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NON-VITAL TOOTH BLEACHING

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Abstract:

Introduction: *Staining and discoloration of anterior teeth is a cosmetic problem that is often the patient's chief complaint. Despite the availability of various restorative procedures, Discoloration can often be corrected totally or partially by a more conservative approach, i.e., bleaching, which is relatively simple to perform and less expensive. Bleaching of discolored, pulpless teeth was first described in 1864 by Truman. Initially, Chlorinated lime was used. Since then a variety of medicaments such as chloride, sodium hypochlorite, sodium perborate, and hydrogen peroxide has been used*

The aim of Work: *This study aimed to give an insight into the various aspects of non-vital tooth bleaching.*

Materials and methods: *This review is a comprehensive search of PUBMED(MEDLINE), and, EMBASE from the year 1850 to 2018. The following search items were used: tooth bleaching, causes of tooth discoloration, the prognosis of bleaching, tooth preparation for bleaching, tooth bleaching materials, the outcome of tooth bleaching.*

Conclusion: *Given the appropriate indication, the bleaching of nonvital teeth is a fairly low-risk intercession to improve the esthetics of endodontically treated teeth. Depending on the situation, the walking bleach technique can be an uncomplicated and convenient method for both patients and dentists. The risk of root resorption cannot be exactly determined given the available data. Sufficient cervical sealing and avoidance of the thermocatalytic method can minimize the risk of resorptions.*

Keywords: *bleaching, tooth preparation, bleaching materials, bleaching techniques, post-bleaching outcomes.*

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INTRODUCTION:

Discoloration of anterior teeth is a cosmetic problem that is often the patient's primary concern. Although restorative procedures are available, discoloration can often be corrected totally or partially by a more conservative approach, i.e., bleaching, which is relatively simple to perform and less expensive. Bleaching of discolored, pulpless teeth was first described in 1864 by Truman. Initially, Chlorinated lime was used [1]. Since then a variety of medicaments such as chloride, sodium hypochlorite, sodium perborate, and hydrogen peroxide has been used [2-7]. An early description (1884) of the use of hydrogen peroxide was reported by Harlan. The "walking bleach" technique that was introduced in 1961 (Spasser, 1961). The method was later modified, and water replaced by 30-35% hydrogen peroxide, to improve the whitening effect. Abbot mentioned Superoxol (30% H2O2) in 1918. The observation that carbamide peroxide caused lightening of the teeth was made in the late 1960s.[8]

ETIOLOGY OF TOOTH DISCOLORATION:

Tooth discoloration is defined as ''any change in the hue, color, or translucency of a tooth due to any cause; restorative filling materials, drugs (both topical and systemic), pulpal necrosis, or hemorrhage may be responsible''.[9]

Etiology of intrinsic discoloration [10]

Pre-eruptive causes	**Post-eruptive causes**
Medications (Tetracycline)	Pulpal necrosis
Metabolism (Fluorosis)	Intrapulpal hemorrhage
Genetics (hyperbilirubinemia, Amelogenesis imperfecta, cystic fibrosis of the pancreas)	Residual pulp tissue after endodontic treatment
	Endodontic materials (medications/irrigants, root canal sealer)
	Filling materials
	Root resorption
	Aging process

EXTRINSIC STAINS ARE CAUSED BY:

Substances like food and beverage and the use of tobacco and its products lead to Extrinsic Stains. The whiteness of the teeth reduce, or they get discolored as these substances tend to adhere to enamel's hydroxyapatite. Over a period, they may penetrate the enamel layer and gradually give rise to intrinsic discolorations. [11]

For e.g.:
Chromogenic Bacteria,
Tobacco,
Mouth rinses,
Plaque.

NATHOO'S CLASSIFICATION:[12]

1. N1 type dental stain or direct dental stain: Colored material binds to the tooth's surface and causes discoloration. The color of chromogen is similar to that of dental stain.
2. N2 type dental stain or direct dental stain: Colored material changes color after binding to the tooth.
3. N3 type dental stain or indirect dental stain: Colorless material or a pre-chromogen binds to the tooth and undergoes a chemical reaction to cause a stain.

