

**Sensitivity after tooth whitening***Sensibilidad después del blanqueamiento dental**Sensibilidade pós-clareamento dental***Julia de Gouvea Ribeiro¹**

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This study aimed to conduct a literature review on the occurrence of tooth sensitivity when using home and in-office whitening techniques and to address the different proposed preventive and treatment. Data collection included publications available in electronic and print formats from the following databases: Google Scholar, SciELO, and PubMed. The inclusion criteria were scientific articles, literature reviews, case reports, dental journals, recent articles from the last 5 years, and exclusion criteria: studies that did not directly address the topic reviewed, as well as irrelevant articles published before 2016. However, 30% of the articles considered significant and published more than 5 years ago were also included in this study, totaling 30 articles for the literature review. Tooth sensitivity is the main adverse event of tooth whitening and is more closely associated with the in-office technique because it uses a higher concentration of the whitening agent. To minimize the reported sensitivity, several treatments that are considered effective have been proposed, such as desensitizing products, medications, low-frequency laser therapy, and shorter time and concentration of the whitening agent in the dental structures.

Descriptors: Tooth Bleaching; Sensitivity to Tooth Bleaching; Sensitivity Tooth Treatment; Evidence-Based Dentistry; Dental Aesthetics.

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Resumén

El objetivo de este estudio fue realizar una revisión bibliográfica sobre la incidencia de sensibilidad dental al utilizar técnicas de blanqueamiento dental en casa y en consultorio, y abordar los diferentes tratamientos preventivos y terapéuticos propuestos. La recopilación de datos incluyó publicaciones disponibles en formato electrónico e impreso en las siguientes bases de datos: Google Scholar, SciELO y PubMed. Los criterios de inclusión fueron: artículos científicos, revisiones bibliográficas, informes de casos, revistas odontológicas, artículos recientes de los últimos 5 años, y criterios de exclusión: estudios que no abordaran directamente el tema revisado, así como artículos irrelevantes publicados antes de 2016. Sin embargo, el 30% de los artículos considerados significativos y publicados hace más de 5 años también se incluyeron en este estudio, totalizando 30 artículos para la revisión bibliográfica. La sensibilidad dental es el principal efecto adverso del blanqueamiento dental y se asocia más estrechamente con la técnica en consultorio debido a que utiliza una mayor concentración del agente blanqueador. Para minimizar la sensibilidad reportada, se han propuesto varios tratamientos que se consideran efectivos, como productos desensibilizadores, medicamentos, terapia láser de baja frecuencia y un menor tiempo y concentración del agente blanqueador en las estructuras dentales.

Descriptores: Blanqueamiento Dental; Sensibilidad al Blanqueamiento Dental; Tratamiento de la Sensibilidad Dental; Odontología Basada en la Evidencia; Estética Dental.

Resumo

Objetivou-se realizar uma revisão de literatura acerca da ocorrência da sensibilidade dentária quando utilizadas as técnicas de clareamento caseiro e de consultório e abordar os diferentes tratamentos preventivos e terapêuticos propostos. Para a coleta de dados, foram utilizadas publicações disponíveis em meio eletrônico e impresso, nas seguintes bases: Google Acadêmico, SciELO e PubMed. Os critérios de inclusão utilizados foram: artigos científicos, revisão de literatura, relatos de casos, revistas da área da odontologia, artigos recentes dos últimos 5 anos e, como critério de exclusão, trabalhos que não abrangiam diretamente o tema revisado, bem como artigos não relevantes e publicados antes de 2016. No entanto, 30% dos artigos considerados significativos e publicados há mais de 5 anos também foram incluídos neste trabalho, totalizando 30 artigos para a revisão de literatura. A sensibilidade dentária é o principal evento adverso do clareamento dental, possuindo uma maior relação com a técnica de consultório por utilizar uma concentração maior do agente clareador. Para minimizar a sensibilidade relatada, foram propostos diversos tratamentos que são considerados efetivos, como os produtos dessensibilizantes, medicamentos, laserterapia de baixa frequência, menor tempo e concentração do agente clareador nas estruturas dentais.

Descritores: Clareamento Dental; Sensibilidade ao Clareamento Dental; Tratamento da Sensibilidade Dental; Odontologia Baseada em Evidências; Estética Dentária.

