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Review article

An overview: insight of dental bleaching agents

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ABSTRACT

The virtue of the "perfect smile" is an easily achievable task with a better understanding of materials and diseases as well as advances in technology. Discoloured teeth can often be completely or partially corrected by whitening as it is conservative, non-invasive, and inexpensive, it is the treatment protocol of choice for the masses. Hydrogen and carbamide peroxides have been used successfully for many years; the teeth whitening technique has changed several times over the past century, and nearly 10 years before the new millennium, the technique was finally recognized by international regulatory agencies. It is important that dentists handle peroxides with a basic knowledge as it has been shown that the results will give satisfactory results. This technique depends on correctly diagnosing the stains, handling the substrates (enamel and dentin), and sensitivity. Dentists are exposed to a wide variety of teeth whitening techniques, products, and brands, and mild peroxide activation devices have been developed over the past two decades. The art is also currently subject to change depending on the effectiveness of the various light sources inactivating peroxide and their relationship to satisfactory end results. To achieve instant whitening without risk or relapse, innovative technologies and promising products have been developed. This article is intended to keep up to date with these new trends providing insight into the current clinical challenges of vital teeth whitening. The purpose of this literature review is to explain the determining factors influencing the successful end-results of the techniques and to provide an overview in order to make an evidence-based treatment decision.

Keywords: Dental Bleaching Agents, Hydrogen Peroxide, Tooth Discolouration, Chromophores.
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INTRODUCTION

Calcium phosphate is in the form of hydroxyapatite, Ca5 (PO4) 3 (OH) as the mineral phase of human teeth [1]. The protein-rich bone bio composite dentin is the innermost layer of a tooth and consists of around 70% hydroxyapatite. There consists of proteins (mainly collagen) and water [2]. Tooth enamel is a highly mineralized tissue consisting of one micrometre long hydroxyapatite needles that integrate various hierarchically ordered microstructures. It is the outer layer of a tooth, and its hardness resistance result from a combination of interference of hydroxyapatite needles held together by an organic protein phase. The film consists mainly of carbohydrates, lipids and salivary proteins [3]. Pure hydroxyapatite (i.e. without the addition of foreign ions) is initially colourless /white, and the proteins mixed are no different. On the other hand, it becomes more porous as the enamel becomes thinner and becomes more transparent with age(for example, due to erosion) when the entire tooth colour darkens [4].

In addition, stains from wine, tea, coffee and smoking, among other things, often impair the "natural" white colour of teeth. Home whitening formulas (such as pastes used in conjunction with toothbrushes) and specialty dental use formulas address this problem (such as whitening or Therefore, whitening is described as any process that improves the appearance of teeth whitening. Tooth decay and periodontal disease are ubiquitous challenges in our communities around the world [1], and modern oral care devices are aimed at preventing them. A manual or mechanical toothbrush and toothpaste with normal diet and a healthy lifestyle (no consumption of alcohol or smoking) can prevent tooth decay and periodontal disease. Advanced

toothpastes have highly complex compositions that contain various agents to protect against tooth decay and periodontal disease, such as: B. fluorides (sodium fluoride, amine fluoride, etc.), chlorhexidine, tin, zinc salts and calcium phosphates such as hydroxyapatite or amorphous calcium phosphates as well as surfactants and various abrasives for effective removal of the plate [5].

In addition, there are various oral hygiene products which (sometimes exclusively) aim on whitening of the teeth. This is because of aesthetic concerns, as a lot of people appreciate white and bright teeth and a beautiful smile which will enhance their quality of life. Teeth will darken as a result of smoking, drinking red wine, or drinking black tea. Furthermore, the overall colour of the teeth is determined by the age of the individual [6]. As a result, oral care firms have launched a variety of teeth-whitening cosmetics. These agents can assist dentists and patients in weighing the advantages and costs of teeth whitening procedures. As a result of the rigorous chemical analysis, such myths (as we prefer to call them) that are used to justify other formulations will be more examined [7].

Tooth surface discoloration

Chromophores are coloured molecules in teeth and can be organic or inorganic [8]. Chromophores capture visible light and mainly reflect the contrasting tone known to the skin, which is normally yellow or brown in teeth. Examples of organic chromophores are tannins or furfurals, which are found in chocolate, tea, red wine and fruits. The bonds are a function of these molecules (e.g., carbonyl groups or aromatic groups). Coloured transition metal ions such as Fe2 + / Fe3 +, Cu2 + or Mn2 + are inorganic chromophores. Organic and inorganic chromophores can coexist as metal complexes, as in haemoglobin, where an organic porphyrin ligand is integrated into an inorganic (inorganic) iron ion [9]. The origins of the spots can be intrinsic or extrinsic. Self-stains can be found in the enamel or in the dentin under the enamel for example, Dean's Index can be used to classify the severity of fluorosis, which ranges from doubtful to extreme. During tooth development, intrinsic staining occurs before tooth eruption and can occur after tooth eruption.

