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Internal Teeth Whitening Techniques: A Comprehensive Clinical Review of Mechanisms, Methods, and Outcomes for Managing Intrinsic Dental Discoloration

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Abstract

Background: Intrinsic tooth discoloration is a common aesthetic concern, often resulting from trauma, pulp necrosis, or residual endodontic materials. Unlike extrinsic stains, intrinsic discoloration originates within the tooth structure, necessitating specialized treatments such as internal bleaching. This minimally invasive approach preserves tooth structure while effectively lightening discolored nonvital teeth using oxidizing agents like hydrogen peroxide.

Aim: This review examines the mechanisms, clinical techniques, and outcomes of internal bleaching, focusing on the walking bleach, inside-outside, and in-office methods. It also evaluates risk factors, patient selection criteria, and long-term efficacy.

Methods: A comprehensive analysis of internal bleaching techniques was conducted, incorporating clinical guidelines, case studies, and comparative efficacy data. Special attention was given to pretreatment assessment, material selection, and procedural steps to minimize complications such as cervical resorption.

Results: Internal bleaching successfully restores tooth color in most cases, with the walking bleach method demonstrating high efficacy and patient compliance. Hydrogen peroxide and carbamide peroxide are the most effective agents, though concentration and application technique influence outcomes. Cervical resorption, though rare (<4%), remains a critical risk, emphasizing the need for proper isolation and intraorifice barriers. Case studies confirm stable aesthetic results with minimal complications at six-month follow-ups.

Conclusion: Internal bleaching is a conservative, cost-effective alternative to prosthetic restorations for nonvital discolored teeth. Success depends on accurate diagnosis, technique selection, and adherence to safety protocols. Future research should focus on optimizing agent concentrations and long-term stability.

Keywords: Internal bleaching, nonvital teeth, walking bleach, hydrogen peroxide, cervical resorption, aesthetic dentistry.

Introduction

Tooth discoloration is a frequent concern among individuals pursuing enhancements in the aesthetic appearance of their anterior teeth. Discoloration or staining is generally characterized by alterations in the color or translucency of one or multiple teeth. The classification of these changes depends on both their origin and anatomical location, distinguishing them as either extrinsic or intrinsic in nature. Accurate identification of the underlying cause is essential to establish an effective and individualized treatment plan.

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Extrinsic discoloration arises due to the deposition of pigments on the outer surface of the enamel. This condition is commonly attributed to external factors such as the consumption of pigmented substances like coffee, tea, and red wine, as well as tobacco use. These external agents lead to superficial staining that can often be managed through professional cleaning and whitening procedures. On the other hand, intrinsic discoloration originates from within the tooth structure, either in the enamel or the underlying dentine. This type may be developmental, as observed in conditions like dental fluorosis and amelogenesis imperfecta, or acquired following tooth eruption due to causes such as pulpal trauma, necrosis, or residual staining from endodontic filling materials [1].

Internal bleaching is regarded as a minimally invasive method intended to restore the natural appearance of nonvital teeth affected by internal discoloration. This approach is advantageous because it preserves tooth structure and is generally more cost-effective than prosthetic solutions such as crowns or veneers. The mechanism behind internal whitening involves the application of oxidizing agents capable of diffusing through the tooth tissues to decompose the pigmented organic compounds, thereby improving tooth color [2]. Hydrogen peroxide and carbamide peroxide are the primary agents used for this purpose due to their effective whitening properties [2].

Several techniques have been developed for the internal bleaching of nonvital teeth, including the walking bleach method, the inside-outside bleaching approach, and in-office bleaching sessions [3]. Among these, the walking bleach and inside-outside techniques have demonstrated comparable efficacy in clinical settings. The walking bleach method is generally preferred due to its convenience and reduced reliance on patient compliance. This technique involves sealing the access cavity after placing the bleaching agent, which negates the necessity for the patient to use a bleaching tray at home. Conversely, the success of the inside-outside method heavily depends on patient adherence to the treatment regimen, particularly in maintaining hygiene and regularly applying the bleaching gel inside a tray and into the access cavity using an interdental brush [4].