Introduction

Currently, the demand for aesthetic procedures is gaining prominence in dentistry. Since the smile is considered a crucial factor in facial aesthetics, the number of patients seeking aesthetic enhancements has increased significantly. It is believed that smile aesthetics are associated with health, youthfulness, dynamism, success, expressiveness, and socioeconomic prestige^{1,2}.

Among the various aesthetic dental treatments, teeth whitening is one of the most sought-after by patients. It is considered a minimally invasive, relatively safe, and effective procedure, as it maintains intact dental structures. However, in some cases, exposure to the pH of the whitening solution can cause adverse effects such as tooth hypersensitivity, gum irritation, and ulceration of the oral soft tissues^{3,4}.

In 1989, Haywood and Heymann published a paper on case reports of patients using bleaching agents, namely 30% hydrogen peroxide and 10% carbamide peroxide. This introduced the vital teeth whitening treatment, which is still used today⁵.

Teeth whitening is performed by applying chemical agents that, through an oxidation reaction, remove organic pigments from teeth⁶. The treatment can be performed using two techniques: at-home bleaching, supervised by a dentist (DJ), also known as tray bleaching, and in-office bleaching, performed by a dentist. Both techniques require the application of carbamide peroxide or hydrogen peroxide to the teeth, varying in concentration⁷.

Tooth sensitivity after or during whitening is reported with both techniques, but more frequently with the in-office method because the bleaching agent is used in a higher concentration. Hydrogen peroxide has a low molecular weight, allowing it to penetrate the enamel, a permeable tissue⁷. During the diffusion of the applied product, the pigment macromolecules are broken down, potentially reaching the nerve endings of the dentin and pulp, activating nociceptors and thus generating an inflammatory reaction that will trigger the sensitivity reported by patients⁸.

Over the years, several alternatives have been proposed for the treatment of tooth sensitivity, including reducing the concentration of the whitening product and



decreasing the time it remains on the tooth; applying desensitizing agents, such as nanohydroxyapatite paste used after using the whitening gel; preoperative analgesia; prescribing medications after whitening, among other proposals⁹. However, the dentist must know the mechanism of action of the whitening agent, as well as the possible chemical interactions between its whitening agents and dental tissues, so that adverse effects are minimized and avoided whenever possible¹⁰.

Given the above, the objective of this study is to identify the occurrence of tooth sensitivity when home and in-office whitening techniques are used and to address the different preventive and treatments proposed.

Methodology

This study conducted a literature review based on a survey of bibliographic sources. Publications available in electronic and printed media were used. Data collection was conducted using the following databases: Google Scholar, SciELO, and PubMed. The search terms used were: "Dental whitening," "Sensitivity to dental whitening," "Treatment of dental sensitivity," and, in English, "Tooth bleaching," "Sensitivity to tooth bleaching," and "Sensitivity tooth treatment." A total of 1,406 studies citing the searched keywords were found. The searches and analyses of the retrieved materials were conducted between July and October 2021.

The inclusion criteria used were scientific articles, literature reviews, case reports, dental journals, and recent articles from the last 5 years. The exclusion criteria were studies that did not directly address the topic under review, as well as irrelevant articles. However, 30% of the articles considered significant and published more than 5 years ago were also included in this review.

Thus, 30 scientific articles on the topics of tooth whitening, tooth sensitivity, and their treatment were selected and used for the review. As can be seen, Laurence Bardin's Thematic Content Analysis was used¹¹, with the thematic categorization of the results.

Results

A total of 1,406 articles were found, of which 1,376 were excluded, leaving 30 scientific articles that will be presented and divided into the following categories: Techniques used in dental whitening, mechanism of action of whitening agents, adverse reactions of dental whitening, and sensitivity and sensitivity treatment.

Techniques used in tooth whitening

Teeth whitening is considered one of the most sought-after procedures in dental offices, primarily due to its applicability, efficiency, and simplicity. The procedure can be performed on vital and non-vital teeth and is recommended for teeth with color changes, such as those darkened physiologically or due to dietary habits, traumatized teeth, and, in selected cases, those with tetracycline staining and fluorosis¹².

For vital teeth, there are two subdivisions of tooth whitening: the supervised at-home method and the in-office

method. Both techniques use carbamide peroxide or hydrogen peroxide^{12,13}.

