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Review Article

Bleaching of Non-Vital Tooth

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Received: January 04, 2020; **Published:** January 22, 2020

Abstract

Introduction: Discoloration of teeth have various cause, vary in their appearance and severity, and have different adhesive ability to the tooth structure. Discoloration can be classified as intrinsic and extrinsic based on the etiology of discoloration. Extrinsic discoloration can be removed by use external agents like abrasives and polishing pastes. For the removal of intrinsic discoloration, bleaching agents are used, the concentration and type of bleaching agents depend on the amount of discoloration. Most commonly used bleaching agents are Hydrogen Peroxide, Sodium Perborate, and Carbamide Peroxide.

Aim of the Work: This review explains the various etiologies of discoloration, property of the bleaching agent and management of discoloration seen in endodontically treated teeth.

Methodology: This review is a comprehensive research of PUBMED from the year 1864 to 2009.

Conclusion: Bleaching can be used as a conservative alternative to manage discolored teeth which are endodontically treated. A good diagnosis which explains the main etiology of discoloration followed by the most suitable selection of bleaching agents, a good placement technique and a thorough knowledge of the risks imposed by bleaching to the soft and hard tissues and proper management of such complications determine a favorable prognosis of bleaching in the short term and in the long term.

Keywords: *Non-Vital Bleaching; Hydrogen Peroxide; Walking Bleach; Thermocatalytic Bleaching*

Introduction

In today's world, the demand for esthetics in a conservative approach is increasing by the day. Patient's nowadays are more aware of different modalities of teeth whitening, and it is considered not only an esthetic standard but also a hygienic upgrade. Tooth bleaching has been in practice since the middle of 19th century [1]. Bleaching agents have seen a revolution in the past years ranging from chlorinated lime to the newer chemical agents like sodium peroxide, sodium hypochlorite, and hydrogen peroxide [2]. Recently, use of lasers and ultraviolet light has also been suggested for bleaching, by activation and speeding the process of bleaching [3]. Prinz [4] in 1924 recommended using heated solutions consisting of sodium perborate and Superoxol for cleaning the pulp cavity [4].

Causes of tooth discoloration

The main factor that affects the treatment outcome of tooth discoloration is to determine the correct cause of discoloration, and hence it is essential that the dental practitioner has a detailed knowledge of the etiology of the discoloration [5].

Color of the tooth is a combined illusion of the enamel and dentin color, and any external or internal discoloration that is present [5]. Discoloration of the tooth can be classified as intrinsic and extrinsic discoloration. Intrinsic discoloration is present because of the combined effect of the color of dentin enamel, and pulpal defects, extrinsic discoloration on the other hand is because of the external deposits or stains absorbed by the enamel of the tooth [6]. Detailed classification of the etiology of discoloration is mentioned in table 1.

Extrinsic Discoloration		Intrinsic Discoloration	
Metallic	**Non Metallic**	**Systemic Causes**	**Local Causes**
Occupational exposure to metallic salts 1. Iron supplements (black) 2. Copper salts (green) 3. Potassium permanganate (violet-black) 4. Stannous fluoride (golden brown) 5. Silver nitrate (grey)	Adsorbed on the tooth surface (plaque, acquired pellicle) 1. Beverages 2. Tobacco 3. Mouth rinses 4. Chromogenic bacteria	1. Medicine related discolouration (tetracycline stain) 2. Flourosis, calcification 3. Genetic causes like hyperbilirubinemia, 4. Congenital erythropoetic porphyria, amelogenesis imperfecta, Cystic fibrosis of Pancreas, Dentin dysplaisa	1. Pulp Necrosis, 2. Age of the patient 3. Remnant of pulp tissues in the canal 4. Hemorrhage of the pulp 5. Restorative material in the coronal third of the canal.

Table 1: *Classification of the etiology of tooth discoloration.*

The stains that are present on the surface of the tooth and can be removed with ease are called extrinsic stains. There are various factors that cause extrinsic stains like the tendency of the material to stick to the tooth surface which depends both on the roughness of the tooth surface and property of the staining material, which is the result of the adhesion of the chromogens to the tooth surface [7]. The age and surface property of the tooth also determines the amount of discoloration; previous studies have shown that stains of coffee and tea are more rigid in older patients compared to young patients [8].

The use of abrasives has been widely recommended for the removal of extrinsic discoloration, this process helps in prevention of any stain formation, and removes the loosely attached extrinsic stains if present. However, for good stain removal, knowing the etiology is of utmost importance [8].