The predictability and effectiveness of internal bleaching are influenced by the etiology of discoloration. Teeth discolored as a result of trauma or pulp necrosis tend to respond more favorably to bleaching compared to discoloration induced by dental materials used during root canal procedures [2]. Therefore, understanding the cause of discoloration not only aids in selecting the appropriate technique but also helps in predicting the likely outcome of the treatment. This discussion aims to explore the critical aspects involved in the assessment and execution of internal bleaching procedures. It further illustrates these principles through a clinical case involving a 28-year-old male patient who underwent internal whitening for a nonvital maxillary central incisor using the walking bleach method. The case highlights the procedural steps, selection criteria, and clinical outcomes, providing insight into the practical application of internal bleaching in restorative dental practice.

Indications

Internal tooth whitening is primarily indicated for the aesthetic management of nonvital teeth that exhibit internal discoloration after undergoing endodontic therapy. This discoloration typically arises from several sources, including hemorrhage within the pulp chamber, pulpal necrosis, residual tissue remnants, and the presence of endodontic materials that were not adequately cleared from the chamber [5]. These substances produce chromogenic byproducts that can infiltrate the dentinal tubules, ultimately resulting in visible discoloration of the adjacent dentin.

In instances of pulpal bleeding—either during the removal of the pulp tissue or following dental trauma—blood components may enter and lodge within the dentinal tubules, producing a pinkish hue in the crown. This discoloration is often transient but may evolve if the condition persists. As hemolysis of the red blood cells occurs, iron is released and interacts with hydrogen sulfide, a byproduct of bacterial metabolism, to form black ferric sulfide. This compound leads to a distinct grey discoloration of the affected tooth [6]. Moreover, the degeneration of proteins within a necrotic pulp can also give rise to internal staining. The severity of this discoloration correlates with the duration of pulp necrosis; the longer the necrotic tissue remains within the canal, the more intense the discoloration of the dentin becomes [5].

Inadequate cleaning and shaping of the access cavity during endodontic treatment can result in the entrapment of pulp tissue remnants, particularly in areas like the pulp horns. These retained tissues may eventually decompose and contribute to discoloration, especially in the coronal portion of the tooth [7]. Additionally, improper removal of root canal filling materials—such as gutta-percha or sealers—from the coronal pulp chamber may also lead to dark staining. This issue typically arises when such materials are left above the level of the alveolar bone, where they remain in contact with the dentin over extended periods [5].

The success of internal bleaching in such cases hinges on both the nature and the duration of exposure to the staining materials. Discolorations caused by metallic compounds are particularly resistant to treatment and present a greater challenge. Before initiating any bleaching protocol, it is essential to ensure that all remnants of these materials are meticulously removed using rotary instruments or burs [5]. This step is critical because the presence of residual staining agents can reduce the efficacy of whitening agents and compromise the overall aesthetic outcome. Therefore, proper diagnosis, complete debridement of the chamber, and identification of the stain origin are necessary steps before proceeding with internal bleaching.

Preparation

Patient Consent

Before beginning internal tooth whitening, patients must be clearly informed that complete restoration of the tooth's natural color cannot be guaranteed. The degree of whitening achieved varies based on factors such as the

cause, depth, and duration of the discoloration. Patients should also receive full disclosure regarding potential risks and complications associated with the procedure to ensure informed consent. One of the most significant, though infrequent, complications is external cervical resorption. Although rare, this condition must be discussed with patients as part of the consent process. Research identifies internal bleaching as a potential contributing factor in approximately 3.9% of external cervical resorption cases. Other leading causes include orthodontic treatment (24.1%) and surgical procedures (5.1%) [8]. The condition typically remains asymptomatic and is usually detected incidentally on radiographs. Radiographically, external cervical resorption appears as a dish-shaped radiolucency near the cementoenamel junction (CEJ). Clinically, the tooth may still respond positively to vitality testing. However, bleeding upon probing, percussion sensitivity, and interdental papillae swelling are possible indicators of the condition [9]. The primary risk factors for developing cervical resorption include a history of dental trauma and the use of internal bleaching agents. Although the exact mechanism behind the condition is still not well understood, minimizing risk involves using bleaching agents with lower concentrations of hydrogen peroxide. The Council of the European Union issued guidance in 2011 recommending that whitening products contain or release no more than 6% hydrogen peroxide. Despite this, some countries still permit the use of higher concentrations, which may increase the risk of adverse effects [3].