Causes of Intrinsic Local Discoloration

These are stains within the matrix of enamel and dentin caused by the deposition or incorporation of substances within these structures. These stains may be caused during the developmental stage, i.e., pre-eruptive or after the eruption into the oral cavity. [13]

1. Pre-eruptive discolorations:

a. Alkaptonuria: Also known as phenylketonuria. It is a recessive genetic disorder which leads to dark brown pigmentation of the permanent teeth. [13]

b. Amelogenesis imperfecta: It affects both primary and permanent dentition, where the enamel is chipped off from the underlying dentin. Hypocalcification; where the thickness of enamel is normal but is soft in consistency and completely abrades soon after eruption, which results in a tooth with a crown that ranges in appearance from a dull opaque white to a dark brown. Also, these teeth are usually rough and pitted. Hypoplastic, where the enamel is quite thin, smooth, hard and yellow in appearance, with occasionally pitting. [14]

c. Dentinogenesis imperfecta: Primary teeth usually are more seriously affected than permanent teeth. The clinical crowns appear reddish-brown to gray opalescent. Frequently enamel is friable and breaks off soon after eruption. The exposed softened dentin then rapidly abrades away. [15]

d. Fluorosis: Black and McKay first reported this condition in 1916. 1 ppm is the optimal concentration in drinking water for healthy dental development. When the intake approaches 2ppm, noticeable white spots occur in the enamel, when it approaches 3ppm, patchy brown discoloration of the enamel occurs. [16]

e. Erythroblastosis fetalis: It is a disorder in which teeth change color from brown to greenish-blue. This condition is typically self-treating, and the staining resolves as the child matures. [17]

f. Porphyria: This condition is characterized by reddish-brown discoloration of teeth known as Erythrodontia which is caused by a pigment called as hematoporphyrin. Primary dentition is more commonly affected as compared to permanent dentition [18]

g. Tetracycline staining: Schwasman and Schuster in 1956 first reported the tooth discoloration caused by incorporation of systemically administered tetracycline. Both primary and permanent dentition are affected as it can cross the placental barrier. [19-21]

The clinical appearance of tetracycline-stained teeth ranges from light yellow to dark grey bands. Usually, the darker shades are confined to the gingival 1/3rd of the teeth, and the lighter shades will often be located exclusively in the incisal 1/3rd.

Minocycline staining:
Adolescents who were served with minocycline for acne exhibited staining of teeth. Minocycline combines with iron and forms insoluble complexes, but it combines poorly to calcium. Some minocycline stains may be responsive to bleaching while others with severe banding may require veneers. [22]

b) Jaundice:
Severe jaundice during infancy causes bluish green or brown staining of primary teeth. These stains are the result of postnatal staining of the dentin by bilirubin or biliverdin. [22]

2. Post-eruptive discolorations:

a) Age:
Extensive secondary dentin formation, thinning and optical changes of enamel in older patients leads to a color change in the crown. Food and beverages also have a cumulative discoloring effect because of the inevitable crack, crazing and incisal wear of the enamel and underlying dentin. Further discoloration is caused by amalgam and other coronal restorations which degrade over time. Bleaching would be more effective in older patients with smaller pulps and generally tend to be less sensitive. [23]

b) Pulpal Necrosis:
Tissue necrosis in the pulp is caused by bacterial, mechanical or chemical irritation which leads to the release of disintegration by-products which may penetrate the tubules and result in discoloring of the dentin. [23]

c) Intrapulpal hemorrhage:

It is the most common result of traumatic injury to a tooth. Blood disintegration products (mainly iron sulfides) which are formed because of hemorrhage and lysis of erythrocytes, permeate dentinal tubules to stain the surrounding dentin, which tends to increase with time. [23]

d) Dentin hyper calcification:

Certain traumatic injuries lead to the extensive formation of tertiary or irregular dentin in the pulp chamber or the canal walls. As a result of which the translucency of the crowns of such teeth gradually decreases, giving rise to a yellowish or yellow-brown discoloration. [23]

e) Iatrogenic Discolorations: [24]
1. Remnants of pulpal tissues: Pulp fragments remaining in the crown, usually in the pulp horns, may cause gradual discoloration. Therefore, the pulp horns must be opened up and exposed during access to ensure removal of pulpal remnants and to prevent retention of sealer at a later stage.

