

A Hope for Smile: Bleaching in Dentistry

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ABSTRACT

Background: The importance of tooth whitening for patients and consumers has seen a dramatic increase in the number of products and procedures over recent years. Nowadays, we find several ways to perform dental whitening, recently ultraviolet light has been used for dental whitening, and propose to exclude the use of bleaching chemicals such as hydrogen peroxide or carbamide. In the following review article, we have covered full details about bleaching and its processes.

Keywords: Hydrogen Peroxide, Sodium Perborate, Carbamide Peroxide.

INTRODUCTION

Tooth discoloration is one of the most commonly reported complaints in patients seeking aesthetic treatment. Variation in tooth color can be influenced by intrinsic and extrinsic factors, ranging from chemical ingestion to consumption of foods that cause staining. Previously numerous bleaching agents who were either direct or indirect oxidizers were employed for the bleaching of non-vital teeth. All agents including aluminium chloride, oxalic acid, pyrozone, hydrogen dioxide, sodium peroxide, sodium hypophosphate, chloride of lime and cyanide of potassium acted on the organic portion of the tooth. The variety of bleaching agents used reflects the diverse nature of the discolouration.

The changes and continuous progress of the materials and techniques on bleaching reflect the efforts of the dental profession towards preservation of tooth structure, enhancing esthetics and restoration of smiles. The future will likely bring about even more innovative systems that are aimed to benefit the general public.^{1,2}

Definition

The external **discolouration** is the accumulation of **stains** on the **tooth** surface. The internal **discolouration** is due to absorption of pigment particles into **tooth** structure. Definition of Tooth discolouration- 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 haemorrhage may be responsible.

Causes of Tooth Discoloration

Foods/drinks- Coffee, tea, colas, wines, and certain fruits and vegetables (for example, apples and potatoes) can stain your teeth.

Tobacco use- Smoking or chewing tobacco can stain teeth.

Poor dental hygiene- Inadequate brushing, flossing, and rinsing with an antiseptic mouthwash to remove plaque and stain-producing substances

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like coffee and tobacco can cause tooth discoloration.

Disease- Several diseases that affect enamel (the hard surface of the teeth) and dentin (the underlying material under enamel) can lead to tooth discoloration. Treatments for certain conditions can also affect tooth color. For example, head and neck radiation and chemotherapy can cause teeth discoloration. In addition, certain infections in pregnant mothers can cause tooth discoloration in the infant by affecting enamel development.^{3, 4}

Medications- The antibiotics tetracycline and doxycycline are known to discolor teeth when given to children whose teeth are still developing (before age 8). Mouth rinses and washes containing chlorhexidine and cetylpyridinium chloride can also stain teeth. Antihistamines (like Benadryl), antipsychotic drugs, and drugs for high blood pressure also cause teeth discoloration.

Dental materials- Some of the materials used in dentistry, such as amalgam restorations, especially silver sulfide-containing materials, can cast a grey-black color to teeth.

Advancing age- As you age, the outer layer of enamel on your teeth gets worn away, revealing the natural yellow color of dentin.

Genetics- Some people have naturally brighter or thicker enamel than others.

Environment- Excessive fluoride either from environmental sources (naturally high fluoride levels in water) or from excessive use (fluoride applications, rinses, toothpaste, and fluoride supplements are taken by mouth) can cause teeth discoloration.

Trauma- For example, damage from a fall can disturb enamel formation in young children whose teeth are still developing. Injury can also cause discoloration to adult teeth.⁵

Types of Bleaching Agents

There are a wide variety of bleaching products available, but most are based on hydrogen peroxide as the active agent ⁴⁴. Hydrogen peroxide may be

applied directly, or produced in a chemical reaction from sodium perborate or carbamide peroxide.

1. Hydrogen Peroxide

Hydrogen peroxide (H₂O₂) is a pale blue liquid, slightly more viscous than water with a molar mass of 34.0147g/mol. Because of its low molecular weight, it can penetrate dentin and release oxygen that breaks the double bonds of the organic and inorganic compounds inside the dentinal tubules.

In dentistry, hydrogen peroxide is used as a bleaching material at different concentrations from 5% to 35%. In order to improve its ease of use in bleaching teeth, it also comes in various delivery systems, most commonly in the form of a gel. It acts as a potent oxidizing agent through the formation of reactive oxygen species and hydrogen peroxide anions.^{6, 7}

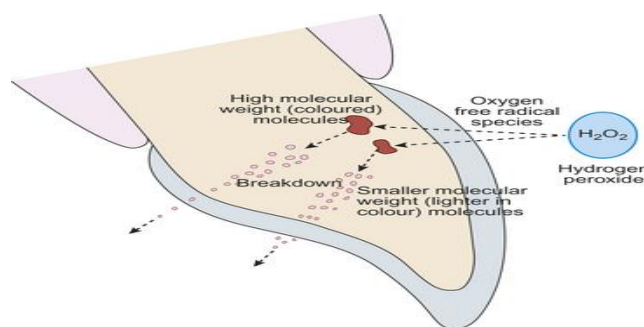


Fig 1: Mechanism of action of hydrogen peroxide.

