

# Teeth whitening – an overview

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**Abstract---**Teeth whitening is a cosmetic procedure that aims to improve the appearance of teeth by removing stains and discoloration. This is achieved through the use of bleaching agents that break down the stains and leave behind a brighter, whiter smile. There are several methods of teeth whitening available, including in-office treatments, at-home treatments, and over-the-counter products. While these treatments are generally safe and effective, it is important to discuss any concerns with a dental professional before undergoing treatment. Teeth whitening can boost confidence and improve one's appearance, but it is important to choose a safe and effective option that works best for an individual's specific needs.

**KEYWORDS:** Teeth whitening, brighter smile, Aesthetics, Stains.

## I. INTRODUCTION:

The media's presentation of flawless white grins has influenced the general populace. The visual quality of film, television, electronic, and print media has increased people's awareness of their own tooth discoloration. Several businesses released both home-based goods in the late 1980s [1].And tooth whitening products that are expertly administered into the US market. They have grown in popularity among the general public, who now wants smiles that are whiter and more attractive. There are numerous approaches of tooth whitening, each with a unique mode of operation. The effectiveness of these various techniques depends on the specific tooth discoloration being addressed [1].

Vital tooth-bleaching, also known as tooth-whitening, has become a common dental operation due to the rising need for a better appearance and whiter smile. It has turned into one of the most rapidly expanding subspecialties of cosmetic dentistry [5]. Compared to other restorative treatment modalities like composite fillings, veneers, or crowns, it offers a more cautious approach to treating discolored teeth. In-office or power bleaching, home bleaching under a dentist's supervision, night guard essential bleaching, and conveniently accessible over-the-counter (OTC) whitening solutions are some of the frequently utilized tooth-whitening techniques [5]. The oxidation of chromophores found in enamel and dentin as well as the breakdown of the extracellular matrix are two of the causes of bleaching [2].

## II. TYPES OF TOOTH STAINING:

### EXTRINSIC:

With extrinsic tooth discoloration, the enamel, or the tooth's surface, is probably the only part of the tooth that is being stained [1]. The following are the most typical extrinsic stain causes:

- Food
- Beverages
- Tobacco

### INTRINSIC:

Because it is embedded in the tooth, this kind of stain is harder to remove with over-the-counter whitening products. It frequently looks greyish [1]. Intrinsic stains include, for instance:

- Specific medicines
- Tooth decay
- Due to trauma or injury to the tooth

### AGE-RELATED:

Your teeth's enamel starts to erode as you get older, which frequently gives them a yellow appearance. Age-related discoloration frequently results from both extrinsic and intrinsic causes.

## III. CAUSES OF TOOTH DISCOLOURATION:

- **Foods/drinks:** Your teeth can be stained by various beverages such as coffee, tea, colas, wines, and certain foods like apples and potatoes.
- **Tobacco:** Whether through smoking or chewing, has the ability to discolor teeth.
- **Lack of proper oral care:** Insufficient brushing, flossing, and rinsing leading to buildup of plaque and substances that cause staining.

- **Disease:** Tooth discoloration can be caused by various illnesses that impact the hard exterior layer (enamel) and the inner substance (dentin) beneath it. Tooth color may also be impacted by treatments used to treat specific conditions. Teeth discoloration can occur as a result of head and neck radiation and chemotherapy, to provide an illustration. Moreover, specific illnesses contracted by expectant mothers may result in the discoloration of their infant's teeth because of their influence on enamel growth.
- **Medications:** Tetracycline and doxycycline are antibiotics that have been observed to cause tooth discoloration in children whose teeth are still growing, which is typically before they turn 8 years old. Teeth can also be discolored by mouth rinses and washes that have chlorhexidine and cetylpyridinium chloride. Medications such as Benadryl, antipsychotics, and those prescribed for hypertension can also lead to staining of the teeth.
- **Dental Materials:** Some materials used in dentistry, especially amalgam restorations that contain elements like silver sulfide, can cause teeth to become discolored, turning gray or black.
- **Aging:** As your teeth get older and their outer layer of enamel wears down, the dentin's natural color starts to show through.
- **Genetics:** Individuals can vary in the thickness and brightness of their enamel, with some people having these characteristics by nature.
- **Environment:** Too much fluoride can discolor teeth, which can be brought on by environmental factors like high fluoride levels in water or too much use of fluoride-based toothpaste, rinses, applications, and supplements taken orally.
- **Trauma:** In young children whose teeth are still growing, enamel formation can be disrupted by a fall. Adult teeth may also become discolored due to trauma.