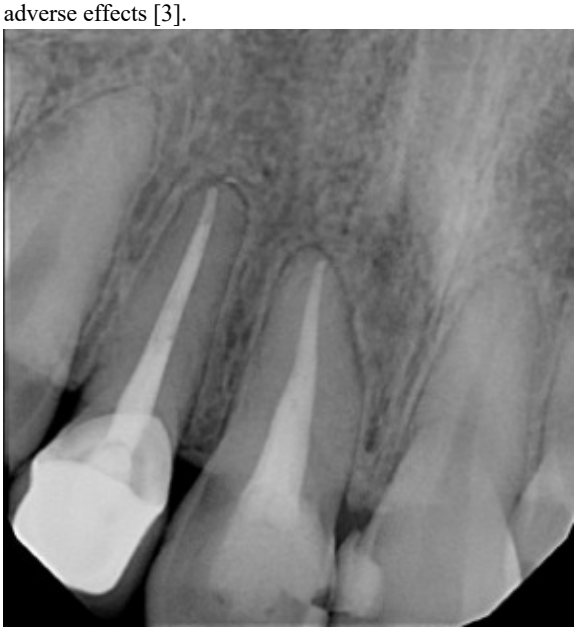

Figure 1: Periapical X-Ray.

Pretreatment Considerations

Prior to initiating internal whitening, a thorough clinical and radiographic assessment is required to ensure that the tooth is a suitable candidate for bleaching. This includes evaluating the quality of the existing root canal treatment, identifying any residual caries, and assessing the condition of the surrounding dentition [5]. Adequate root canal obturation, absence of apical pathology, and an intact coronal seal are necessary prerequisites before proceeding with bleaching. Attention must also be given to the condition of adjacent teeth, especially if they contain caries or defective restorations. However, these restorations should generally be postponed until after the bleaching process. Performing them beforehand can interfere with the bleaching effect and may result in shade mismatches. Additionally, the final shade outcome of the bleached tooth cannot be predicted with certainty, so delaying restorative work ensures a more accurate shade match.

Documenting the initial and final tooth color is an essential part of treatment planning. Pre- and post-treatment clinical photographs offer objective evidence of the treatment's effectiveness and help manage patient expectations. These images also serve a useful function for case documentation and follow-up comparisons, which are important for evaluating treatment outcomes and detecting any complications [5]. Overall, careful patient selection, comprehensive consent, and precise pretreatment evaluation are all critical to minimizing complications and maximizing the aesthetic success of internal tooth whitening.

Technique or Treatment

The foundation of internal tooth whitening rests on the use of hydrogen peroxide, either directly or through compounds that release it, such as carbamide peroxide or sodium perborate. Hydrogen peroxide serves as the key active agent because of its oxidative potential. It penetrates the enamel and dentin to interact with chromophore molecules—pigments responsible for discoloration—breaking them into smaller, colorless components. These fragmented molecules reflect light differently, resulting in a visibly lighter tooth shade. Enhancing the activity of hydrogen peroxide with adjunctive heat or light has been shown to accelerate and amplify whitening effects [10]. Among the available bleaching agents, carbamide peroxide and hydrogen peroxide are generally more effective in achieving better results, measured in shade guide units, than sodium perborate [11].

Walking Bleach Technique

A clinical case study exemplifies the use of the walking bleach method, a common approach for managing discoloration in nonvital teeth. The procedure begins with proper tooth isolation using a rubber dam to ensure moisture control and prevent leakage of the bleaching agent into adjacent tissues. Any previously placed restorative materials in the coronal area are removed to allow unobstructed access to the pulp chamber. The chamber is then disinfected using sodium hypochlorite, which serves as an antimicrobial agent and assists in dissolving remaining organic tissue.