Intrinsic staining can be caused by pulp haemorrhagic products following trauma. Blood infiltration into the dentinal tubule leads to discoloration [10]. Dental interventions such as amalgam fillings or orthodontic therapies can also trigger these. Because enamel is a permanent structure, abrasive treatments can only dissolve intrinsic stains if some of the enamel is removed. However, this cannot be achieved on a daily basis. Practice good oral hygiene at home. Some chemical or mechanical means of removing intrinsic stains in dentin from the outside are next to impossible. Due to their microporous nature, stains adapt very well to dentin Internal therapies, such as endodontic bleaching with peroxides, are possible, but they are invasive operations that are only done in dental clinics.

On the wall, there is extrinsic staining. Every chemical or mechanical means of extracting intrinsic stains in dentin from the outside is virtually impossible. Stains bind closely to dentin due to its microporous nature.

Internal therapies, such as endodontic bleaching with peroxides, are possible, but these operations are painful and only done in dental clinics. Some chemical or mechanical means of removing intrinsic stains in dentin from the outside are almost impossible. Stains conform very well to dentin because of its microporous nature. Internal treatments, such as endodontic bleaching with peroxides, are possible, but these techniques are time-consuming. They are invasive operations that can only be done in dental clinics [11].

Extrinsic discolouration is a form of staining that occurs outside the body. These conditions are suitable for incorporating organic and inorganic chromophores. An extrinsic discoloration is found on the tooth surface, i.e. on the enamel of the tooth and the exposed dentin, in particular on tooth surfaces that are difficult to clean and surfaces with a thick film layer Organic and inorganic chromophores are deposited directly on the tooth surface (especially when gets roughly) or (more likely) absorbed by rocks, bio-fibres, and other biofilms to create certain stains [12].

Organic dyes are likely to be located on or between plaque and pellicle because they have a good affinity for proteins. Calculus is a form of pathological calcification that is often inorganic. Brushite (CaHPO4 2 H2O), hydroxyapatite (Ca5(PO4)3(OH)), whitlockite (_-(Ca,Mg)3(PO4)2), octacalciphosphate (Ca8(HPO4)2(PO4)4 5 H2O), and octacalciphosphate (Ca8(HPO4)2(PO4)4 5 H2O), and the calcium phosphate lattice can also contain other inorganic ions (chromophores) [3].

They typically come from chromophores-containing meats, liquids, or smoking. Additionally, the additives of oral care materials have the potential to stain tooth surfaces. Since these ingredients are usually a different colour than the receptacle, this is referred to as "indirect staining". The tooth surface can be stained over a period of time by the following antibacterial agents such as stannous fluoride and its other salts as well as mouth washes containing chlorhexidine.

As suggested by researchers the tooth surface is protected from staining by various anti-biofilm agents. White powders such as hydroxyapatite are examples of particulate calcium phosphates. In an in-situ study, Kensche et al. found that mouth rinse containing hydroxyapatite that eliminates initial bacterial colonisation on bovine enamel surfaces in a comparable way to 0.2 percent chlorhexidine. The anti-adhesive properties of hydroxyapatite particles may clarify this effect. Despite being an antibacterial agent that prevents bacterial metabolism, chlorhexidine's staining effect is extremely complicated,

as defined by Addy and Moran. Chemical process of originally colourless compounds may also produce chromophores. Due to chemical reaction between stannous fluoride which is present in toothpaste with volatile sulphur compounds that are produced by oral bacteria results in coloured tin sulphide. Abrasive procedures (such as tooth paste and brushing, as well as advanced dental cleaning) and pharmaceutical treatments (such as peroxides) are used to remove extrinsic stains [13].

Whiteness of teeth

In vitro and in vivo approaches have been developed to measure whiteness and colour, and to test the effectiveness of a bleach (e.g., Film Cleaning Ratio [PCR], a popular in vitro method). The oral cavity, coffee, or tea are sometimes used in staining solutions to test in vitro PCR [14].

Tooth colour can be measured using a variety of methods, including shadow guides, colorimetry, spectrophotometry and computer processing of digital images. The Lobene stain index, which is based on a visual examination of the tooth colour, is widely used. It can only be used to determine whether or not there are any extrinsic stains [15]. Staining is graded by form (no stain detected, medium stain, moderate stain, and rough stain) and area (no stain detected, stain covering up to 1/3 of the region, stain covering > 1/3 to 2/3 of the region, stain covering > 2/3 of the region, and stain covering > 2/3 of the region). Colour hue guides may be used to measure tooth stain in a semi-quantitative manner. It can only be used to see if there are any stains present on the tooth surface [16].

