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Review Article

Benefits and Drawbacks of Current Bleaching Methods

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Abstract

Background: There are various methods for whitening teeth, each with their own mechanism of action. The productiveness of these different methods is count on the tooth discoloration that is being treated.

Objectives: The aim of this review article was to evaluate the benefits and drawbacks of current bleaching methods.

Methodology: Collecting data was by collecting the related articles between the years 2008 to 2018 that have been published in PubMed indexed journals.

Conclusion: Operator should have a thorough understand about chemical composition of all teeth bleaching materials and complete awareness about the drawbacks of different techniques used for that purpose.

Keywords: *Bleaching; Tooth Whitening*

Introduction

Nowadays, Patient demands for esthetic white perfect smile can be achieved in popular manner after improvement of chair side tooth whitening products and introduction of widely used home bleaching components. Modern societies have been changed their self-awareness toward the aesthetic needs after the social media influencers such as famous players, musicians, fashion models and actors whom focused to keep white perfect smiles during their appearance among their audience [1]. There are different modalities of treatment for discolored teeth, including removal of surface stains through scaling and polishing, micro-abrasion and macro-abrasion, dental bleaching, veneering and placement of full coverage porcelain crowns.

Causes of teeth discoloration

Teeth discoloration classified into extrinsic and intrinsic stains. Extrinsic stains are located on the outer surface of teeth, whereas intrinsic stains are internal. Stains on the external surfaces of teeth (referred to as *extrinsic discolorations*) are common and may be the result of numerous causes that include poor oral hygiene, Remnants of Nasmyth's membrane (stained enamel cuticle) which is more common condition in children than adults, Existing restorations, Gingival bleeding, Plaque accumulation, Eating habits and presence of chromogenic microorganisms [2]. In older patients, stains on the surfaces of the teeth are more likely to be brown, black, or gray and occur on areas adjacent to the gingival tissue. Poor oral hygiene is a contributing factor, but coffee, tea, and other types of chromogenic food or

medications can produce stains (even on plaque-free surfaces). Tobacco stains also are observed frequently [3]. Intrinsic discolorations are caused by deeper internal stains or enamel defects; these stains are more complicated to treat than external types. Teeth with vital or non-vital pulps and root canal–treated teeth can be affected. Causative factors include; hereditary disorders, medications (particularly tetracycline preparations), high fevers associated with early childhood illnesses and excess fluoride [4]. The staining may be located in enamel or in dentin. Discolorations restricted to dentin still may show through the enamel. Regarding tetracycline stains, various preparations of the tetracycline antibiotic drug can cause the most distracting, generalized type of intrinsic discoloration. The severity of the staining depends on the: dose of the drug, duration of exposure to the drug and type of tetracycline analogue used [3,4]. Different types of tetracyclines induce different types of discoloration, varying from yellow-orange to dark blue gray. The dark blue-gray, tetracycline-stained teeth are considerably more difficult to treat than teeth with mild yellow-orange discolorations. Staining from tetracycline type drugs most frequently occurs at an early age and is caused by ingestion of the drug concomitant with the development of the permanent teeth [5]. The presence of excess fluoride in drinking water and other sources at the time the teeth are forming can result in intrinsic stain called Dental fluorosis. Because of the high fluoride content in the enamel, fluorosed teeth may be difficult to treat with acid-etching and resin-bonding procedures [6]. Localized areas of demineralization or the failure of the enamel to calcify properly can result in hypo-calcified white spots. After eruption, poor oral hygiene also can result in decalcified white spots. Poor oral hygiene during orthodontic treatment frequently results in these types of decalcified defects. White or discolored spots with intact enamel surface (i.e. surface not soft) are often evidence of intraoral re-mineralization, However, such spots are not indications for invasive treatment (unless for esthetic concerns) [5,6]. Aging effects also can result in yellowed teeth. As patients grow older, the tooth enamel becomes thinner because of wear and allows the underlying dentin to become more apparent. Also, there is often a continuing deposition of secondary dentin in older individuals that resulting in greater dentin thickness. This deposition results in a yellowing effect, depending on the intrinsic color of the dentin. Non-vital teeth also can become discolored intrinsically. These stains usually occur in individual teeth after eruption has taken place. The pulp may become infected or degenerate as a result of; Trauma, Deep caries and Irritation from restorative procedures. If these teeth are properly treated by root canal therapy, they usually retain their normal color. If treatment is delayed, discoloration of the crown is more likely to occur [7]. The degenerative products from the pulp tissue stain the dentin and are readily apparent because of the translucency of the enamel. Trauma resulting in calcific metamorphosis (i.e. calcification of the pulp chamber, root canal, or both) also can produce significant yellowing of the teeth. This condition is extremely difficult to treat. As mentioned before, tooth bleaching is a popular cosmetic procedure that can give someone a brighter smile and the appearance of youth by reducing discoloration on stained teeth. There are a variety of bleaching techniques which include: in-office procedures and home treatments. The results of both are generally successful, although a common side effect is an increase in tooth sensitivity. This generally resolves within a few weeks after treatment is discontinued. The sensitivity side-effect can be reduced by pre-treating with calcium, fluoride preparations, or both. As demand for in-office external teeth whitening grows, so does the demand for less costly customer-directed programs. These include professionally-dispensed custom-tray-based systems and over-the-counter (OTC) systems. The latest tooth whitening trend is the availability of whitening treatments or kits in non-dental retail settings, such as mall kiosks, salons, spas and more recently, aboard passenger cruise ships. Improvement is measured in terms of shade by using either the Vita Shade Guide (4 shade ranges (A-D) with 4 to 5 darkness levels within each shade range) or the L*a*b* system which measures the change in lightness (L*, which should increase) and yellowness (b*, which should decrease) from pre-treatment to post treatment (American Dental Association (ADA), 2006) [8].

