

REVIEW ARTICLE

Teeth discoloration removal and management: a review

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ABSTRACT

Healthy, clean white teeth increase self-confidence and enhance personality. Teeth discoloration is a frequent dental finding associated with clinical and esthetic problems which differ in etiology, appearance, composition, location, and severity. Diagnosis of the cause and severity of teeth discoloration is a critical step before initiating the treatment for it. Few studies have focused on the teeth discoloration removal and management but most of them were trials. The aim of this study was to highlight the different causes for teeth discoloration and the available variable modalities in removing and managing the discoloration.

Keywords: Teeth discoloration, management, esthetic problems, stain removal.

Introduction

Obtaining healthy and clean teeth helps in enhancing life. Healthy, clean white teeth increase self-confidence and decrease complain. Having clean white teeth depends on two factors, first factor is maintaining the oral hygiene by different ways like teeth brushing and flossing, the second factor is using cosmetic treatments to whiten teeth. The causes of discoloration are varied and complex [1]. Having white smile is an easily achievable task with a better understanding of materials and diseases along with advances within the technology. There are different causes for teeth discoloration which may be either intrinsic discoloration or extrinsic discoloration [2].

In order to understand the type and etiopathogenesis of the discoloration and stain a thorough history should be taken from the patient that should include [1,2]: medical history of neo-natal or early childhood illness, any drugs taken or maternal disease; personal history of quality of their diet, consumption of beverages between meals, history of malnutrition; family history of presence of any genetic disorder, or diseases; dental history of previous restorations, root canal treatment, trauma, use of mouthwashes including supplementation, residence in natural water fluoridation areas and social history of the nature of the work and exposure to metal, history of tobacco or betel leaf chewing habit and smoking.

Types of Stains

Intrinsic stain

Intrinsic stains occur much deeper in the tooth. Sometimes they occur when the tooth is forming, by incorporating

dark pigmented molecules into the crystal structure of the tooth [3]. It can be caused from multiple factors like [4]: enamel crack or tooth decay can allow extrinsic stain penetrating the enamel causing intrinsic stain, using tetracycline antibiotics may cause intrinsic grey color, pulp hemorrhage, or infection alter the teeth color; high percentage of fluoride can cause dental fluorosis which appears as white patches on the teeth; genetics may play a role in teeth discoloration, alkaptonuria, congenital erythropoietic porphyria, congenital hyperbilirubinemia, amelogenesis imperfect, and dentinogenesis imperfect.

Extrinsic stain

Extrinsic discoloration is outside the tooth substance and lies on the tooth surface or in the acquired pellicle [5]. The origin of the stain may be:

Metallic

Extrinsic staining of teeth may be associated with occupational exposure to metallic salts and with a number of medicines containing metal salts [6]. The characteristic black staining of teeth in people using iron supplements and iron factory workers is well documented [7]. A study

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was conducted on five students having black stain; this stain was scraped then underwent analysis for trace elements. The results have shown that three students had calcium ions with percentage (17.15%), magnesium ions (0.72%), and ferrous ions with percentage 2.56%, while the other remaining two students had calcium ions 14.86%, magnesium ions 0.82%, and free from ferrous ions [8]. Copper causes a green stain in mouth rinse containing copper salts [9] and in workers in contact with the metal in industries. There are other metals which may be responsible for discoloration like silver nitrate salt causing a grey color, stannous fluoride causing a golden brown color, and potassium permanganate causing a violet to black color [10].

Non-metallic

The non-metallic extrinsic stains are adsorbed onto tooth surface deposits such as plaque or the acquired pellicle. The possible etiological agents include dietary components, beverages, tobacco, mouth rinse, and other medicaments. Chromogenic bacteria can cause either green and orange stain in children with poor oral hygiene and black/brown stains in children with good oral hygiene [11]. The mechanism for chromogenic bacterial discoloration has not been identified yet. Tobacco smoking is a common cause for teeth discoloration which ranges from brown to black stain [12].