The in-office technique offers faster results compared to the at-home technique, as clinical sessions vary between one and three, maximum 45-minute sessions. However, its biggest disadvantage is the harshness of the whitening gel and its higher concentration of peroxide on the oral mucosa. Another disadvantage is its high cost and a higher rate of color recurrence over the long term^{13,14}.

The at-home technique offers the advantage of less potential for tissue damage, a better long-term prognosis for color recurrence, lower cost, and fewer and shorter appointment times. Another method used in dentistry is the combination of both techniques, enabling improved sensitivity control, resulting in better aesthetic results and improved treatment durability^{13,15}.

The use of light sources in dental procedures has been recommended by manufacturers. Although their effectiveness is not proven in the available literature, they claim to speed up the whitening process, resulting in shorter surgery times. Therefore, the use of light sources should be administered with caution, as their effectiveness is questionable¹³.

Mechanism of action of whitening agents

Regardless of the technique used, both bleaching agents, based on peroxide solutions, have a low molecular weight and the potential to denature proteins. Because they are oxidizing agents, they react with the macromolecules responsible for pigments. Through oxidation, the organic portion is converted into carbon dioxide and water. The process of removing pigmentation from the tooth occurs through the diffusion of oxygen^{12,16}.

The composition of carbamide peroxide ($\text{CH}_4\text{N}_2\text{O}-\text{H}_2\text{O}_2$) is based on the combination of hydrogen peroxide and urea. Upon contact with saliva or tissues, they dissociate, causing the hydrogen peroxide to decompose into oxygen and water, and the urea into ammonia and carbon dioxide. Ammonia facilitates oxygen penetration by increasing the tooth's structural permeability, while urea initially neutralizes the pH of the medium¹⁶.

It is important to emphasize that knowledge of the etiology of darkening, as well as the whitening agents, their techniques, and effects on the dental structure and tissues, is fundamental for the success of dental whitening¹⁷.

Adverse reactions to tooth whitening and tooth sensitivity

The most reported adverse reactions to whitening on vital teeth are gingival or oral mucosa irritation and tooth sensitivity. Hydrogen peroxide in concentrations of 30 to 38% is extremely aggressive when in contact with soft tissue, potentially causing not only irritation but also burns. Therefore, the use of barriers is essential for in-office procedures¹⁸⁻²⁰.

The procedure also causes, regardless of the technique, adverse reactions to the dental structure, such as increased roughness, wear, and microhardness of the dental enamel²⁰.



Tooth sensitivity is one of the most common adverse effects during and/or after whitening treatment, reported by patients during changes in temperature between hot and cold; 1 in 2 patients report feeling discomfort as a result of the treatment^{7,21}. It can be aggravated when it occurs more frequently and without the necessary monitoring by a specialized professional^{7,22}. Tooth sensitivity presents itself in different degrees, ranging from mild to severe. When present only in the early stages of treatment, it is generally acceptable, allowing for the completion of tooth whitening^{7,13}.

There are three possible hypotheses for the cause of sensitivity during whitening treatment. The first is based on direct stimulation of nerve endings located in the initial portion of the dentinal tubules and primary afferents of the trigeminal nerve that innervate the tooth. The second theory is based on the ability of odontoblasts to receive various stimuli through mechanical, chemical, and thermal signals. Finally, the third possible hypothesis correlates dental sensitivity with stimulation of the innervation present within the tooth, through the movement of dentinal fluid within the dentinal tubules. The hypotheses should not be considered in isolation, as they may be interrelated depending on the stimulus, region, or depth of the dentin^{13,23,24}.

Sensitivity treatment

It's important to note that not every patient will experience sensitivity during or after whitening. Therefore, the therapeutic recommendation is individualized, considering each patient's degree of sensitivity²⁵.

Currently, there are some possible treatments, such as the use of desensitizing agents, available on the market at an acceptable cost for most patients. 5% sodium fluoride is included in toothpastes to combat sensitivity. This agent can be used 10 minutes before the whitening procedure, combined with 2% potassium nitrate, or immediately after treatment, applied topically^{25,26}.

Desensitizers containing fluoride act by promoting the depolarization of odontoblast endings, promoting the effectiveness of the desensitizing agent over the long term, and sealing the dentinal tubules. Potassium nitrate, on the other hand, acts by minimizing the ability of the nerve fibers in the dental pulp, as diffusion occurs through the hard dental tissues, thus preventing the transmission of pain signals to the central nervous system^{25,27}.