Jorgensen and Carroll researches had clarified that the most conservative way to modify the color of teeth is bleaching procedure. The most frequently used bleaching techniques are “power bleaching” (in-office) and “at-home bleaching”. Power bleaching uses elevated concentration of bleaching agent (30 - 35% hydrogen peroxide) administered in a dental practice setting. On the other hand, at-home bleaching employs low concentrations of whitening agent (10 - 20% carbamide peroxide) positioned in a custom-made mouth guard and used daily over a 2 - 6-week period [9-11]. The office-administered power bleaching procedure is an adequate alternative to low processing at-home bleaching, specifically in severe discolored individual teeth, uncooperative patient and if fast esthetic transformation is desired. The bleaching process could be initiated jointly by using power bleaching and at-home bleaching starting with power bleaching in the dental office and continue the procedure in home [12]. There is a conception that gives the reason of the initial whitening of the tooth color to enamel dehydration but degradation of tooth whitening after from dental bleaching is original sign that occurs inevitably [13]. Matis., *et al*. [14] in a randomized clinical trial showed that the rebound effect is associated with 10% and 15% concentrations of

carbamide peroxide gels. Giachetti., *et al.* [15] the regression of bleaching efficacy with at-home and in-office bleaching techniques in this study were not clinically considerable but the bleaching outcomes were preserved for a long period of time.

Teeth sensitivity following the procedure is commonly related to microscopically small enamel defects and subsurface pores, which enables the whitening agent to infiltrate to the dentinal tubules and ultimately the pulp, resulting in reversible pulpitis and consequently teeth thermal sensitivity without developing it to irreversible pulpitis. The strength and the powerlessness of the side effects are linked to peroxide concentration, time, gel applications number of times, raising of pulp temperature after light activation. Schulte., *et al.* [16] found that strong sensitivity made 14% of patients cutting off their bleaching treatment. However, dentin exposure plays an important factor in tooth sensitivity because it is often misdiagnosed as not exist [17]. However, other researchers [11] have found a relationship between the incidence and seriousness of thermal sensitivity with gingival recession and the duplication of treatments, but not the actual period of the treatment.

Adverse effects of tooth whitening

Burns, irritation and oedema

In the study of Walsh [18], he concluded that thirty percent H_2O_2 can cause severe irritation or burns on contact with skin or eyes. Bhat [19] revealed that following inadvertent irrigation of H_2O_2 into the periodontal ligament during root canal treatment or during bleaching procedures, contact of the H_2O_2 with blood and tissue proteins produces effervescence, liberating oxygen and causing tissue emphysema. Seltzer [20] stated that after application of 30% H_2O_2 at 15 minute intervals (four applications) may reach to the tip of rat tongue, oedema was followed by intraepithelial and some sub-epithelial vesiculation, changes preventable by prior administration of catalase. Dorman HL and Bishop JG [21] confirmed that prolonged application of a dilute 0.3 molar H_2O_2 solution onto the ventral tongue of dogs similarly resulted in oedema. Tombes MB and Galluci B [22] in their study referred to the effects of hydrogen peroxide mouth rinses and stated that it can be responsible for objective and subjective adverse effects including mouth irritation, discomfort, dryness, loss of taste, elongation of filiform papillae and diffuse mucosal whitening.