#### IV. CHEMISTRY IN TOOTH WHITENING

Chromogens, substances with color or darker shades, accumulate in the tooth (intrinsic) or on the tooth (extrinsic) to cause tooth stains [1]. Thus, "bleaching" is referred to as the chromogens chemical breakdown. Chromogens can be divided into two groups: big organic compounds with conjugated double bonds and substances containing metals [1]. Physically removing the stain or using a chemical reaction to lighten the color of the teeth are two ways to achieve whitening. Hydrogen peroxide reacts with double bonds and oxidise them in the process of bleaching organic molecules. The chromogen changes color as a result, becoming a lighter molecule. The metallic components are significantly more difficult to bleach; veneers, bonding, or crowns would be better solutions aesthetically. Some professional products contain sodium hypochlorite (NaOCl), which reacts with the chromogen's double bonds in a manner similar to that of peroxide [1].

Peroxides oxidise conjugated systems of unsaturated organic compounds (such as aromatic compounds, alkenes, and alkynes) so that light is no longer absorbed and they cease to function as chromophores. The underlying chemical processes are numerous and intricate. In a nutshell, using peroxides to bleach causes organic chromophores to oxidise into non-colored organic molecules. It is implicitly expected that following washing operations will eliminate these organic components from the tooth surface [3]. Interestingly, inorganic ions like  $Fe^{3+}$  do not oxidise in the presence of peroxides and retain their color. Yet, it is logical to presume from a chemical standpoint that they are also eliminated once the surrounding bio-organic molecules have been oxidized to a point where the ions are released into the bleaching solution. These intricate chemical processes' overall kinetics are unknown [3].

#### V. COMPOSITION OF COMMERCIAL WHITENING AGENTS:

Current whitening agents contain both active and inactive ingredients. The active ingredients are hydrogen peroxide or carbamide peroxide compounds. However, the main inactive ingredients may include thickeners, carriers, surfactants and pigment dispersants, preservatives and flavorings.

- **THICKENING AGENTS:** Carbopol (carboxypolymethylene) is the most commonly used thickener in whitening agents. Its concentration is usually 0.5-1.5%. This high molecular weight polyacrylic acid polymer has two main advantages. First, it increases the viscosity of whitening agents, which allows the whitening gel to stay better on the substrate. Second, it increases the active oxygen release of the whitening material up to 4 times.
- **CARRIER:** Glycerin and propylene glycol are the most commonly used carriers in commercial whitening agents. A carrier can retain moisture and help dissolve other ingredients.
- **SURFACTANT AND PIGMENT DISPERSANT:** Gels containing a surfactant or pigment dispersant can be more effective than those without. The surfactant acts as a surface wetting agent that allows diffusion of the active whitening agent. In addition, the pigment dispersion keeps the pigments in suspension.
- **PRESERVATIVE:** Methyl, propyl paraben and sodium benzoate are commonly used as preservatives. They have the ability to inhibit the growth of bacteria in whitening agents. In addition, these substances can accelerate the breakdown of hydrogen peroxide, releasing transition metals such as iron, copper and magnesium.
- **FLAVORING AGENTS:** Flavoring agents are substances used to improve the taste and consumer acceptance of whitening products. For example, peppermint, spearmint, wintergreen, sassafras, anise, and a sweetener such as saccharin.

#### VI. TYPES OF TEETH WHITENING PROCEDURES:

- **VITAL TOOTH WHITENING**
  - In-office whitening
  - At-home or dentist-supervised overnight whitening
  - Over-the-counter (OTC) whitening

- NON-VITAL TOOTH WHITENING

### VITAL TOOTH WHITENING:

There are three main methods of vital teeth whitening:

**In-office or power whitening**, At-home or dentist-supervised overnight whitening, and Over-the-counter (OTC) whitening.

