International Surgery Journal
*Portillo FRL et al. Int Surg J. 2025 Jun;12(6):1053-1059*
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20251415

**Review Article**

# Internal tooth bleaching: a review

**Fernando Rosas López Portillo[1], Aurea Elizabeth Valle Urias[2], Tonantzin González Arredondo[3], Jesus Gamez Valenzuela[4], Felix Manuel Manjarrez Guerrero[3], Ingryd Fabiola Molina Angulo[5], Enedina Duarte Quintero[2], Patricia Medina Santos[2], Cristhal Duque Urióstegui[6], Alan I. Valderrama Treviño[7]***

[1]Department of Graduate Clinic of Oral Rehabilitation, Autonomous University of Sinaloa, Mexico
[2]Department of Teaching Clinic, Autonomous University of Sinaloa, Mexico
[3]Department of Orthodontics, Autonomous University of Sinaloa, Mexico
[4]Department of Pediatrics Clinic CIDOC, Autonomous University of Sinaloa, Mexico
[5]Department of Periodontics Clinic, Autonomous University of Sinaloa, Mexico
[6]Department of Orthodontics, NOVA, Mexico City, Mexico
[7]Department of Biomedical Research, UNAM, Mexico City, Mexico

**Received:** 10 April 2025
**Revised:** 25 April 2025
**Accepted:** 29 April 2025

***Correspondence:**
Dr. Alan I. Valderrama Treviño,
E-mail: alan_valderrama@hotmail.com



## ABSTRACT

Intracoronal bleaching is a conservative, cost-effective aesthetic procedure designed to enhance the color of non-vital teeth over an extended period. The selection of bleaching agents, application methodologies, and comprehension of biological interactions with both soft and hard tissues are pivotal for achieving immediate treatment success. Presently, bleaching agents predominantly utilize peroxide-releasing compounds in diverse formulations applied to enamel and dentin. This review aims to provide a comprehensive overview of key aspects of intracoronal bleaching, including primary adverse effects and considerations essential for optimizing treatment efficacy.

**Keywords:** Dental bleaching, Intracoronal tooth whitening, Dental cosmetic enhancement, Non-vital teeth, Tooth discoloration, Aesthetic dentistry, Pulpal injury

## INTRODUCTION

Dental discoloration, referred to as discromía, exhibits variability in location, etiology, and severity. It compromises the patient's aesthetic appeal and has a detrimental effect on their self-esteem and overall quality of life 1-3 especially when there are pulpal injuries.[4,5] In recent years, the increasing demand for a brighter smile has led to a rise in treatments for non-vital teeth with discoloration, as the population seeks more effective aesthetic solutions (Figure 1).[3,6] Internal bleaching is a conservative treatment option for non-vital teeth with intrinsic discoloration. The underlying cause of the discoloration plays a significant role in determining the final outcome of the bleaching process. Regular monitoring of these teeth through clinical evaluation and radiography is essential due to the risk of color recurrence, which can adversely affect the patient's self-esteem and overall quality of life.[6,7] The application of this treatment is recommended with a detailed explanation of its characteristics, expected outcomes, and a thorough evaluation of the tooth's condition. This assessment is crucial to determine whether the bleaching treatment will be effective or if additional prosthetic interventions are required.[6]

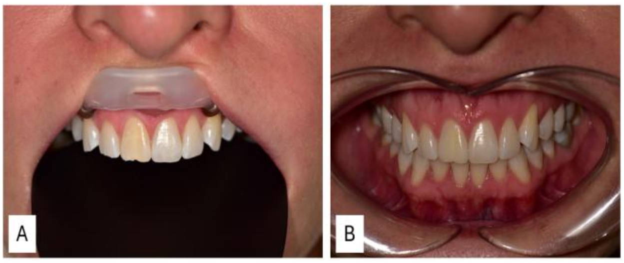


**Figure 1: Internal bleaching performed on a patient with discoloration of tooth 11. ((A) The patient visits the consultation seeking dental bleaching. During the interview, discoloration is noted in tooth 11; the patient mentions having experienced a blow with a glass, which led to a fracture of the incisal edge. (B) Photograph taken 8 days after completing the root canal treatment and following the first replacement of internal bleaching).**

## TOOTH DISCOLORATION

Chromophores, the colored compounds found in teeth, are derived from both organic and inorganic sources. These chromophores absorb visible light and reflect the complementary color perceived by the eyes, often appearing as yellow or brown. Organic chromophores consist of molecules with double bonds, including carbonyl groups or aromatic rings, such as tannins or furfurals, commonly found in substances like coffee, tea, red wine, and certain fruits.