Management of Discoloration and Stains

Intrinsic staining

Micro abrasion

Enamel micro abrasion is a conservative method for removing outer enamel layer to remove outer enamel discolorations. It was noted in an *in vitro* study that the enamel micro abrasion technique results in a loss of enamel of around 25–200 μm depending on the number of applications and acids concentration. In 1916, micro abrasion for the teeth was done using acids [13]. After that, various principles have been conducted for the micro abrasion. The technique used for the enamel micro abrasion is done by employing a mixture of 18% hydrochloric acid and pumice or 6.6% and 10% hydrochloric acid with silica carbide particles, or even 37% phosphoric acid gel associated with extra fine grain pumice in proportions of equal volume [14].

Bleaching

Tooth bleaching is one of the most important methods used to remove the teeth discoloration and vary in the technique from one patient to another depending on the difference in the reason and grade of discoloration [1]. The commonly used techniques of bleaching are:

Vital teeth bleaching techniques:

In office bleaching: Higher concentrations of hydrogen peroxide (25%–40%) are used in the clinics to achieve quicker tooth lightening. In-office bleach, with its immediate

positive outcome, can kick-start a home bleaching regimen. It overcomes the problems of patient compliance, manual dexterity, and is ideal for those patients with high gag reflex. It prevents patients from the distaste of the bleaching gel [15].

Whitening toothpaste: Whitening paste in comparison to standard toothpaste contains higher amounts of abrasives and detergents, which make it very effective in removing extrinsic stains, significantly improving the appearance of teeth but not the underlying color [16]. Some whitening toothpastes contain a low concentration of carbamide peroxide or hydrogen peroxide that can bleach the tooth by one or two shades. Hydrogen peroxide with a percentage (1%) is now included within the bleaching dentifrices which is only stable when mixed on the brush. Blue covarine is incorporated within silica toothpaste making the tooth whiter [17].

Whitening rinses: The rinse comprises hydrogen peroxide, which reacts with the stains, lightening the tooth by one to two shades. Manufacturers recommend rinsing for 3 months twice daily for 60 seconds each [18].

Over-the-counter whitening strips and gels: The strips and gels are two groups of novel tooth whitening systems. In 1980, whitening strips were introduced which are thin layers of polyethylene strips containing hydrogen peroxide gel with percentage (5.3%), shaped to cover the anterior teeth from canine to canine, and they were more effective in comparison with home bleaching using 10% carbamide peroxide in trays [19].

The concentration of hydrogen peroxide is on the rise with 6.5% hydrogen peroxide-coated strips available. The principles for using the whitening strips with different hydrogen peroxide concentrations are first using 5.3% strips twice daily for 30 minutes or 6.5% hydrogen peroxide for 30 minutes in a day. The disadvantages of the strips are difficulty in placing on misaligned teeth; also, they are irritating to the gingiva [20].

A novel trayless system was introduced comprising 10% hydrogen peroxide as thin membrane system (Treswhite Ultradent Products). It ensures an increased comfort as it has a gel barrier at the margin of the gingiva. As the strips require no dispensing, an error at this stage is avoided and is hassle-free as it is disposed after every use. Whitening gels comprise peroxide, which is applied with specific brushes directly onto the surfaces of the teeth. The technique for using whitening gels is by application, 20–30 minutes twice daily for 14 days. The dental brushes are discarded according to manufacturer's instruction for decreasing microbial contamination. Whitening strip products and gels lighten the teeth by one to two shades [21].

Tray-based home bleaching: Tray-based tooth whiteners are available both professionally and over the counter (OTC). OTC trays are stock trays that are not comfortable, as they do not adapt to every mouth. Professional trays are fitted trays, in which carbamide peroxide or hydrogen peroxide is applied at home by the patient with special concentrations prescribed by the dentist [18].

The advantages of night guard vital bleaching (NGVB) are safe technique, not expensive, easy, and has a high success rate. Lower concentration of the bleaching agent is recommended to be used for longer time durations for more number of sessions. Higher concentrations of viscous bleaching agents to whiten the teeth pronto are linked with an increased risk of thermal sensitivity. Depending on the patient's lifestyle, availability of time, and sensitivity, dentist can recommend bleaching during the day or night [22].

Non vital teeth bleaching:

Inside and outside bleaching technique: First, a custom made tray is manufactured for the patient then the bleaching gel is applied on the internal and external surfaces of the discolored treated endodontic tooth. After that, the tray is applied for preserving the gel. Using 10% Carbamide peroxide is preferred in this technique. The access cavity is left open during treatment so that the 10% Carbamide peroxide can be regularly changed. If there is any doubt about the endodontic status, it is required to check the root filling before bleaching [23].