Hydrogen peroxide is naturally produced, controlled, used, and destroyed during normal body functioning. The human body uses the glutathione redox cycle, catalase, ascorbate, superoxide dismutase, prostaglandin E1, glutathione peroxidase, vitamin E, and plasma peroxidase to protect itself against oxidative stress .

2.3.2. Sodium Perborate

Sodium perborate (NaBO₃) is a white, odourless, water-soluble chemical compound available as a powder. It has been employed as an oxidizer and bleaching agent especially in washing powder and other detergents since 1907. It is stable when dry, however in the presence of an acid, warm air, or water, it breaks down to form sodium metaborate, hydrogen peroxide and nascent oxygen.

There are various types of sodium perborate: monohydrate, trihydrate, and tetrahydrate, which

differ in oxygen content and thus determine their bleaching efficacy. Sodium perborate is easy to control and widely used in intra-coronal bleaching.⁸

2.3.3. Carbamide Peroxide

Carbamide peroxide ($CH_6N_2O_3$) is a white crystalline solid that releases oxygen in contact with water. Concentrations used for bleaching purposes range between 10% to 35%. A 10% carbamide peroxide solution breaks down into 3.35% hydrogen peroxide and 6.65% urea. Urea further breaks down into ammonia and water and may provide some beneficial side effects, because it tends to increase the pH of the solution.

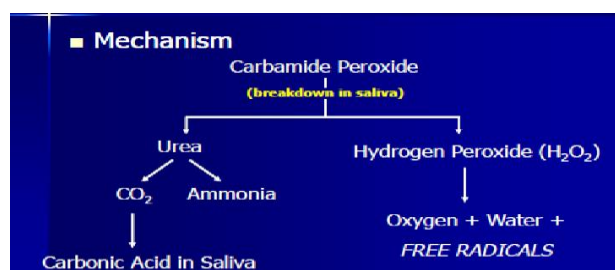


Fig 2: Mechanism of action of carbamide peroxide.

Factors Affecting the Efficacy of Bleaching

The effect of time or frequency, the concentration of the bleaching agent, characteristics of the tooth substrate, activation with light, heat, plasma, or a sealed Environment have been evaluated.

Time and Frequency

Increasing the exposure time to the bleaching agent and the frequency of the bleaching session will improve the whitening efficacy in terms of color change. The number of bleaching sessions required and the optimal concentration will probably differ according to the type of the discoloration and the characteristics of the tooth substrate.⁹

The concentration of Bleaching Agent

The higher the concentration of the bleaching agent, the faster the bleaching rate will be. The ultimate colour change and the time required for stabilization with different levels of hydrogen peroxide and carbamide peroxide needs to be examined in further studies.¹⁰

Tooth Substrate

The tooth is composed of three different hard tissues, the enamel, dentin and the cementum. These tissues vary in their inorganic and organic composition and also demonstrate various structural components which undergo changes with age and internal and external stimuli. The characteristics of tooth substrate have an essential influence on the effect of tooth whitening. Further studies are needed to determine which structures or processes within the enamel and dentin are most influenced by the active bleaching agent.

Light Activation

Quartz-tungsten-halogen (QTH) lamps, plasma arc lamps, laser systems with a variety of wavelengths, and light-emitting diodes (LED) have been used for activation of bleaching agents used in power bleaching.¹¹ The required wavelength to induce such energy corresponds to 248nm and lower which cannot be used in the oral cavity for safety reasons. However, indirect excitation of hydrogen peroxide via photo-activators that absorb the light energy and transfer it to the hydrogen peroxide molecules have been suggested with the use of lights in the range of the visible spectrum ranging from 380 to 750 nm.

Heat

Davidi et al. showed in extracted human molars and premolars, stained with tea solution that a mild increase of temperature from 37°C to 45°C enhanced the bleaching efficacy. When a significant increase in temperature with the use of intense lights in a study on an extracted human upper central incisor fitted with thermocouples and simulating intrapulpal fluid flow.

Ozone

The concomitant use of ozone to increase the oxidative capability of the bleaching agent has been suggested as a method of improving bleaching effectiveness.

Adverse effects-

Adverse effects of tooth bleaching procedures on hard and soft tissues of the oral cavity are as follows-

- Tooth sensitivity and gingival or mucosal irritation
- Minor orthodontic tooth movement
- Temporomandibular dysfunction due to long-term tray use
- Sore throat.¹²

CONCLUSIONS

Literature suggests that the mechanisms of tooth whitening by peroxide occur by the diffusion of peroxide through the enamel to cause oxidation and hence lightening of colored species, particularly within the dentinal regions. The efficacy of light-activated systems versus non-light activated controls in clinical studies is limited and conflicting. Other factors which can influence tooth bleaching outcome include the type of stain, initial tooth color and subject age.¹³

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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