Inorganic chromophores, on the other hand, are typically colored ions of transition metals such as $Fe^{2+}$ /$Fe^{3+,}$ $Cu^{2+}$, $OMn^{2+}$, chromophores may exist in combination and can also be generated through chemical processes involving the reduction and oxidation of initially colorless compounds.

Internal tooth discoloration pertains to factors influencing the natural color and optical properties of dental structures, with causes located in either the enamel or dentin. Intrinsic tooth stains primarily occur before tooth eruption and development. Subsequently, hemorrhagic pulpal products resulting from trauma and dental procedures, such as amalgam fillings or endodontic treatments, can lead to internal discoloration by releasing corrosion products that penetrate the dentin, causing irreversible stains.[9,10]

## DENTAL TRAUMA

Dental trauma can lead to the rupture of pulpal blood vessels, causing hemorrhage and the release of iron, which transforms into ferric sulfide, resulting in black discoloration. The outcome of this process is contingent upon pulpal vitality. If the pulp remains viable, enzymes will break down the extravasated erythrocytes into iron and amino acids as part of the inflammatory response, allowing the pulp to revascularize and recover its color within 2-3 months. Conversely, in cases of necrosis, hemolysis of the extravasated erythrocytes does not occur, and the discoloration persists.[11]

## PULPAL CANAL CALCIFICATION

The discoloration is likely associated with decreased tooth translucency due to calcification and tertiary dentin deposition in certain cases. Odontoblasts, when exposed to bacterial infiltration or traumatic stimuli, trigger accelerated calcification as a defensive response. This process reduces translucency and results in a yellowish hue.[12]

## ENDODONTIC MEDICATIONS AND IRRIGANTS

Tetracyclines are the primary cause of intrinsic dental staining, with exposure during intrauterine development and childhood leading to intracoronal discoloration. Quinolones and minocycline, derivatives of tetracyclines, are linked to greenish discoloration. The application of tetracyclines in root canals during endodontic procedures results in discoloration, similar to combinations involving sodium hypochlorite and chlorhexidine, which form a dark brown precipitate that stains both dentin and enamel and combination of ethylenediaminetetraacetic acid (EDTA) with chlorhexidine results in the formation of a pink or white precipitate. This reaction is often associated with the chemical interaction between EDTA and chlorhexidine, leading to the creation of a smear layer that covers the dentinal tubules.[14-17]

## CORONAL RESTORERS AND FILLING MATERIALS

The gutta-percha sealer and endodontic cements, particularly those containing bismuth oxide like MTA, can lead to oxidation or corrosion, resulting in gray or pink discoloration of dentin. MTA is known to cause more pronounced discoloration when exposed to blood or hypochlorite. Additionally, amalgam restorations release corrosion products that penetrate dentin, leading to irreversible gray stains, which may require bleaching. Furthermore, restorations that are not well adapted can lead to leakage and secondary caries.[12,16]

## PULPAL NECROSIS

Intrapulpal hemorrhage, resulting from damage to the Intrapulpal blood vessels, can precede necrosis and lead to discoloration of the dental structure. The breakdown of necrotic pulp tissue releases proteins, facilitating bacterial invasion. Bacteria that produce hydrogen sulfide react with iron to form ferric sulfide, contributing to further discoloration. Inadequate removal of necrotic tissue during endodontic procedures can worsen this effect, emphasizing the importance of thorough cleaning and disinfection (Figure 2).[17]