Intrinsic discoloration, on the other hand, is present due to the presence of any pulp remnants or chromogenic bacteria inside the tooth which may be present either before or after odontogenesis [9]. On this basis the intrinsic stains are also divided into pre and post-eruptive stains [8,9]. The presence of excess fluoride in the water may cause endemic fluorosis which is the most common form of pre-eruptive discoloration [10]. Tetracycline staining is also a pre-eruptive form of staining which occurs due to interaction of the antibiotic and the hydroxyapatite crystals of the enamel during the phase of mineralization. Pre eruptive staining can also be caused due to the presence of clotted blood in the dentinal tubules such as in the case of erythroblastosis fetalis, sickle cell anemia and thalassemia, inherited disorders like amelogenesis and dentinogenesis imperfect may also cause staining [8]. Post eruptive staining can be seen due to aging as a result of deposition of secondary and tertiary dentin or pulp stones [10]. Iatrogenic causes like amalgam restorations or incomplete endodontic treatment may also cause post-eruptive intrinsic staining [8].

Causes of intrinsic local discoloration

Tissue necrosis as a result of chemical or bacterial irritation in the pulp causes necrosis of the pulp which releases by-products, which penetrates the dentinal tubules and causes discoloration. The amount of discoloration is directly proportional to the length of time the by-product has stayed in the tubule. In such cases an intracoronal bleaching is required [11]. Any trauma caused to the tooth can lead to hemorrhage of the pulp that causes rupture of blood vessels and deposition of red blood cells in the dentin causing discoloration of the tooth [12]. Pulp tissue that remains in the tooth after pulp extirpation may also cause discoloration of the tooth in the same manner [13]. Intracanal medicaments and sealer used for obturation when remains in the canal can also cause discoloration. Materials like Mineral Trioxide Aggregate, and tetracycline, when used as a dressing for endodontic cases, can also cause discoloration of the canal. In such cases it is made sure that a proper coronal seal is maintained so that the medicament doesn't cause discoloration in the canal [14]. Resorption of the root also causes a pinkish discoloration that acts as the diagnostic test for resorption as it is generally asymptomatic [15].

Commonly used bleaching agents

The most potent agents used for whitening of the endodontically treated teeth are Sodium perborate, Hydrogen peroxide, and Carbamide peroxide. Hydrogen peroxide is generally used in a concentration of 5-35%. It is either directly applied onto the tooth surface or released through the reaction between sodium perborate and carbamide peroxide [11]. The main mechanism by which hydrogen peroxide causes bleaching is by release of free radical, the free oxygen radicals released, due to its low molecular weight penetrates the dentinal

tubules and breaks the bond between organic and inorganic molecules. This release of oxygen radical is fastened by application of heat, light or chemical agents like sodium hydroxide [16,17]. Carbamide peroxide is composed of hydrogen peroxide and urea. The presence of glycerin in the composition of carbamide peroxide makes it more stable than hydrogen peroxide [11]. Sodium perborate is present in the powder form and is inactive in the dry state, with the addition of water or an activating agent it breaks down into hydrogen peroxide, free oxygen, and sodium metaborate which accelerates the bleaching reaction. Because of its physical structure sodium perborate is more stable compared to hydrogen peroxide [18].

Bleaching techniques for root canal treated teeth

In today's era of conservative dentistry, bleaching of an endodontically treated tooth serves as a conservative approach as compared to the more invasive treatment directed towards esthetic approach. Porcelain fused to metal crown hides the discoloration well but cases where porcelain crown is given, one round of bleaching is required to reduce the discoloration so that it is not visible through the crown [18].

For a good prognosis of non-vital tooth bleaching, it's essential to know the cause of discoloration and control the etiology. External cleaning and polishing of the tooth is required to know the extent of discoloration present in the tooth [19].

Preparation of the tooth surface before starting bleaching

The tooth has to be examined for any fractured restorations and good apical and coronal seal. A good apical seal prevents the ingress of any microorganisms in and out of the root canal. The coronal seal helps prevent the leakage of bleaching agents in the canal which may cause resorption of the roots. The fractured restorations or any other new carious lesion is supposed to be filled with a temporary restorative material and the final shade of the filling is decided based on the shade of the tooth after bleaching [20]. The root canal is cleaned of any debris or remnants of necrotic pulp present in the canal. Sodium hypochlorite is used to clean the canal and remove any remaining pulp tissue. It is advised that the tooth surface is treated with orthophosphoric acid to open the dentinal tubules to facilitate better penetration of bleaching agent into the dentin, therefore, removing the chromogens [18]. Removal of smear layer is a controversial procedure during bleaching as some studies suggest that it might facilitate the resorption of bleaching agents below the cervical seal leading to resorption [21].

Sealing of the tooth in the cervical third

To maintain a good seal, the filling material in the tooth is reduced 1 - 2 mm below the CEJ using a periodontal probe which is placed in the pulp cavity, the extent of the removal of restorative material is also confirmed externally. The root filling can be removed using a Gated Glidden bur, heated hand pluggers, touch and heat handpieces etc. different filling materials that can be used to create the cervical seal are Zinc oxide, zinc phosphate cement, Glass Ionomer cement, Resin composites, Cavit and IRM. A comparative study that compared the effectiveness of sealing agents revealed that Cavit and IRM provide better sealing than zinc phosphate cement [22]. The temporary materials like zinc cement and Cavit have to be removed before the final restorative procedure has to be done in the tooth. For the final cervical seal material, Rotstein suggested GIC to be the best choice of filling material as it was effective against 30% hydrogen peroxide solution [23]. The extent of the cervical sealing material should coincide with the epithelial attachment externally near the CEJ, the shape of the filling should also follow the anatomic contours of the tooth [24].