The effectiveness of bleaches is often measured relatively by comparing the degree of whiteness before and after treatment and evaluating individual percentages of bleach. The analysis would be more complex if the colour of a tooth were not standardized. Placement rails can be used to distinguish the different parts of the jaw.

Peroxide-based teeth whitening in-office

Many common chemicals are used to whiten teeth, such as those found in commercially available toothpastes. (Table 1).

Table 1: Examples of widely used whitening agents in home and professional products (in alphabetical order; the most efficient whitening agents are underlined) [17]

Whitening Agent	Mode of Action
Abrasives (e.g., hydrated silica, perlite, alumina) Most important toothpaste ingredient for stain removal	Mechanical removal of extrinsic stains
Anti-redeposition agents (e.g., polyphosphates, sodium citrate)	Preventing chromophores from being deposited and where external stains are present, calculus formation is inhibited. could be used
Calcium phosphates (e.g., hydroxyapatite)	Adhesion of white calcium phosphate particles on the tooth surface, and prevention of bacterial attachment/plaque-formation on the teeth
Colorants (e.g., blue covarine)	Shifting colour absorption and reflection spectra from yellow to blue.
Proteases and enzymes (e.g., papain, bromelain)	Support stain removal due to protein degradation (hydrolysis of peptide bonds)
Peroxides are a form of peroxide (e.g., hydrogen peroxide, calcium peroxide)	Oxidation of organic chromophores
Polyaspartate (e.g., sodium polyaspartate)	Plaque forming inhibition

Teeth whitening can be done by dentists in the hospital ("in the office") or by patients at home (without a prescription; "OTC"). Lightening with hydrogen peroxide (H2O2; HOOH) or calcium peroxide (CaO2; Ca2 + OO) and related compounds is a common chemical method. In-home bleaching (also known as "heavy bleaching") is performed with concentrated H_2O_2 in water for about 20 to 30 minutes (35 weight percent). Caution is advised as it is a liquid hydrogen peroxide. The solution oxidizes quickly and is dangerous to soft tissues. As a result, the gingiva and tongue must be well protected (e.g., rubber dam, water-soaked gauze). In some cases, office teeth whitening has been linked to inflammation of the tooth pulp. In addition, peroxides are antibacterial agents that can alter the balance of the oral microbiota [18].

Irradiation with heat lamps to activate the oxidative reaction is often used to support oxidative operation. Chemically, this irradiation may not have any influence on the oxidative effect of hydrogen peroxides, but the improved local temperature can improve the reaction rate. According to Viscio et al., irradiation to activate hydrogen peroxide had not yet been clinically validated. Exposure to light while using 35 percent hydrogen peroxide had no effect in a clinical study. As of 2014, according to Carey, the influence of radiation is unknown, neither in terms of the amount of bleaching received, nor on the longevity of the bleaching procedure during the bleaching process.

It is possible with a patient-specific mouthguard that contains a spray that contains 10 to 20 percent carbamide peroxide. A carbamide gel was prepared at a concentration of 10%. The American Dental Association has recommended a 10-Rbamid gel for home whitening. Peroxide concentration, several overnight treatments are required to achieve visible results. Both the strong whitening and the night bleach have been shown to whiten teeth many years after the treatment [19].

Colour gels and bleaching strips, all of which are peroxide dependent, are other bleaching solutions. In the existence of catalytically active compounds such as metal ions, noble metals (Pt) and enzymes, hydrogen peroxide decomposes to (I) H2O2 over time! H 2 O + 12 O 2 (catalase). Peroxides oxidize the conjugated systems of unsaturated organic compounds, which absorb visible light and act as chromophores, preventing light from being absorbed. They are based on a variety of chemical reactions that are simple and complex. In simple terms, peroxide whitening induces the oxidation of organic chromophores into colourless organic compounds.

These organic compounds should be removed from the tooth surface after washing. Peroxides do not oxidize inorganic ions like Fe3 +, but remain coloured after treatment. However, it is chemically possible to assume that they will also be removed after treatment. The surrounding (bio) organic molecules are oxidized and the ions are released into the

bleaching liquid. These complex chemical reactions are an unknown general kinetic. As a result, Fearon believes that whiteness can only be insufficiently regulated during the power whitening process [20].

Whitening toothpastes

For smokers, for example, whitening toothpastes are available. Many "all-in-one" or "multifunctional" toothpastes claiming to have properties of whitening. They also contain abrasives and/or whitening agents (see Table 1). To evaluate the effectiveness of toothpaste whitening, studies were carried out in vitro and in vivo [21]. When it comes to whitening toothpastes, we differentiate between (external) stain prevention and (external) stain remover. The primary additive in toothpaste is abrasive that are formulated for removing stains. Whitening toothpastes often contain stronger abrasives and more of them than traditional toothpastes to help properly rub off external stains. Toothpaste with a strong abrasive will generally remove the outer layer of enamel and any stuck or embedded stains. The outer layer of the tooth (tooth enamel and exposed dentin) makes a polishing process (with a high whiteness effect) unnecessary.