In-office whitening uses a high concentration of teeth whitening agents (25- 40% hydrogen peroxide). Here, the dentist has full control during the procedure and can stop it when the desired tone/effect is achieved. In this procedure, the whitening gel is applied to the teeth after protecting the soft tissues with gum or alternatives, and the peroxide is further activated (or not) by heat or light for about an hour in the dental office [15]. Various types of treatment lights including; Halogen treatment lights, plasma arc lamps, Xe-halogen light, diode lasers (both 830 and 980 nm diode lasers) or metal halide light (Zoom) can be used to activate the whitening gel or accelerate the whitening effect. In-office treatments can result in significant whitening after just one treatment, but many more may be necessary to achieve optimal results [15].

**At-home or dentist-supervised overnight whitening** generally uses little whitening agent (10-20% carbamide peroxide, equivalent to 3.5-6.5% hydrogen peroxide). In general, it is recommended to use 10% carbamide peroxide for 8 hours a day and 15-20% carbamide peroxide for 3-4hours a day. This treatment is performed by patients themselves, but it must be performed under the supervision of dentists during check-up visits. The whitening gel is applied to the teeth with a custom-made mouth guard that is worn at night for at least 2 weeks. This technique has been used for decades and is probably the most widely used [15].

Advantages: patient self-management, shorter sitting, high safety, fewer side effects and low costs. Despite the fact that patients can bleach at their own pace, this at-home whitening technique, with its various whitening concentrations and regimens, has become the gold standard by which other techniques are judged. However, it is by no means without its disadvantages, as active patient consent is mandatory and the technique suffers from a high discontinuation rate. In addition, the discoloration depends on the maintenance of use, and the results are sometimes more ideal because some patients do not remember to use the platform every day. Conversely, overuse is also possible in overzealous patients, often resulting in heat sensitivity of up to 67%.

Some doctors recommend using 35% hydrogen peroxide for in-office teeth whitening, followed by home whitening with gels containing 10%, 15% or 20% carbamide peroxide. Bailey and Swift (1992) showed that higher concentrations of whitening agents can generate more peroxide radicals for whitening, resulting in a faster whitening process. However, this rapid whitening process can increase the side effects of tooth sensitivity, gum irritation, throat irritation and nausea.

**Over-the-counter (OTC)** whitening products have grown in popularity in recent years. These products consist of a low concentration of bleach (3-6% hydrogen peroxide) and are applied to the teeth themselves with gum shields, strips or paint. They are also available as whitening teeth cleaners, disposable trays, whitening strips and toothpastes. They should be administered twice in 8 days for a maximum of 2 weeks. OTC products are considered the fastest growing sector of the dental market. However, the safety of these whitening agents can be highly questionable because some are not regulated by the Food and Drug Administration.

**NON-VITAL TOOTH WHITENING:** There are many non-essential teeth whitening techniques used today, such as walk-in and modified step-in whitening, non-essential power whitening, and indoor/outdoor whitening. The inbound whitening technique involves compressing a mixture of sodium perborate and water in the pulp chamber of the diseased tooth [13]. The procedure is repeated from time to time until the desired whitening result is achieved. This technique was modified with a combination of 30% hydrogen peroxide and sodium perborate sealed in a cellulose chamber for a week; this is known as a modified walking white. In internal non-critical power whitening, hydrogen peroxide gel (30-35%) is placed in the cellulose chamber and activated either by light or heat. The temperature is usually 50-60°C and is maintained for five minutes before the tooth is extracted. Let cool for another 5 minutes [13]. The gel is then removed, the tooth is dried and the "walking whitening technique" is used between visits until the tooth is checked in 2 weeks to assess the need for further treatment. Finally, the internal/external whitening technique is a combination of internal whitening of non-essential teeth with a home whitening technique.

### VII. TYPES OF TEETH WHITENING SYSTEMS:

- WHITENING TOOTHPASTES
- OTC WHITENING STRIPS AND GELS
- WHITENING RINSES
- TRAY-BASED TOOTH WHITENERS
- IN-OFFICE WHITENING

#### WHITENING TOOTHPASTES:

Whitening toothpastes usually contain higher amounts of abrasives and detergents than regular toothpastes to remove tougher stains. White toothpastes do not contain a whitening agent (sodium hypochlorite), but some contain small concentrations of carbamide peroxide or hydrogen peroxide to help brighten teeth [6]. Whitening toothpastes can usually lighten teeth by a shade or two.