**Figure 2: Consecutive bleaching process. A 51-year-old patient presented to the dental office with mobility in tooth 11 and discoloration in tooth 12, resulting from a motor vehicle accident. (A) Root canal therapy was performed on tooth 12, followed by the initial session of internal bleaching; (B) fifteen days after completing the root canal treatment, a second internal bleaching session was conducted on tooth 12 (C).**

## CONGENITAL MALFORMATIONS AND DENTAL FLUOROSIS

Beyond these factors, certain malformations are linked to dental discoloration, particularly those with a hereditary component. Conditions such as dentinogenesis imperfecta and amelogenesis imperfecta, as well as hematological disorders like erythroblastosis fetalis, thalassemia, and sickle cell anemia, can lead to pre-eruptive staining. This discoloration often results from the presence of coagulated blood within the dentinal tubules, affecting the tooth's appearance before it erupts into the oral cavity.[18]

Dental fluorosis arises from excessive fluoride intake during tooth mineralization. This condition frequently occurs endemically due to the consumption of natural water sources with fluoride concentrations exceeding 1 ppm. The severity and extent of fluorosis are directly linked to the patient's age at the time of exposure and the amount of fluoride ingested.[4] Determining the etiology of dental discoloration is crucial, as it forms the basis for an accurate diagnosis, which in turn guides the appropriate treatment approach. Understanding the underlying cause helps in selecting the most effective therapeutic strategy to address the discoloration effectively.

## INTRACORONAL WHITENING

Dental whitening procedures are grounded in chemical and physical principles, primarily involving two methods: oxidation and reduction. The hydrogen peroxide whitening technique is specifically based on oxidation, where oxygen is directly released to lighten the teeth (Figure 3).[19] Schematic depiction of the internal bleaching procedure, illustrating the root canal sealing and the oxidative reaction in the coronal region induced by hydrogen peroxide ($H_2O_2$). Intracoronal whitening has been associated with several potential adverse effects, with invasive cervical external root resorption (ECIRR) being a major concern. Furthermore, there are discussions in the literature regarding the potential carcinogenic effects of peroxides used in this procedure. These risks highlight the importance of careful application and monitoring during the treatment process.[20]

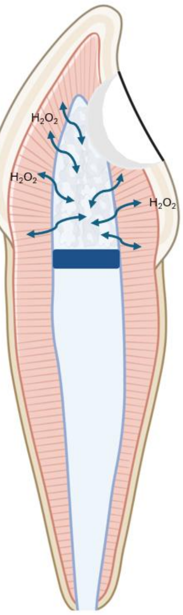


**Figure 3: Illustration of the hydrogen peroxide oxidation process in internal bleaching.**

Schematic depiction of the internal bleaching procedure, illustrating the root canal sealing and the oxidative reaction in the coronal region induced by hydrogen peroxide ($H_2O_2$).

## INTERNAL WHITENING PROCEDURE

This minimally invasive procedure has been utilized since the 19th century to enhance dental aesthetics in cases of intrinsic discoloration. It commences with a comprehensive initial assessment, including a detailed history of the discoloration's duration and any previous dental trauma or treatments. Clinical and radiographic examinations are conducted to diagnose the cause of the discoloration and verify the adequacy of the root filling, ensuring no endodontic pathology is present.

Discussing the patient's aesthetic expectations, associated risks, and available treatment options is essential. Following the evaluation, the procedure involves preparing and accessing the pulp space, treating any existing caries, and polishing the crown's external surface. This is performed under absolute isolation using a rubber dam to ensure the removal of any residual necrotic tissue.

In cases where a tooth has undergone previous endodontic treatment, the procedure involves removing any existing root filling materials and restorers, particularly from the labial aspect of the pulp chamber. Following endodontic treatment or retreatment, a coronal barrier is established by sealing the orifice with a suitable material, such as resin-modified glass ionomer, positioned just below the cemento-enamel junction. This barrier is essential to prevent the whitening agent from leaking into the root canal.