2. Intracanal medicaments: Several intracanal medicaments are liable to cause internal staining of the dentin. Phenolics or iodoform based medicaments sealed in the root canal and chamber are in direct contact with dentin sometimes for longer periods, allowing penetration and oxidization. These compounds tend to discolor the dentin gradually.

3. Obturating materials: It is a frequent and severe cause of single tooth discoloration. Incomplete

removal of obturating materials and sealer remnants in the pulp chamber, mainly those containing metallic components, often results in dark discoloration.

4. Restorations:

a) Amalgam:

Silver alloys have severe effects on dentin because of the dark colored metallic components that can turn the dentin dark grey. When used to restore lingual access preparations or a developmental groove in anterior teeth as well as in premolars, amalgam may discolor the crown, such discolorations are difficult to bleach and tend to discolor again with time. Replacing the amalgam restoration with an esthetic restoration usually corrects the problem.

b) Pins and Posts:

Metal pins and prefabricated posts are sometimes used to reinforce a composite restoration in the anterior teeth. Discolorations from inappropriately placed pins and posts are caused by a metal seen through the composite or tooth structure. In such cases, coverage of the pins with a white cement or removal of the metal and replacement of the composite restoration is indicated.

c) Composites:

Microleakage around composite restoration causes staining. Open margins may allow chemicals to enter between the restoration and the tooth structure and discolor the underling dentin. Also, composites may become discolored with time, affecting the shade of the crown, which needs to be replaced with a new well-sealed restoration.

BLEACHING AGENTS FOR WHITENING OF ROOT-FILLED TEETH:

The most commonly used bleaching agents in dentistry are hydrogen peroxide, sodium perborate and carbamide peroxide. [25]

Hydrogen Peroxide:

It is a clear, colorless and odorless liquid. Higher concentrations of these solutions must be handled with care as they are thermodynamically unstable and may explode unless refrigerated and kept in the dark container [24]. Because of its ischemic effect on skin and mucous membrane, it resembles a chemical burn. It is especially painful if it comes in contact with the nail bed or the soft tissue under the finger nail. It can be used for both intra and extra-coronal bleaching. [25]

Sodium perborate:

It is a stable white powder. When fresh, it contains about 95% perborate corresponding to 9.9% of the available oxygen. It is stable when dry and decomposes in the presence of acid, warm air or water.[26]

3 types of sodium perborate preparations are available, Monohydrate, trihydrate, and tetrahydrate. They differ in oxygen content, which determines their efficacy. Commonly used preparations are alkaline, their pH depends on the amount of hydrogen peroxide released and the residual metaborate. It is used for intracoronal bleaching, more easily controlled and safer than concentrated hydrogen peroxide solutions. [27]

Carbamide per-oxide :

Also known as urea peroxide, carbamoyl peroxide, perhydrol urea, carbamide urea, urea H_2O_2 and H_2O_2 carbamide. It is a clear, colorless odorless liquid. When used as a bleaching agent its breakdowns to hydrogen peroxide. Previously used only for extra-coronal bleaching.

Lee et al (2004), found that carbamide peroxide had very low levels of extra-radicular diffusion of peroxide in the presence of cemental defects. Therefore, it could be an alternative to the other intra-coronal bleaching agents. 35% carbamide and 35% H2O2 were more effective than Na perborate after 7 days. [28]

Non-vital bleaching:

These procedures are carried out for endodontically treated teeth.

Indications: [29]

a) Discoloration of the pulp chamber
b) Dentin discoloration
c) Discolorations not amenable to extra-coronal bleaching

Contraindications: [29]

a) Superficial enamel discolorations
b) Defective enamel formation
c) Severe dentin loss
d) Presence of caries
e) Discolored composites
f) Extensive restorations

Clinical Bleaching Techniques for Endodontically Treated Teeth [30]

Bleaching of endodontically treated teeth that present with chromatic alterations is a conservative alternative to a more invasive esthetic treatment such as placement of crowns or veneers.

Extrinsic Stain Treatment: Professional hygiene treatment and the use of prophylactic cups and less aggressive pastes are the most commonly used procedure to treat extrinsic stains.