To prevent the bleaching agent from diffusing into the periodontal tissues and to avoid complications such as cervical resorption, a 2-mm intraorifice barrier is placed. This layer typically consists of glass ionomer cement and provides an effective seal above the root filling. Intraorifice barriers are essential in internal bleaching not only to prevent apical and lateral leakage but also to preserve the structural integrity of the tooth and minimize the risk of external

cervical resorption [12,13,14]. Other acceptable barrier materials include resin composites and mineral trioxide aggregate (MTA).

A cotton pellet moistened with 40% hydrogen peroxide is then introduced into the pulp chamber. The access cavity is sealed temporarily using Intermediate Restorative Material (IRM), and the rubber dam is removed. The patient is scheduled to return at two-week intervals to evaluate the whitening progress. The bleaching application is repeated until no further visible improvement is achieved. Clinical photographs are taken after each session using the Vita Classical Shade Guide to objectively document the tooth's color change. Postoperative radiographs are also captured periodically to monitor any adverse reactions, including the onset of cervical resorption. When the desired outcome is achieved, a permanent adhesive restoration is completed to seal the access cavity and restore full function and aesthetics.

Inside-Outside Bleaching Technique

The inside-outside bleaching technique offers an alternative method that targets both the internal and external surfaces of the discolored tooth. In this technique, unlike the walking bleach method, the access cavity is intentionally left open during the bleaching period. The root canal filling is covered with a base material to prevent the bleaching agent from penetrating into the canal system. The patient is given a custom-fabricated, vacuum-formed splint to wear over the treated tooth. A small quantity of 10% carbamide peroxide is applied into the open pulp chamber and onto the corresponding area in the splint. The patient is instructed to wear the splint overnight. The advantage of this method lies in the low concentration of the bleaching agent, which reduces the likelihood of complications such as cervical resorption. Additionally, this approach eliminates the need for an intermediate restoration during the bleaching process, thereby simplifying interim maintenance [15].

Figure 2: Initial Bleaching.

Follow-up appointments are scheduled approximately every three days to assess progress and to ensure that the access cavity remains free of debris. Once the tooth reaches the intended shade, the access cavity is cleaned thoroughly and sealed with a temporary material, such as glass ionomer cement. A final, permanent restoration is then placed after about one week to allow time for the residual oxygen to dissipate from the dentin, which helps avoid compromised bonding. Despite its advantages, the inside-outside technique carries some practical limitations. Patient compliance is critical because failure to return promptly for sealing of the access cavity can increase the risk of bacterial contamination and reinfection. The fabrication and use of a bleaching tray also add cost and complexity, potentially reducing the appeal of this method for some patients [15].

In-Office Bleaching Technique

In-office bleaching provides a controlled environment for internal whitening and allows the use of more concentrated bleaching agents. While commonly associated with vital teeth, it is also applicable to nonvital cases. The initial steps mimic those of the walking bleach technique. After isolating the tooth and disinfecting the pulp chamber, the clinician seals the root canal and places a barrier material, often a resin-modified glass ionomer, over the obturation. The bleaching agent, typically 35% hydrogen peroxide, is applied directly into the pulp chamber and allowed to act for about 20 minutes. After this period, the agent is thoroughly rinsed out, and the process is repeated as needed within the same appointment. This concentrated application can yield faster results than home-based techniques and is useful when rapid aesthetic improvement is desired [15].

However, the use of high-concentration hydrogen peroxide necessitates stringent precautions. Proper rubber dam isolation is mandatory to protect surrounding tissues from chemical burns. The pulp chamber must also be properly sealed to prevent leakage. After treatment, the access cavity is left open for a few days, or temporarily sealed, depending on the clinician’s judgment and the observed whitening effect. A permanent restoration is scheduled in a follow-up appointment, usually after ensuring that the desired color has stabilized. This method offers the benefit of faster results and professional supervision but may not be suitable for all patients due to cost, sensitivity risk, or time constraints. The possibility of cervical resorption, although rare, remains a concern, particularly with higher concentrations of hydrogen peroxide. Therefore, case selection and risk-benefit analysis are critical before opting for internal in-office bleaching [15].