Once the tooth is sealed cervically, the bleaching agent is applied to the tooth. Sodium perborate with water is the most common mixture used in the ratio of 2:1. Sodium perborate can also be mixed with hydrogen peroxide for a faster result. The powder is mixed with the appropriate liquid and is made into a paste which is the applied in the cervical cavity with the help of an amalgam carrier or endodontic plugger. The bleaching agent should be changed every 3 - 7 days until the change in discolouration becomes visible on the tooth surface. A good inter appointment restorative material should be placed to avoid leakage of the bleaching agent in the oral cavity [25].

Bleaching techniques used for non vital tooth bleaching

Walking bleach

Marsh first described the concept of walking bleach for endodontically treated teeth [26]. This procedure requires the placement of bleaching agent into the pulp cavity and sealing it with a temporary material. The bleaching agent used is sodium perborate mixed with water. Mixture of sodium perborate and hydrogen peroxide has also been suggested by Nutting and Poe [27] in 1963 suggested the use of hydrogen peroxide with sodium perborate as it accelerates the reaction. Several studies have shown good evidence of successful bleaching with walking technique. Recently bleaching using carbamide peroxide has also shown comparative results with sodium perborate and hydrogen peroxide (Figure 1) [28].

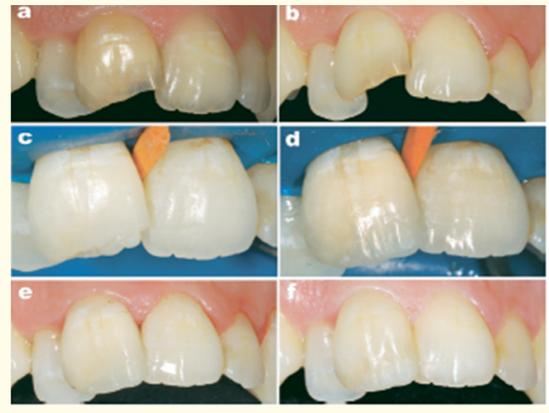

Figure 1: *a) Preoperative image of traumatic right upper central incisor showing discolouration. (b) walking bleach technique done on the tooth for three appointments (c, d) post operative composite resin restoration done after 7 days post bleaching. (e) Post operative view (f) I year post operative view [18].*

Thermocatalytic technique

This technique uses heat as the activating agent for bleaching. Hydrogen peroxide in the concentration of 30 - 40% is placed in the pulp chamber, heat is applied on the bleaching agent with the help of an electric heating device, heated ball burnisher and lamps designed especially for this. Heat application accelerates the process of bleaching [29]. Thermocatalytic bleaching is coupled with walking bleach technique that is bleaching agent is placed in the pulp chamber in between appointments to accelerate the bleaching reaction [18].

In office technique

The in-office technique for non-vital tooth bleaching has two different schools of thoughts. According to some authors, the bleaching agent is applied with the help of a tray on the concerned tooth without any material going in through the access opening [30]. The other school of thought is that the pulp chamber should be accessible during the application of bleaching agent. This technique requires a good cervical seal and the bleaching agent is applied in the pulp chamber and the buccal surface with the help of a tray. In-office technique is usually combined with walking bleach for better and faster results [18].

Complications of non-vital tooth bleaching

There are a few risks or complications associated with bleaching namely tooth sensitivity if the bleaching material comes in contact with a vital tooth, some adverse effects on the adhesion of restorative materials, risk of root resorption and external or internal resorption. The most frequently occurring complication is a reduction in the hardness of the enamel and dentin which can further lead to fracture of the tooth in the long run [31]. Many studies have suggested that if fluoride application is done on the tooth surface before starting the bleaching process it reduces the complications by formation of a fluoride rich layer on the enamel surface which later diffuses into the tubules causing increase the remineralization of the tooth [32]. Bleaching agent, when it comes in contact with the oral mucosa causes burning on the mucosa, but it does not cause any long term complications. Cervical resorption is generally a multifactorial condition and occurs due to various reasons like orthodontic treatment, dental trauma and surgery, Heithersay in a report mentioned that internal bleaching was responsible for 3.9% of the resorption cases and if resorption was accompanied by any of the other reasons of resorption the frequency was increased up to 13.6% [33].

Conclusion

Within the limitations of this study we can conclude that bleaching can be used as a conservative alternative to manage discolored teeth which are endodontically treated. A good diagnosis which explains the main etiology of discolouration followed by the most suitable selection of bleaching agents, a proper placement technique and a thorough knowledge of the risks imposed by bleaching to the soft and hard tissues and proper management of such complications determine a favourable prognosis of bleaching in the short term and in the long run.

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Volume 19 Issue 2 February 2020