Table 2. A list of popular abrasives found in toothpastes. Strong abrasives are more effective than soft abrasives at removing stains, but they can damage the enamel and, in particular, exposed dentin. (INCI: International Nomenclature of Cosmetic Ingredients).

Hardness	Expected Stain	Removal
Sodium bicarbonate	NaHCO3	Soft Low
Dicalcium phosphate dihydrate (brushite)	CaHPO4 _ 2 H2O	Soft Low
Calcium carbonate	CaCO3	Soft Low
Calcium pyrophosphate	Ca2P2O7	Medium hard Medium
Hydroxyapatite	Ca5(PO4)3(OH)	Medium hard Medium
Hydrated silica	SiO2 _ n H2O	Medium hard Medium
Perlite A	mineral silicate	Hard High

Name (INCI) Chemical Formula Relative

Too abrasive compounds can damage enamel, exposed dentin, and gingiva, so toothpaste abrasive should be kept to a minimum level. Low-abrasive toothpaste, on the other hand, may cause increased staining of the tooth surface due to its lower cleaning effectiveness (e.g., for sensitive teeth; gentle cleaning of exposed dentin). Hydrated silica, SiO2 n H, is a common abrasive used in topical application materials.

Hydrated silica, SiO2 n H2O, calcium carbonate, CaCO3, and alumina, Al2O3 are all common abrasives. (Table 2). The particle size, morphology and hardness of these abrasives can also vary. In particular, the water content, the crosslinking, the particle shape and the particle size have a major influence on the properties of silica abrasives. Particulate hydroxyapatite is a biomimetic agent used to prevent dental caries in the oral cavity. It also appears to be a promising abrasive due to its similarity to tooth minerals and its whitening effect caused by both polishing and impact on the tooth surface.

The adhesion of hydroxyapatite particles to the tooth enamel has been proven. leads to less coverage of the tooth surface. Some white pigments with a higher refractive index than calcium phosphates such as titanium dioxide (TiO2) are not biomimetic. Another type of treatment is a polymer-based calcium phosphate coating on teeth. Dabanoglu et al. reported good bleaching results in human premolars harvested in an in vitro particulate hydroxyapatite assay. In a study conducted by Jin et al. they observed certain lightening effects of various calcium phosphate particles in a toothpaste that also contained carboxymethyl cellulose in removed human teeth. According to Kim et al.[22] the whiteness effect of a toothpaste based on hydroxyapatite corresponded to two commercially available toothpastes, but the overall formulation of the toothpastes was not specified. In a hybrid in vitro / in vivo study,[23] stronger whitening effect using nanohydroxyapatite and a matrix of self-organizing peptides as an adhesive on the tooth surface, which binds the radiating projection of hydroxyapatite particles onto the tooth surface. According to Lelli et al. the particle adsorption on the tooth surface caused by a toothpaste containing zinc carbonate hydroxyapatite and Fabritius - Vilpoux et al. investigated the in vitro interaction of teeth with particulate hydroxyapatite and found a dose-response relationship.[24] Much effort is being made to develop abrasives that remove stains with the least amount of enamel damage.

The RDA (Radioactive Dentin Abrasion) value is a standard metric for determining the abrasive used in toothpaste. RDA values below 250 are considered safe in toothpastes. The PCR value is one method for evaluating the cleaning efficacy of toothpastes and abrasives (pellicle cleaning ratio). Since both parameters are dependent on the same outcome, a high RDA value is normally correlated with a high PCR value (mechanical abrasion on the tooth surface).The two conditions, though, do not have much of a statistical relationship.

CONCLUSION

Whitening can be accomplished in two ways: chemical bleaching of peroxides and industrial brushing with toothpaste abrasives. Chemical bleaching produces excellent results, particularly when performed in a controlled environment, such as a dental office, with high peroxide concentrations. Mechanical cleaning makes use of abrasives that are tougher than stains but not as hard as enamel. The whitening industry is huge in terms of size of the economy, which means there is a lot of rivalry between manufacturers and not all arguments are backed up by empirical evidence. Since tooth discoloration is closely related to diet and other causes, determining the demographic inclusion criteria is a major planning challenge. And conducting clinical studies in the field of teeth whitening (such as smoking, chlorhexidine). Finally, certain in vivo mechanisms of action of bleaches are not clear. Mechanical studies are therefore required to explain the mode of action from a chemical and biological point of view. This is a critical requirement in developing more effective teeth

whitening formulations. In addition to natural teeth whitening, prevention is another important area of research and removing stains from restorative materials.

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