Each internal bleaching technique presents distinct advantages and limitations. The walking bleach method is effective and well-suited for patients seeking a straightforward in-office approach without requiring trays. The inside-outside method, although dependent on patient compliance, offers a low-risk, conservative alternative with predictable results using a lower concentration of bleaching agent. In contrast, in-office bleaching provides rapid whitening under professional supervision but requires rigorous isolation and carries a slightly higher risk of complications due to the use of stronger chemicals. Regardless of the chosen technique, proper diagnosis, patient education, and post-treatment monitoring are essential to ensure effective outcomes and minimize the risk of adverse effects. The ultimate choice of technique depends on the etiology of discoloration, tooth condition, treatment goals, and patient preferences [15].

Clinical Significance

The walking bleach technique utilizing hydrogen peroxide provides an effective and minimally invasive

option for treating internal discoloration in nonvital teeth. It preserves natural tooth structure, offers an affordable alternative to full-coverage restorations, and can achieve favorable aesthetic outcomes without the need for prosthetic intervention. Its conservative nature makes it suitable for patients concerned with both function and appearance following endodontic therapy. Given its ability to restore tooth color without compromising structural integrity, it remains a valuable treatment option in aesthetic dentistry, particularly for anterior teeth affected by trauma, necrosis, or residual endodontic materials. The economic advantage further enhances its appeal, particularly in cases where patients wish to avoid the higher cost and biological impact of crowns [15].

Case Report

A 28-year-old male patient with a medically stable background, specifically controlled hypertension, presented with concerns regarding the color of his upper right central incisor. He had previously received endodontic treatment on this tooth in July 2021. According to his account, discoloration began to appear approximately one month following the root canal procedure. His initial complaint during the consultation was based on advice he had received from another dentist, who recommended crown placement to restore the tooth's color and appearance.

The patient had already undergone similar treatment on the adjacent upper right lateral incisor, which was restored with a porcelain-fused-to-metal (PFM) crown following root canal therapy. That outcome had left him satisfied, influencing his assumption that a similar intervention would be necessary for the central incisor. However, despite his willingness to undergo crown placement, the potential drawbacks—particularly the loss of sound tooth structure and long-term restorative cycle implications—were discussed. As an alternative, internal bleaching was proposed using the walking bleach technique. This approach was favored for its conservative protocol, reduced biological cost, and significantly lower financial burden when compared to fixed prosthetic restorations. The patient agreed to proceed with the noninvasive option. At the initial clinical examination, shade matching using the VITA classical guide indicated a C4 shade on the discolored upper right central incisor. The treatment plan involved placing 40% hydrogen peroxide into the pulp chamber at two-week intervals, followed by shade reassessment [15].

Following the first application, notable color improvement was observed. The tooth color shifted to a C3 shade. The patient reported no discomfort or sensitivity. A second intracoronal application of hydrogen peroxide was carried out two weeks later. This session resulted in a further improvement, with the tooth reaching a C1 shade. Clinical documentation using photographic images and the VITA guide confirmed this color progression. A third application was performed to ensure stability and uniformity, though no additional whitening was observed, and the tooth remained at the C1 shade. Throughout the procedure, the tooth was monitored for potential complications. Radiographs were taken to rule out signs of external cervical resorption, and clinical evaluation confirmed the absence of symptoms. The rubber dam isolation, intraorifice sealing, and adherence to standardized protocols helped minimize risk. At the six-month follow-up, the C1 shade was maintained, and no discoloration or adverse clinical signs were noted. The patient expressed satisfaction with the aesthetic result and appreciated the conservative nature of the treatment compared to his previous crown experience [15].

The outcome of this case supports the use of the walking bleach technique as a viable and effective alternative for managing intrinsic discoloration in nonvital anterior teeth. The maintenance of shade stability over time and the absence of complications such as resorption further affirm its clinical reliability. The case also highlights the importance of patient education in selecting appropriate treatment options that align with both clinical needs and patient expectations.

Figure 3: Six-months Follow up.