#### OTC WHITENING STRIPS AND GELS

They deliver a thin layer of peroxide gel to plastic strips that are shaped to fit the oral surfaces of the teeth. There are various white tape products on the market with different instructions. A typical set of instructions is to use the strips twice a day for 30 minutes for 1 day [6]. The whitening of teeth is visible in several days and this method can lighten teeth by 1 or 2 shades. Some

newer whitening strip products only require one 30-minute application per day and have the same whitening endpoint as twice-daily products.

Whitening gels are peroxide-based gels that are applied directly to the tooth surface with a small brush. The manufacturer's instructions are usually twice a day for 1 days. Like whitening strips, teeth can usually be lightened by 1 or 2 shades

#### **WHITENING RINSES**

White washes contain oxygen sources, such as hydrogen peroxide, which react with chromogens. Rinse twice daily for 60 seconds according to manufacturer's instructions [6]. It takes up to 3 months for the color of the teeth to improve by 1 or 2 shades.

#### **TRAY-BASED TOOTH WHITENERS**

Platform-based teeth whitening systems are available for professional and OTC use. This method uses a suitable base containing carbamide peroxide whitening gel, which is used 2-hours a day or overnight. In general, following the manufacturer's instructions, teeth whitening can be noticed in a few days, lightening teeth by 1-2 shades.

#### **IN-OFFICE WHITENING**

Faster teeth whitening can be achieved with in-office whitening because the products offer a higher concentration of peroxide than OTC. Therefore, the gingival tissues are usually protected before the agent is applied. Some products claim to increase the oxidation of chromogens when exposed to heat or strong blue light between 80 and 520 nm, which activates the product when the teeth are on, allowing chemical reactions to occur more quickly [18]. Some specialists use laser systems to increase the speed of chemical reactions [18]. Teeth whitening results are visible after one 30-60 minute treatment. More dramatic results can be achieved with multiple applications.

### **VIII. EFFECTS OF DIFFERENT TOOTH WHITENING AGENTS**

The most popular and well-researched teeth bleaching method is night guard essential bleaching with 10% CP. Some dentist-supervised home bleaching products that contain 10% CP have received the seal of approval from the American Dental Association. Techniques for night guard crucial whitening teeth discolored by ageing, moderate fluorosis, trauma, inborn discoloration, and tetracycline have been successful [5]. In a long-term clinical experiment, 98% of subjects experienced tooth whitening by 10% CP, and 82% of patients kept the whitening effect for up to 47 months after treatment. In the beginning of treatment, teeth may whiten a little bit more quickly with higher CP concentrations (15% and 20%) that are available for at-home bleaching [5].

Equivalent peroxide concentrations in HP and CP tooth-whitening treatments show comparable whitening effectiveness with negligible negative effects. Because of their low cost to the consumer and aggressive marketing by manufacturing companies, a variety of OTC whitening products, such as whitening strips or tray less whitening systems, paint-on gels, gels with pre-fabricated trays, and whitening toothpastes, have grown in popularity in recent years [5].

An OTC product (paint-on gels and whitening strips) and home bleaching systems under the supervision of a dentist are effective when compared to a placebo or no treatment, and the effectiveness varies due to different levels of active ingredients, according to a recent systematic review of home-based chemically induced tooth whitening [5]. Higher HP (30–38%) concentrations are used during chair side in-office bleaching operations, which are closely supervised by a dentist. Many clinical trials have shown that in-office bleaching, either by itself or in combination with additional take-home bleaching solutions, is effective [5]. All treatment methods were able to achieve six grades of whitening, according to a randomized clinical trial comparing the effectiveness of at-home, over-the-counter, and in-office bleaching techniques. However, the time factor involved in the treatment was significantly different, with the in-office bleaching technique requiring the least time [5]. Nonetheless, the at-home bleaching treatment was the approach that was most well-liked by the patients [5].

