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INTERNAL TOOTH WHITENING: A COMPREHENSIVE REVIEW

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Abstract

Internal tooth whitening, also known as non-vital bleaching, is a widely used technique to address intrinsic discoloration in non-vital teeth caused by trauma, pulpal necrosis, endodontic materials, or other factors. Unlike external whitening, this procedure targets stains within the tooth structure, offering a minimally invasive solution to improve aesthetics. This review explores the history, techniques, materials, efficacy, and complications associated with internal bleaching, with an emphasis on evidence-based practices and advancements in the field. Techniques such as the walking bleach method, in-office bleaching, and combined approaches are discussed, highlighting their effectiveness and limitations. Key materials, including sodium perborate, hydrogen peroxide, and carbamide peroxide, are evaluated for their bleaching efficacy, safety, and risks. Potential complications, such as external cervical resorption and structural weakening, are addressed, along with strategies to mitigate these risks, including the use of intraorifice barriers. Recent innovations, such as biocompatible bleaching agents and digital monitoring tools, have further enhanced the safety and predictability of internal tooth whitening. The review also examines the application of internal bleaching in pediatric and adolescent patients, emphasizing the need for cautious and tailored approaches. Overall, internal tooth whitening remains a reliable and minimally invasive option for restoring the aesthetics of discolored non-vital teeth, provided clinicians adhere to modern protocols and evidence-based practices.

Introduction

Tooth discoloration in non-vital teeth is a common aesthetic concern that can arise from trauma, endodontic treatment, or prolonged exposure to staining agents. Internal tooth whitening, also known as non-vital bleaching, has become a widely adopted technique to restore the natural appearance of discolored teeth. Unlike external whitening procedures, internal bleaching targets discoloration from within the tooth structure, offering a minimally invasive solution for improving aesthetics (Jin, Paranhos, Salamone, Bongiorno, & Brizuela, 2024). This article provides an in-depth exploration of internal tooth whitening, including its history, techniques, efficacy, complications, and recent advancements, based on the latest evidence and clinical studies.

Historical Background

The concept of internal tooth whitening dates back to the 1960s when Brown (1965) introduced early efforts to address discoloration in root-filled teeth. Over time, significant advancements in materials and techniques have enhanced the safety and efficacy of the procedure. The walking bleach technique, proposed by Nutting and Poe in 1963, remains one of the most widely used methods for internal bleaching (Attin, Paqué, Ajam, & Lennon, 2003). This technique involves the placement of bleaching agents inside the tooth, allowing them to act over several days before removal. Subsequent studies have refined the procedure, introducing more effective bleaching agents and barriers to minimize risks.

Internal bleaching methods have evolved significantly, shifting from the use of less predictable methods, such as heat-activated hydrogen peroxide, to more controlled and evidence-based approaches. The transition to modern bleaching agents and protocols has contributed to a higher success rate and fewer complications. For example, sodium perborate, introduced in later years, has become a safer and more predictable agent for internal bleaching due to its gentle action and reduced risk of external cervical resorption (Plotino, Buono, Grande, Pameijer, & Somma, 2008).

Causes of Tooth Discoloration in Non-Vital Teeth

Tooth discoloration in non-vital teeth can result from several intrinsic factors, including:

1. Pulpal Necrosis and Hemorrhage: Decomposition of pulp tissue or blood breakdown products can cause dark stains within the dentin. These stains are particularly challenging to remove due to their penetration into the dentinal tubules (Zimmerli, Jeger, & Lussi, 2010).

2 .Endodontic Treatment Materials: Residual obturation materials, such as gutta-percha and sealers, may lead to staining if not adequately removed. Sealers containing silver or zinc oxide-eugenol are particularly prone to discoloring the surrounding tooth structure (Plotino et al., 2008).

3 .Trauma: Dental trauma can lead to calcific metamorphosis, which alters the translucency and color of the tooth. The deposition of reparative dentin and pulp chamber obliteration contribute to a yellowish or brownish appearance (Leith, Moore, & O'Connell, 2009).

4 .Medications: Intracanal medicaments, such as tetracycline or certain antiseptics, can also contribute to discoloration if they interact with dentin (Attin et al., 2003).

These discoloration mechanisms pose unique challenges, necessitating targeted interventions like internal tooth whitening that specifically address intrinsic stains.

Techniques for Internal Tooth Whitening

1. Walking Bleach Technique

The walking bleach technique involves placing a paste of sodium perborate mixed with water or hydrogen peroxide into the pulp chamber. The agent is sealed temporarily within the tooth, allowing gradual whitening over days or weeks. This method has demonstrated long-term success in randomized controlled trials (Pedrollo Lise, Siedschlag, Bernardon, & Baratieri, 2018). The

gradual nature of the walking bleach technique minimizes the risk of over-bleaching and allows the clinician to monitor progress.

Despite its efficacy, the walking bleach technique requires careful protocol adherence to prevent complications, such as external cervical resorption. Studies suggest that the use of intraorifice barriers, such as glass ionomer cement, is essential to prevent the leakage of bleaching agents into the periodontal tissues (Oskoee, Bahari, Daneshpooy, Ajami, & Rahbar, 2018).