The whitening agent, commonly sodium perborate mixed with distilled water, is placed in the access cavity and compacted with small cotton pellets to eliminate excess moisture. The cavity is temporarily sealed with a material like Cavit white, and the patient is advised to monitor the change in tooth tone and avoid over-whitening. Once the desired result is achieved, typically after four weeks, the whitening material is removed. Postoperative photographs are taken to compare tooth tone and monitor any color regression over time. The definitive restoration, including an orifice barrier and base, is completed under absolute isolation, with regular clinical and radiographic follow-up scheduled to ensure color stability and tooth integrity (Figure 4).[21]

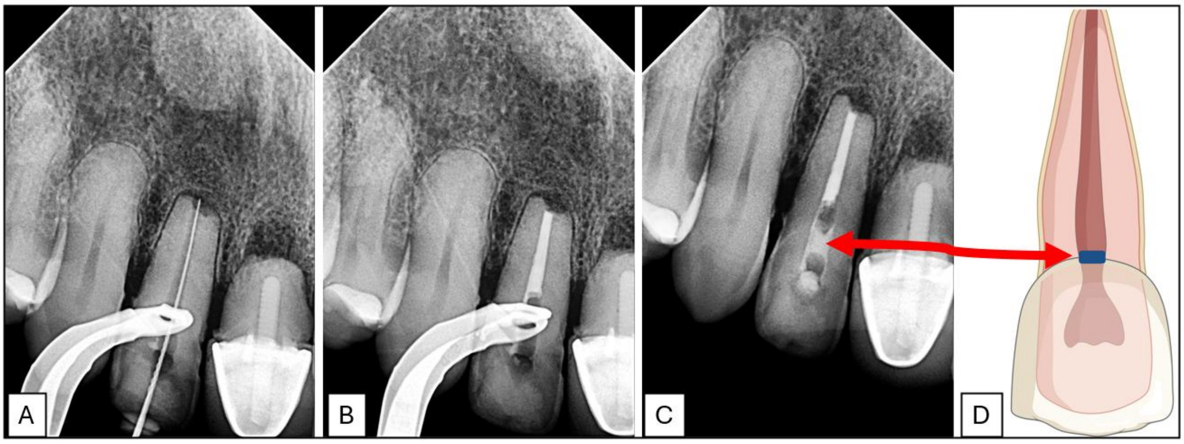


**Figure 4: Root canal therapy and internal bleaching of tooth 22. (A) Conductometry Radiograph: A radiograph is taken to confirm the conductometry performed using an apical locator. (B) Desobturation and Sealer Removal: The root canal is desobturated, removing all filling material and remaining sealer. (C) Sealing with Glass Ionomer and Internal Bleaching: The canal is sealed with glass ionomer to ensure an adequate seal. Following this, the bleaching agent is placed to conduct internal bleaching. (D) Schematic representation of the root canal sealed with glass ionomer.**

**Table 1: Effect of dental bleaching agents.**

| Bleaching agent | Compound | Mechanism of action | Side effects | Concentration |
|---|---|---|---|---|
| **Peroxides** | Hydrogen peroxide | Decomposition: $H_2O_2 \rightarrow H_2O + O_2$ releasing oxygen that penetrates the dental enamel pores, reaching the underlying dentin and oxidizing embedded stains. | Dental sensitivity. Invasive cervical root resorption. Enamel damage. Irritation of surrounding tissues. | 3-10%<br>15-30% |
| | Carbamide peroxide | Ammonia, $co_2$, and $h_2o_2$ penetrate the enamel and transform chromophores through oxidation. | Dental sensitivity. Enamel damage. Irritation of surrounding tissues. | 10-16%<br>30-35 -40% |
| | Sodium perborate | Releases sodium metaborate, hydrogen peroxide, and oxygen; the peroxide diffuses from the chamber dentin to the internal surface of the enamel, producing bleaching through oxidation. | Enamel damage. Pulp irritation. Discordant recoloration. | |
| **Abrasive agents** | Hydrated silica | Hydrated form of silica that removes discoloration through gentle abrasion. | Dental sensitivity. Enamel damage. Alteration of oral microbiota. | 4-10% |
| | Sodium hexametaphosphate (SHMP) | Mixture of polymeric metaphosphates that, when bound to calcium, prevent erosive tissue loss. | Dental sensitivity. Enamel damage. Irritation of surrounding tissues. | 1% and 5%. |