Enhancing Healthcare Team Outcomes

Internal bleaching serves as a conservative and effective method for treating intrinsic discoloration in nonvital root-filled teeth. By preserving existing tooth structure and avoiding invasive procedures like crowns or veneers, it offers patients a reliable solution that balances aesthetics, function, and cost. Its simplicity and success in managing post-endodontic discoloration make it a preferred first-line approach in many clinical settings. The effective management of discolored endodontically treated teeth requires coordinated efforts among members of the dental care team. Dentists, endodontists, hygienists, and dental assistants must work collaboratively to assess the patient's needs, determine the appropriate treatment plan, and carry out internal bleaching procedures while monitoring for potential complications. The dentist plays a central role in diagnosing the discoloration and evaluating the condition of the previous endodontic treatment. When needed, the case may be referred to an endodontist for further evaluation or retreatment prior to the bleaching process. Dental hygienists and assistants support these interventions by preparing the treatment area, maintaining infection control protocols, and educating the patient on oral hygiene practices that support long-term results [15].

Interprofessional collaboration ensures that every aspect of care—diagnosis, treatment planning, procedural execution, and follow-up—is handled efficiently. The dentist’s clinical decisions must integrate the input of all

supporting staff, ensuring that procedural steps such as shade matching, barrier placement, material handling, and post-treatment documentation are coordinated seamlessly. This teamwork improves the quality of care and minimizes errors, leading to better outcomes and patient satisfaction. Communication within the healthcare team is vital to patient safety and efficiency. Clear clinical documentation, timely follow-up appointments, and appropriate referrals enhance the treatment workflow and help prevent complications such as cervical resorption. The dental team must also maintain open communication with the patient, ensuring that they understand the nature of the procedure and the steps involved in their care. This collaborative environment supports shared decision-making and encourages active patient participation, which is especially important in elective procedures like internal bleaching [15].

Ethical considerations are central to treatment planning. Dentists have a responsibility to respect patient autonomy by providing all necessary information about internal bleaching, including potential risks, treatment limitations, and available alternatives. Informed consent must be obtained in a clear and transparent manner. The patient should understand that although internal bleaching is effective, it may not always result in full restoration of the natural tooth color, and further treatment options may be considered if aesthetic goals are not met. Respecting patient preferences and ensuring confidentiality throughout the process strengthens trust and reinforces ethical practice. In conclusion, internal bleaching is not just a clinical procedure but a reflection of team-based healthcare delivery. Successful outcomes depend on technical expertise, interprofessional coordination, patient communication, and ethical responsibility. When executed within a well-functioning healthcare team, internal bleaching enhances both clinical and patient-centered outcomes, contributing to higher standards of care in restorative dentistry.

Conclusion:

Internal tooth whitening represents a vital conservative approach in aesthetic dentistry, offering a reliable solution for intrinsic discoloration in nonvital teeth. This review highlights the efficacy of techniques such as the walking bleach, inside-outside, and in-office methods, each tailored to specific clinical scenarios. The walking bleach technique, characterized by its simplicity and reduced reliance on patient compliance, emerges as a preferred choice, particularly for anterior teeth affected by post-endodontic staining. Its success is underscored by case studies showing significant shade improvement (e.g., C4 to C1 on the Vita Classical Shade Guide) with minimal adverse effects.

The mechanisms of internal bleaching hinge on the oxidative breakdown of chromophores by hydrogen peroxide or carbamide peroxide. However, the procedure's safety and predictability depend on meticulous execution, including rubber dam isolation, intraorifice barriers (e.g., glass ionomer cement), and thorough removal of pulp tissue remnants. Cervical resorption, though rare, remains a critical concern, linked to high peroxide concentrations and inadequate sealing. The European Union's recommendation to limit hydrogen peroxide to 6% reflects efforts to mitigate this risk, though higher concentrations are still used clinically with careful monitoring.

Patient selection and pretreatment assessment are paramount. Teeth discolored due to trauma or necrosis respond better than those stained by metallic endodontic materials. Radiographic evaluation and informed consent—emphasizing potential limitations and risks—are essential to align patient expectations with achievable outcomes. The case report presented illustrates the technique's success in a 28-year-old male, with stable results at six months and high patient satisfaction compared to prosthetic alternatives.