2. In-Office Bleaching

In-office bleaching utilizes higher concentrations of hydrogen peroxide or carbamide peroxide, activated by heat or light, to achieve immediate results. This technique is particularly advantageous for patients seeking rapid aesthetic improvements. Knezevic et al. (2022) compared in-office bleaching with the walking bleach technique and found that while in-office methods are faster, they may have a higher risk of post-treatment sensitivity and structural weakening of the tooth.

One notable advantage of in-office bleaching is the ability to control the procedure under clinical supervision. However, clinicians must exercise caution when using heat activation, as excessive heat can increase the risk of external cervical resorption (Newton & Hayes, 2020).

3. Combined Techniques

A hybrid approach combines in-office and walking bleach techniques to optimize outcomes. This method begins with an in-office session to initiate whitening, followed by the walking bleach technique for sustained results. Studies suggest that the combined approach is particularly effective for cases of severe discoloration, where traditional methods alone may fall short (Knezevic et al., 2022).

Materials Used in Internal Bleaching

1. Bleaching Agents

-Sodium Perborate: Widely used in the walking bleach technique, sodium perborate is less aggressive than hydrogen peroxide, making it a safer option for long-term use. Its decomposition releases oxygen, which penetrates dentinal tubules to break down chromogenic molecules (Plotino et al., 2008).

-Hydrogen Peroxide: Available in concentrations ranging from 10-35%, hydrogen peroxide is a potent bleaching agent that can penetrate dentin to break down stains. While effective, its higher concentrations increase the risk of complications, such as tooth sensitivity and external resorption (Frank, Kanzow, Rödig, & Wiegand, 2022).

-Carbamide Peroxide: A less concentrated and slower-acting alternative to hydrogen peroxide, often used in combination techniques. Its release of hydrogen peroxide over time makes it ideal for gradual whitening (Frank et al., 2022).

2. Intraorifice Barriers

The placement of intraorifice barriers is critical to prevent the diffusion of bleaching agents into the cervical region. Glass ionomer cement, resin-modified glass ionomer, and composite materials are commonly used as barriers. Studies by Oskoee et al. (2018) and Abduljalil, Sakalli, and Basmaci (2023) have highlighted the importance of these barriers in enhancing fracture resistance and minimizing the risk of external cervical resorption.

Efficacy of Internal Tooth Whitening

Internal bleaching has been shown to achieve significant and predictable improvements in tooth color. A systematic review by Frank et al. (2022) found that sodium perborate and hydrogen

peroxide-based agents were equally effective for removing discoloration. Additionally, Knezevic et al. (2022) reported comparable success rates for walking bleach and in-office techniques, with the latter offering faster results.

Long-term follow-ups confirm that internal bleaching provides stable outcomes for most patients. Pedrollo Lise et al. (2018) conducted a randomized clinical trial and found that the majority of treated teeth maintained their whitened appearance after one year. However, relapse of discoloration is possible, particularly in cases where causative factors, such as trauma or staining agents, persist.

Complications and Risk Management

1. External Cervical Resorption (ECR)

External cervical resorption is the most concerning complication associated with internal bleaching. Heithersay (1999) identified overuse of heat or high-concentration hydrogen peroxide as potential risk factors. Modern protocols, such as avoiding excessive heat activation and using intraorifice barriers, have significantly reduced the incidence of ECR (Newton & Hayes, 2020).

2. Structural Weakening

Prolonged exposure to bleaching agents can reduce the fracture resistance of endodontically treated teeth. Studies by Oskoee et al. (2018) and Sakalli, Basmaci, and Dalmizrak (2022) demonstrated that intraorifice barriers play a protective role by limiting the penetration of bleaching agents into vulnerable areas.

3. Tooth Sensitivity

While less common in internal bleaching compared to external techniques, tooth sensitivity can still occur. Proper sealing of bleaching agents within the pulp chamber is essential to minimize sensitivity-related issues (Zimmerli et al., 2010).

Advancements in Internal Tooth Whitening

Recent advancements have focused on improving the safety and efficacy of internal bleaching:

1 .New Bleaching Agents: The development of less aggressive and more stable bleaching agents has reduced the risk of complications (Kahler, 2022).

2 .Improved Barriers: Modern intraorifice barriers, such as resin composites and bioactive materials, have demonstrated superior performance in preventing bleaching agent leakage (Abduljalil et al., 2023).

3 .Digital Monitoring: Digital shade-matching tools and spectrophotometers enable precise evaluation of bleaching outcomes, ensuring consistent results (Frank et al., 2022).

Internal Bleaching in Pediatric and Adolescent Patients

Internal bleaching is particularly beneficial for children and adolescents with discoloration from trauma or developmental conditions. Leith et al. (2009) reported successful outcomes in young patients using modified walking bleach techniques. However, clinicians must exercise caution to avoid over-bleaching and ensure the preservation of developing tooth structures.

Conclusion

Internal tooth whitening is an effective and minimally invasive solution for addressing discoloration in non-vital teeth. Techniques such as the walking bleach method and in-office bleaching have demonstrated high success rates, with advancements in materials and protocols further enhancing safety and efficacy. However, clinicians must remain vigilant about potential complications, such as external cervical resorption and structural weakening. By adhering to

evidence-based practices and leveraging modern innovations, dental professionals can achieve optimal aesthetic outcomes while preserving tooth integrity.

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