Walking bleach technique: This technique depends on making a mixture of sodium perborate with water into the pulp chamber of the discolored root filled tooth. Repeat this technique several times until the removal of discoloration. The technique can be modified using a combination of sodium perborate and 30% hydrogen peroxide which is applied for 1 week into the pulp chamber [23]. Mixing sodium perborate with hydrogen peroxide increases its effectiveness. If there is any doubt about the endodontic filling status of the tooth, preoperative X-ray should be taken to make sure the quality of the filling [24].

Laser assisted bleaching technique: This technique depends on using high-power energy with bleaching gel which contains thermally absorbed crystals, fumes silica, and 35% hydrogen peroxide. Gel is applied and activated with laser which activates crystals in the gel allowing disassociation of oxygen penetrating the enamel layer and removing the stain [25].

Internal non-vital power bleaching: The procedure is identical, in terms of isolation and preparation of the tooth, as that described above, except that the bleaching agent and its application/activation are different. Hydrogen peroxide gel (30%–35%) is placed in the pulp chamber and activated either by light or heat. The temperature is usually between 50°C and 60°C maintained for 5 minutes before the tooth is allowed to cool down for a further 5 minutes [25]. The gel is removed by washing with water for a further minute. 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 necessary. A variation on this technique uses 35% hydrogen peroxide gel applied both internally to the pulp chamber and externally to the labial surface of the tooth, with light activation internally and externally [26].

Extrinsic stains

This type of stain can be managed by both the patient himself and the dentist.

Personal management

Diet and habit: The patient is asked to decrease food and drinks causing extrinsic stains, also, they should brush their teeth immediately after consumption of these types of food. The most common habit causing extrinsic stain is tobacco smoking; so, the patient is asked to reduce the amount of tobacco smoking [5].

Tooth brushing: Brushing your teeth is an important part of the dental care routine. For having a healthy mouth and smile the American Diabetes Association (ADA) recommends some principles like teeth brushing twice per day using a soft-bristled brush, the size and shape of the brush should fit the mouth with small head allowing to reach all areas easily, use an ADA-accepted fluoride toothpaste, change the toothbrush every 3 or 4 months, or when the bristles are frayed [1,5].

The proper brushing technique is to move the toothbrush gently back and forth in short strokes in a 45° angle to the tooth surface, all surfaces of the teeth should be brushed properly. Avoid touching the gum by the toothbrush bristles to avoid injuring the gum. The inner surfaces of the teeth are brushed by tilting the brush vertically then moving up and down [1,5].

Professional management

Oral prophylaxis: Dental Prophylaxis or Scaling is generally the term used by dentists for cleaning the teeth. The procedure for Dental Scaling of teeth is now routinely recommended by dentists nowadays as the best way to maintain good dental health and removal of extrinsic stains, which can be done using either sonic or ultrasonic scaler [5].

Polishing: Tooth polishing is a procedure carried out as a part of oral prophylaxis in most dental practices. It is an act of smoothening the tooth surfaces to make it glossy and lustrous. Although the term polishing has been used to describe the professional removal of soft deposits and stains from the tooth surfaces, in reality, this includes both cleaning and polishing. During polishing, plaque, biofilm, stains, and acquired pellicle are removed [1].

Air jet polishing: In this technique, air is used for removing the supragingival extrinsic stain in spite of using the traditional method for polishing (polishing paste and rubber cup). This technique depends on using air under pressure with abrasive powder and water for removing the stain [12].

Clinical Studies Showing Different Methods for Discoloration Removal and Management

In a study [27], a 12-year-old male child suffering from mild-to-moderate fluorosis staining on both anterior and

posterior teeth specially on his upper two central incisors. Treatment steps included: after rubber dam application and isolation of both upper centrals, polishing was done using a mixture of 18% hydrochloric acid and pumice. This mixture was applied on the labial surface of the tooth and then polishing using rubber cup. After that the tooth is rinsed with water for 5 seconds. This procedure was repeated until the stain was decreased. After that, topical fluoride application is done for 3 minutes. All these steps were repeated for three visits until the patient was satisfied. On follow up, the patient was satisfied with the results without showing sensitivity.