The inside-outside technique offers a lower-risk option for compliant patients, leveraging carbamide peroxide's gradual action, while in-office bleaching provides rapid results under professional supervision. Despite their differences, all methods share the goal of minimizing structural compromise while maximizing aesthetics. The economic advantage of internal bleaching over crowns or veneers further enhances its appeal, particularly for cost-conscious patients. Interprofessional collaboration is crucial for optimal outcomes. Dentists, endodontists, and hygienists must coordinate to ensure proper diagnosis, technique execution, and follow-up. Ethical practice demands transparent communication about treatment limitations, ensuring patients understand that complete color restoration is not always achievable.

Future directions should explore advanced biomaterials to reduce resorption risks and refine peroxide delivery systems for enhanced safety. Long-term studies are needed to validate the stability of bleaching outcomes beyond six months. In conclusion, internal bleaching stands as a cornerstone of minimally invasive aesthetic dentistry, balancing efficacy, safety, and cost-effectiveness. By adhering to evidence-based protocols and prioritizing patient-centered care, clinicians can consistently achieve predictable, durable results for discolored nonvital teeth.

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تقنيات تبييض الأسنان الداخلية: مراجعة سريرية شاملة للآليات والأساليب والنتائج في معالجة تصبغات الأسنان الجوهرية

الملخص

الخلفية :تصبغ الأسنان الجوهري يُعد من المشكلات الجمالية الشائعة، وغالبًا ما ينشأ نتيجة للرضوض، نخر اللب، أو بقايا مواد المعالجة اللبية. بخلاف التصبغات الخارجية، فإن التصبغات الجوهريّة تنشأ داخل بنية السن، مما يتطلب علاجات متخصصة مثل التبييض الداخلي. يُعد هذا الإجراء محدود التدخل، ويُحافظ على بنية السن مع تحقيق نتائج فعالة في تفتيح الأسنان غير الحية باستخدام عوامل مؤكسدة مثل بيروكسيد الهيدروجين.

الهدف :تهدف هذه المراجعة إلى دراسة آليات وتقنيات التبييض الداخلي ونتائجه السريرية، مع التركيز على تقنيات التبييض بالمشي، والتبييض الداخلي-الخارجي، والتبييض داخل العيادة. كما تستعرض عوامل الخطورة، معايير اختيار المرضى، والفعالية طويلة الأمد.

المنهجية :أُجري تحليل شامل لتقنيات التبييض الداخلي، شمل الإرشادات السريرية، دراسات الحالة، وبيانات مقارنة الفعالية. وتم التركيز بشكل خاص على تقييم الحالة قبل العلاج، اختيار المواد، والخطوات الإجرائية لتقليل المضاعفات مثل الامتصاص العنقي.

النتائج :أثبت التبييض الداخلي فعاليته في استعادة لون السن في معظم الحالات، مع تفوق طريقة "التبييض بالمشي" من حيث الكفاءة ورضا المريض. يُعد بيروكسيد الهيدروجين وكارباميد بيروكسيد من أكثر العوامل فعالية، على الرغم من أن التركيز وطريقة التطبيق يؤثران على النتائج. يبقى الامتصاص العنقي من المضاعفات النادرة (أقل من 4%)، لكنه يمثل خطرًا مهمًا، مما يستدعي عزلًا جيدًا واستخدام حواجز داخلية مناسبة. تؤكد دراسات الحالة استقرار النتائج الجمالية مع الحد الأدنى من المضاعفات بعد ستة أشهر من المتابعة.

الاستنتاج :يُعد التبييض الداخلي خيارًا محافظًا وفعالًا من حيث التكلفة مقارنةً بالتركيبات السنية في معالجة تصبغات الأسنان غير الحية. يعتمد النجاح على التشخيص الدقيق، اختيار التقنية المناسبة، والالتزام بالبروتوكولات الوقائية. يجب أن تركز البحوث المستقبلية على تحسين تركيزات العوامل المستخدمة واستقرار النتائج على المدى الطويل.

الكلمات المفتاحية :التبييض الداخلي، الأسنان غير الحية، تبييض بالمشي، بيروكسيد الهيدروجين، الامتصاص العنقي، تجميل الأسنان.