Intrinsic Stain Treatment: Intrinsic stains from systemic causes are difficult to treat without prosthetic rehabilitation. For intrinsic stains to be removed, chemicals such as hydrogen peroxide are required because they penetrate enamel and dentin and decolorize or solubilize the chromogens.

Initial Treatment:
It is important to determine the cause of tooth discoloration. Preliminary hygiene treatment should be provided before starting the procedure. Pre-treatment and post-treatment photographs are very helpful in showing the results which are obtained at the end of treatment to the patient. Quality of the root filling should always be assessed by taking radiographs before the treatment is commenced. Replacement of inadequate root filling should always be done before bleaching, , and the new filling material should be allowed to set for at least 7 days after obturation before the bleaching procedure is started.

Restoration of carious lesion should be carried out and deficient restorations should be identified and replaced. Shade matching with the whitened tooth must be done of the existing restorations and to be replaced if required. It is advisable to restore carious lesions or replace deficient fillings with temporary materials before treatment or to replace restorations after completion of bleaching. Carious lesions or other deficient fillings should be temporized or restored at the end of treatment. [30]

There are basically three different options for lightening nonvital teeth:

- The walking bleach,
- Inside/outside bleaching and the
- In-office bleaching techniques [31]

Walking bleach technique:
First described by Spasser, it uses a paste of sodium perborate mixed with water [32]. This mixture was then inserted into the access cavity. A modification of this technique was later described which advocated mixing of sodium perborate with hydrogen peroxide [33]. Although subsequent studies revealed no significant differences between the effectiveness of the two methods, an improvement was found in vitro when sodium perborate was mixed with carbamide peroxide instead of distilled water [34].

Technique:

1. Tissue-conserving access cavity is prepared which also allows visibility and cleansability of the entire pulpal cavity.
2. The root-canal filling material is shortened 2-3 mm subgingivally.
3. An impermeable base is then laid on the root-canal filling material (resin modified glass-ionomer cement [RMGIC] or conventional GIC)
4. The application of RMGIC showed a better apical seal than conventional GIC.
5. The bleaching gel is inserted into the tooth and the access cavity is sealed to the outside with a provisional filling.

Cavit and Coltosol exhibited better results than Fermit which had surpassed zinc-oxide eugenol and zinc phosphate as a provisional restorative material. Seal against bacterial penetration is one of the ideal properties associated with a provisional adhesive restoration. Follow-up of the procedure is done after a few days, and the bleaching agent is reinserted into the access cavity if required [35].

Carbamide peroxide or hydrogen peroxide can be used instead of sodium perborate for walking bleach procedure. 37% carbamide peroxide shows better dentinal penetration when compared with 20% hydrogen peroxide or 27% carbamide peroxide [36].

Duration of application of bleaching agent has a direct co-relation with the success of the bleaching procedure. This also explains the success of walking bleach over In-office bleaching technique. Application of calcium hydroxide is recommended after the desired bleaching results are obtained [37]. This ensures diminishing of oxygen inhibition of polymerizing definitive composite filling, counteraction of increased permeability of dentin and raising the low Ph value in the cavity caused by the bleaching agent. Ascorbic acid solution (10%) can be used to promote normal adhesive bond strength instead of waiting for the restoration. Additionally, ethanol and acetone in the adhesive systems have shown negation to the inhibiting effect of bleaching agent on polymerization [38].

Fig. 1 Young patient after anterior tooth trauma and endodontic treatment

Fig. 2 Status after the walking bleach technique with three applications of 35% hydrogen peroxide (Opalescence Endo, Ultradent). [31]

Inside/outside Bleaching:

Advocated by Settembrini et al., this technique encompasses bleaching of both the internal and external surfaces of the tooth [39]. Low concentration of bleaching gel used is a certain advantage of his technique. The access cavity is left open during treatment for ease of change the 10% carbamide peroxide periodically. A custom-made bleaching tray ensures application of the bleaching agent in and around the tooth [31].

Construction of Bleaching Tray:

1. Take an alginate impression
2. Construct an appropriate bleaching tray
3. Palatal and labial reservoirs for the target tooth should be designed
4. Tray over the adjacent teeth is cut back to avoid the placement of the bleaching gel.