Histologic adverse changes

In a histologic study in women about the effect of home bleaching and smoking on marginal gingival epithelium proliferation, da Costa., *et al.* [23] revealed that there are also changes in epithelial proliferation rate and morphological changes with epithelial thickening but fewer epithelial ridges. The PCNA (proliferating cell nuclear antigen) index, an indication of cell proliferation, increases in basal and para-basal layers of epithelium. At baseline, although smokers had a significantly higher PCNA index than non-smokers, this difference disappeared following bleaching indicating stimulation of cell division activity by peroxide similar to that produced by smoke. In view of this, some studies concluded that 10% carbamide peroxide could act as a tumour promoter in the presence of mutated cells. This is augmented by the study of Albuquerque., *et al.* [24] they concluded that Weekly (for four weeks) 20 minutes applications of 10% carbamide peroxide onto the dorsal tongue of rats also increased basal layer PCNA expression, but this is only transitory, with increased PCNA expression evident only on day 1 after the last application and not on day 10 or 20 at which there were no mucosal alterations were detected. At a cellular level, Schraufstatter., *et al.* [25] demonstrated hydrogen peroxide to induce poly-ADP-ribose polymerase activation followed by NAD depletion and a fall in ATP, resulting eventually in cell death. Regarding the effect of bleaching materials on dental pulp, Bowles W H, Burnes H Jr [26] clarified that dental pulp is reported to have a low peroxidase enzyme activity due to a sparse cell population of fibroblasts. Studies have reported the inhibition as well as inactivation of pulpal enzymes by H_2O_2. The quantity of peroxides penetrating the pulp chamber of extracted teeth exposed to peroxides is sufficient to produce toxic effects on cultured fibroblasts, and though there have been few reports of untoward pulpal responses, this suggests caution is warranted.

Cervical root resorption

Cervical root resorption after internal (non-vital) tooth bleaching is reported in the study of Baratieri LN., *et al.* [27] they concluded that intra-coronal bleaching requires healthy periodontal tissues and a root canal that is properly obturated to prevent the bleaching agent from reaching the periapical tissues. *In vitro* studies [28-32] have concluded that sodium perborate in water, sodium perborate in

3% and 30% hydrogen peroxide, and 10% carbamide peroxide are all efficient at internal bleaching of non-vital teeth. Howell RA [33] focused in his study on adverse thermal effects used in bleaching procedures, he stated that various heat sources may be applied to speed the reaction and improve the bleaching effect that lead to pulp reactions. CJ Tredwin., *et al.* have been summarized the available data to support a correlation between internal tooth bleaching and cervical root resorption. They stated it was important to note that there were a large number of cases that had suffered from the known trauma. In these cases it was very difficult to distinguish if the root resorption noted was due to the effect of the bleach or due to the trauma [34]. Other different studies confirmed that a high concentration of hydrogen peroxide in combination with heating seems to promote cervical root resorption [27,35]. Cvek M and Lindvall AM clarified that the underlying mechanism for this effect is unclear, but it has been suggested that the bleaching agent reaches the periodontal tissues through the dentinal tubules and initiates an inflammatory reaction [36]. Rotstein in his *in vitro* studies using extracted teeth showed that hydrogen peroxide placed in the pulp chamber penetrated the dentine with subsequent hazards [37]. Some studies revealed that intra-coronal bleaching with 30% hydrogen peroxide reduces the micro-hardness of dentine and enamel and mechanically weakens the dentine [38,39].

Tooth sensitivity

Tooth sensitivity is a common adverse effect of external tooth bleaching [40], Data from various studies of 10% carbamide peroxide indicate that from 15 - 65% of patients reported increased tooth sensitivity [16,41-43]. Higher incidences of tooth sensitivity (from 67 - 78%) were reported after bleaching with H_2O_2 in combination with heat [44,45]. Tooth sensitivity normally persists for up to four days after bleaching [16,44] but durations of up to 39 days have been reported [42,43]. In a clinical study that compared two different brands of 10% carbamide per-oxide bleaching agent, 55% of the 64 patients reported tooth sensitivity and/or gingival irritation, and 20% of those who had experienced adverse-effects terminated the treatment because of discomfort [42]. The mechanisms that could account for the tooth sensitivity after external tooth bleaching have not yet been fully established, but an *in vitro* experiment has shown that peroxide can penetrate enamel, dentine and enter the pulp chamber [46].

Conclusion

Operator should have a thorough understand about chemical composition of all teeth bleaching materials and complete awareness about the drawbacks of different techniques used for that purpose. Enamel/dentin thickness plays a significant role in the trans-enamel and trans-dentinal cytotoxicity of a 10% H_2O_2 bleaching gel to human dental pulp cells. In addition, the application of this gel for 45 or 15 minutes on enamel-dentin disks prepared to mimic mandibular human incisors decreased significantly cell toxicity in comparison with that caused by high concentrated gels (35% H_2O_2) and determined a similar esthetic outcome when the number of bleaching sessions was increased.

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