technique. (42)

For in-office non vital bleaching techniques a higher concentration of hydrogen peroxide (35%) is used similar to in-office vital tooth technique. The bleaching agent is placed inside the chamber and is activated using heat or light. The bleaching gel remains in the tooth for 15-20 minutes and is then rinsed off. The procedure can be repeated to obtain the desired result. (49)

The inside/outside technique as the name implies involves application of the bleaching agent on the outside (labial surface) and inside (endodontically sealed chamber) of the discolored non-vital tooth. The bleaching agent used is 10%-20% carbamide peroxide gel and is placed inside the tooth chamber and on the vacuum drawn splint of the non-vital tooth. Then similar to the at-home bleaching technique under controlled visits the progress is

noted and the gel is re-applied until proper results are obtained. (49)

Finally for walking technique a mixture of sodium perborate and water is placed within the cavity of the endodontically treated non vital tooth. The gutta percha within the tooth is removed 2 mm below the CEJ with a heated instrument or a low speed small round bur. A cervical barrier of 2mm thickness is then placed within the cavity which can be glass-ionomer cement or a flowable resin replicating the CEJ (cemento enamel junction) level on the outside. The mixture of the whitening gel is then placed and covered and sealed with a temporary restoration. In subsequent visits the result is evaluated and the process is repeated until the tooth color matches the adjacent teeth. (50)

In modified walking technique, a mixture of sodium perborate with 30% hydrogen peroxide is used to enhance the bleaching efficacy. (42) The whole application process remains the same however the process of bleaching might require fewer days than the walking technique.

Both walking and modified walking techniques are most commonly used as compared to other methods. Walking technique can also be used for primary discolored non vital teeth.

The bleaching process sounds promising but it might not be able to meet the patient's high expectations. The results are highly dependent on the baseline shade of the teeth, type of discoloration, level of tooth sensitivity, current condition of the tooth, patient's lifestyle and compliance and the time available for bleaching. (43)

CONCLUSION

The significance of tooth whitening intended for patients and consumers has seen an intense rise in the numeral of products and procedures over current years, with a simultaneous rise in the publications over this topic. Literature proposes that the tooth whitening mechanisms by peroxide take place by the dispersion of peroxide over enamel to cause oxidation and later lightening of colored species, mostly surrounded by the dentinal regions. In outlook of the above, we clinched that the procedures of whitening are very self-contradictory; yet, they provide positive results for tooth whitening, even though sensitivity subsequently after treatment is a common adverse effect.

Declaration: Present research related to tooth whitening illustrates that it is nonviolent, nontoxic and effective once manufacturer's protocol is followed, however there are certain risks of which the profession (dentist and dental hygienist) and users should be aware.

This review article summarizes current research and valuation of the safety and effectiveness of tooth whitening regimens.

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