A case series report published involved different cases with different types of discoloration and various treatment procedures [28]:

First case was 25-year-old patient suffering from brownish discoloration due to moderate fluorosis existing on the middle third of the two maxillary central incisors, the incisal third of the maxillary lateral incisors and the cervical third of mandibular right lateral incisor, and canine teeth. Treatment steps included: after rubber dam application and teeth isolation, micro abrasion with 11% hydrochloric acid with silicon carbide applied on the tooth surface and then polishing the tooth surface using rubber cup in low speed handpiece. After that, the tooth was rinsed with water to remove any remnants. It was clear that the stains were reduced. Macro-abrasion was done using 12-fluted composite finishing bur in a high-speed handpiece for removal of 0.3 mm of the hypoplastic enamel. At the end, topical fluoride was applied on the tooth surface to decrease sensitivity and esthetic enhancement.

Second case was 28-year-old patient suffering from diffuse yellowish discoloration on his upper incisors. The dentist decided to remove the discoloration with vital bleaching technique using (H_2O_2). After rubber dam application and teeth isolation, H_2O_2 gel was applied on the discolored surfaces then activated by light. This procedure was repeated for three times in the same visit and repeated also after 1 week in the second visit. The discoloration was removed completely and the patient was satisfied with the results.

Third case was 30-year-old patient suffering from black brownish discoloration on his upper centrals due to trauma from 7 years. The teeth were not vital so the dentist decided to first make endodontic treatment then non vital bleaching using the technique (walking bleaching technique). In this technique, sodium perborate was applied in the access cavity and changed every week for 3 weeks. After that, calcium hydroxide was applied for 2 weeks in the chamber for neutralizing the effect of sodium perborate. The discoloration was removed and the patient was satisfied with his esthetic teeth.

The fourth case was 20-year-old female patient suffering from brownish discoloration of her upper incisors. This discoloration by clinical examination was from the moderate fluorosis. The dentist preferred to treat the patient by making laminate veneers. After rubber dam

application, teeth were prepared and impression was taken in the first visit. In the second visit, the veneers were bonded to the teeth using nano-hybrid shade (A1) composite. The patient was satisfied by her esthetic appearance.

The fifth case was 22-year-old patient suffering from dark brownish discoloration on middle third and yellowish brown discoloration on cervical third of the crowns of both the maxillary and mandibular anterior teeth. With clinical examination, this discoloration was from tetracycline. Teeth number (11,51) were first endodontically treated because they were carious with exposed pulp. After that, the dentist decided to manage the discoloration of the upper anteriors with ceramic crowns because the discoloration was grade four in which veneers cannot manage, but, the lower anteriors were less in the degree of discoloration and the dentist applied composite veneers on all the lower anteriors which was enough to manage the discoloration and the patient was satisfied with the final esthetic appearance.

In a study [29], 32-year-old female patient suffered from yellowish brown discoloration on her upper central incisors. By clinical examination, the cause of this discoloration was moderate fluorosis. The patient asked the dentist to use a conservative method for discoloration management without any micro abrasion. The dentist selected bleaching with (in office bleaching technique). First the teeth were polished with pumice, then H_2O_2 gel was applied on the teeth after isolation with rubber dam and the gel was activated using light cure. This procedure was repeated three times and after each one, desensitizing agent was applied on the teeth surface to prevent any sensitivity. After that, alginate impression for the teeth was taken for making special custom tray for the patient, then, home bleaching was done by using 22% Carbamide peroxide agent on the custom tray. Following up after 6 months, teeth were esthetic and the patient was satisfied by the results.

Conclusion

Teeth discoloration is an esthetic problem faced due to several causes. This discoloration differs in severity and methods of removal from one patient to another. It is obvious that during the removal of the discoloration, both the dentist and the patient have a role to manage the discoloration and obtaining good results. There are scarce studies that were conducted on the teeth discoloration removal and most of them were trials which also showed the unclear results. It is recommended to establish studies which focus on teeth discoloration causes and methods for management and removing this discoloration.

Disclosure Statement

The authors have nothing to disclose.

List of Abbreviations

H_2O_2	Hydrogen peroxide
NGVB	Night guard vital bleaching
OTC	Over the counter

Conflict of interest

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