Patient Instructions:

1. Insert the tip of the bleaching syringe into the access cavity of each root-filled tooth and fill the cavity with the 10% carbamide peroxide.
2. Load the appropriate reservoir within the tray with a pea-sized amount of the 10% carbamide peroxide
3. Insert the tray over the teeth and remove the excess gel as necessary

The splint is worn at night also to guard the open tooth. After a period of bleaching, the patient should clean the access cavity. A recall is recommended every two or three days to monitor the color change. When the desired color has been attained, the access cavity is cleaned and then closed with a restorative material [40].

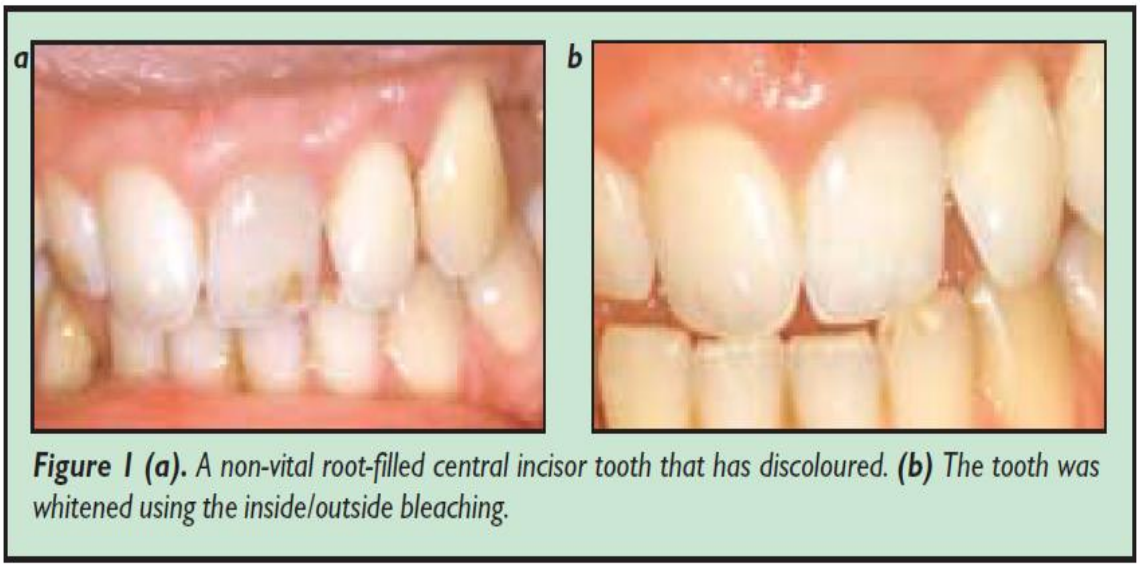

Figure 1 (a). *A non-vital root-filled central incisor tooth that has discoloured.* ***(b)*** *The tooth was whitened using the inside/outside bleaching.*

[40]

THERMOCATALYTIC TECHNIQUE:

This technique involves the placement of the oxidizing agent. Generally, 30% to 35% H_2O_2 in the pulp chamber followed by heat application either by electric heating devices or specially designed photoflood lamps for 5min. This process should be continued until the desirable results are achieved. Should not be repeated for more than 5-6 times. Care should be taken that the temperature of the heating device does not exceed 114°F. Lamp unit should be 13 inches away from the patient. Metal clamps should not be used. Recall the patient in a week to assess the color after rehydration. Repeat the procedure, if necessary.

Potential damage by this method is the external cervical root resorption caused by irritation to the cementum and periodontal ligament. Therefore, application of highly concentrated H2O2 and heat during intra-coronal bleaching is questionable [41-45].

CONCLUSION:

the bleaching of nonvital teeth is a fairly low-risk intervention to improve the esthetics of endodontically treated teeth given the appropriate indication,, the walking bleach technique can be a simple and suitable method for both patients and dentists depending on the situation. With the available data, the risk of root resorption cannot be precisely determined. Sufficient cervical sealing and evading of the thermocatalytic method can diminish the hazard of resorptions. Further development of the conventional bleaching agents by adding radical scavengers such as thiocarbamide or using sodium percarbonate seems promising regarding minimizing the penetration of hydrogen into the periodontal space.

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