### **IX. RISK ASSOCIATED WITH TOOTH WHITENING**

#### **ON MUCOSA**

An improperly fitting tray pressing against the gingiva and/or the use of extra material might irritate soft tissue. Just adjusting and polishing the tray and/or giving the patient instructions to use less material are examples of management [5]. An in-office bleaching process typically uses a higher HP concentration. Because HP is a caustic material, it can burn the mucosal or gingival tissue.

Thus, whenever delicate tissues are being protected during in-office bleaching operations, a rubber dam or light-cured resin supplied by the manufacturer should always be employed [5].

#### **ON ENAMEL AND DENTIN**

Numerous studies have examined the effects of bleaching on enamel morphology and surface texture, morphological alteration of the enamel surface, increased porosity of the superficial enamel structure, demineralization and decreased protein concentration, organic matrix degradation, modification in the calcium: phosphate ratio, and calcium loss, supporting the hypothesis that bleaching agents are chemically active components potentially able to remove certain types of stains from teeth [11]. Vital teeth must be directly exposed to the enamel surface for an extended amount of time, which varies according on the According to a recent study, enamel was harmed by all four types of opalescence teeth whiteners. According to recent research, there are significant differences between tests in terms of methodology, bleaching chemical kind, application time, load, and indentation placement. As a result, enamel micro hardness might differ from place to place. This could be the cause of the disagreements in the literature [5]. A consistent technique must be created to assess how tooth-bleaching products affect the micro hardness of enamel and dentine.

## ON SYSTEMIC HEALTH

Although their concentrations are far lower than those of in-office bleaching agents since the latter are monitored by the dentist, there is greater worry about the potential negative effects of home bleaching agents [11]. Patients may occasionally experience small stomach or bowel disturbances as well as gastrointestinal mucosal irritation, such as a burning palate or throat. Nonetheless, the majority of studies in the literature have found that using little amounts of hydrogen peroxide for tooth whitening is still safe [11].

## X. DISCUSSION:

Teeth whitening has become increasingly popular in recent years, with more and more people seeking to achieve a brighter, more confident smile. This review article has provided an overview of the different methods available for teeth whitening, as well as their advantages and disadvantages [12].

One of the most significant advantages of teeth whitening is that it can have a significant positive impact on a person's self-esteem and confidence. A brighter smile can help individuals feel more attractive, and can even improve their social and professional interactions. Additionally, teeth whitening is a relatively non-invasive cosmetic procedure that can be completed quickly and with minimal discomfort.

However, there are also some disadvantages associated with teeth whitening. One of the most common side effects is tooth sensitivity, which can occur when the whitening agents penetrate the enamel of the teeth and irritate the nerves inside. Additionally, overuse or misuse of teeth whitening products can damage the enamel of the teeth, leading to weakened or more susceptible teeth over time [18].

When it comes to the most effective method of teeth whitening, professional treatments performed by a dentist are generally considered to be the most effective. These treatments use stronger whitening agents and are administered under the supervision of a dental professional, which can help to reduce the risk of side effects and ensure optimal results. Laser or light-accelerated whitening, in particular, can produce dramatic results in a short amount of time, while take-home trays and strips can be used for more gradual, long-term whitening [17].

Teeth whitening can be a safe and effective way to improve the appearance of your smile, provided it is done properly and under the supervision of a dental professional. While there are some risks associated with teeth whitening, the benefits can be significant for those looking to boost their confidence and self-esteem. Ultimately, the choice of which teeth whitening method to use will depend on individual needs and preferences, and should be made in consultation with a dental professional [4].

## XI. CONCLUSION:

In conclusion, teeth whitening is a popular cosmetic procedure that can significantly improve the appearance of one's smile. While there are many different methods available, professional treatments performed by a dental professional are generally considered to be the most effective and safe. However, it is important to be aware of the potential risks associated with teeth whitening, such as tooth sensitivity and enamel damage. Before undergoing any teeth whitening treatment, it is important to consult with a dental professional to determine the best method for individual needs and to ensure the treatment is administered safely and effectively. With proper care and maintenance, teeth whitening can be a safe and effective way to achieve a brighter, more confident smile.

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