Another treatment method is low-level laser phototherapy, which promotes the regeneration of traumatized tissues. This therapy provides analgesic, anti-inflammatory, and biomodulatory benefits. It is considered a good option for controlling postoperative symptoms, acting as an additional therapeutic alternative after teeth whitening^{25,28}.

Discussion

This study showed that teeth whitening techniques have been present and performed in dental offices for decades, evolving over time. Currently, two teeth whitening techniques are used: supervised at-home whitening and in-office whitening, and a combination of both is possible^{1,16}.

The demand for teeth whitening has been increasing in recent years, as it is an aesthetic, conservative, and safe procedure¹. According to study²⁶, it can be considered tooth whitening effective, whatever the technique used, as long as it is applied correctly, together with the whitening material, corroborating a study that defended the same point of view⁹.

Authors²⁹ conducted a comparative study between in-office teeth whitening techniques and supervised home teeth whitening on vital teeth. The study concluded that the in-office whitening technique produces faster results compared to supervised home whitening. However, it has a higher color recurrence rate. The home technique, on the other hand, requires longer treatment time but has less color recurrence and longer-lasting whitening. However, another group of researchers³⁰ described that the combination of the two whitening techniques proved to be more effective than the home technique alone. However, according to the authors, after 15 days, the three protocols achieved similar results in terms of effectiveness.

Study¹⁶ reported that tooth sensitivity consists of a pronounced response of the pulp to an aggressive stimulus, influenced by the exposure of the dentinal tubules and increased permeability. Thus, during tooth whitening procedures, molecules and active radicals found in the whitening agents pass through the dentinal tubules to the pulp, causing postoperative sensitivity. The exposure of the dentinal tubules and the resulting sensitivity are directly related to the high concentration of the whitening agents and the length of time they remain in contact with the tooth structures.

Authors³ conducted a case report on the management of tooth sensitivity associated with tooth whitening. The study reported that tooth sensitivity is considered the most common adverse effect among patients undergoing the aesthetic whitening procedure. Typically, tooth sensitivity is a temporary effect that can cause significant discomfort, but it is not long-lasting.

Researchers³¹ conducted research during the application of 35% hydrogen peroxide in the office to compare the effectiveness of the whitening procedure and sensitivity. They found that when a tooth is exposed to the whitening agent for a shorter period, a lower degree of sensitivity occurs. The study²¹, which refers to the concentration of peroxides in whitening agents, concluded that the higher the concentration found, the greater the oxidation generated in the pulp tissue, which may also be one of the factors responsible for the sensitivity reported by patients.

To minimize the reported sensitivity, several treatments have been proposed and are considered effective. According to a study²⁵, one of the forms of treatment for sensitivity is to reduce the concentration of whitening agents, in addition to analgesia through medications and anti-inflammatories, as well as the topical application of some of the desensitizers, with potassium nitrate and sodium fluoride being widely used to control tooth sensitivity.



Authors⁹ reported that potassium nitrate can be used as a pretreatment to prevent sensitivity resulting from tooth whitening. According to the study, this agent easily diffuses through dentinal and pulp tissue, providing an analgesic effect and thus reducing the likelihood of sensitivity.

Study²⁸ described another treatment method that, according to the authors, minimizes tooth sensitivity caused by tooth whitening. This involves the use of a low-frequency laser, which can reduce this harmful effect without affecting the mechanism of action of the whitening agents. Laser therapy is used in various treatments that require the regeneration of damaged tissues. This therapy provides anti-inflammatory, analgesic, and biomodulatory effects. Therefore, low-level laser therapy is considered an important treatment method, as it stimulates and repairs tissues injured after whitening.

Thus, it was concluded that tooth sensitivity after whitening treatment is considered the most frequently described adverse event in the literature. To avoid sensitivity, it is important that the professional selects the correct technique, considering each patient's specific needs and limitations, avoiding potential discomfort²⁵.

Conclusion

Based on the literature review, it can be concluded that: tooth sensitivity is the main adverse event of dental whitening, having a greater relationship with the in-office technique because it uses a higher concentration of the whitening agent; to minimize the reported sensitivity, several treatments have been proposed that are considered effective, such as desensitizing products, medications, low-frequency laser therapy, shorter action time and concentration of the whitening agent in the dental structures.

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