## DISCUSSION

One way to treat these non-vital pieces is internal whitening, first mentioned in the literature by Truman in 1864.[1] This option serves as a conservative alternative to procedures like resin restorations, veneers, or ceramic crowns, as it maximally preserves the dental structure, thereby maintaining its resistance to fracture.[22,23]

Discoloration of non-vital teeth treated endodontically is a common occurrence, primarily resulting from pulp injuries, contamination within the pulp chamber, residual pulp tissue, and root filling materials. These factors contribute to the internal staining that can affect the aesthetic appearance of the tooth.[4,17,24] The degradation of blood during erythrocyte hemolysis releases iron, which can form ferric sulfide, a black compound that causes dark tooth staining.

This aesthetic issue is particularly bothersome when it affects anterior teeth. Internal whitening, also known as intracoronal or ambulatory whitening, is a commonly used treatment for such cases. Compared to alternatives like veneers or crowns, this procedure is minimally invasive and cost-effective. It involves placing a whitening agent in the pulp chamber of a tooth that has undergone root canal therapy, followed by sealing the access cavity with a temporary restoration.

The whitening agent is replaced weekly until the desired color is achieved. Classic whitening agents include hydrogen peroxide, carbamide peroxide, and sodium perborate, with carbamide peroxide often used in external treatments but also combined with other agents.[25,26] Hydrogen peroxide is a colorless, low molecular weight liquid that easily penetrates dentin, functioning as a potent oxidizing agent. It breaks the double bonds of both organic and inorganic compounds within the dentinal tubules (Table 1). Table summarizes common dental bleaching agents, their chemical composition, mechanisms of action, potential side effects, and typical concentration ranges used in clinical practice.

Upon decomposition, hydrogen peroxide can generate free radicals, reactive oxygen species, and peroxide anions through three possible pathways. The whitening effect is primarily attributed to reactive oxygen radicals, which interact with organic chromogens in the tooth structure, leading to the breakdown of pigmented molecules and resulting in tooth whitening. This oxidative mechanism is widely accepted as the fundamental process behind hydrogen peroxide's bleaching action.[27] Most whitening products contain hydrogen peroxide, typically formulated as a commercial gel. The use of radiant light alongside the gel can amplify the interaction between the peroxide and the tooth, thereby enhancing the bleaching effect (Figure 4).

Carbamide peroxide is a white, odorless crystalline solid that dissolves in water to release urea and hydrogen peroxide, which subsequently decompose into water, carbon dioxide, and ammonia, facilitating the bleaching process. It contains approximately 3.35% hydrogen peroxide and 6.65% urea.

Sodium perborate, another commonly used agent, is an odorless, water-soluble powder that decomposes into sodium metaborate, hydrogen peroxide, and oxygen when exposed to water, heat, or acidic conditions. A 2022 meta-analysis by Ariadne Charis Frank confirmed that internal bleaching using carbamide peroxide, hydrogen peroxide, or a combination of sodium perborate with hydrogen peroxide is significantly more effective at reducing discoloration in non-vital teeth than sodium perborate alone. This enhanced efficacy is attributed to the oxidizing agents' ability to break down blood degradation pigments like ferric sulfide, which primarily cause dark staining.

The variation in effectiveness is likely due to their differing mechanisms: sodium perborate releases hydrogen peroxide slowly upon hydration, whereas carbamide peroxide (35-37%) and hydrogen peroxide (35%) act faster by producing free radicals that oxidize dental chromogens.5 Multiple studies assessing the prognosis of intracoronal bleaching over periods exceeding 12 months have reported significant variability in study designs, including bleaching techniques, follow-up intervals, and success and failure criteria. Success rates varied between 45% and 100%.

Failures were primarily attributed to color relapse or the occurrence of resorption defects, particularly when high concentrations of hydrogen peroxide were applied alongside heat without the placement of an orifice barrier. These findings emphasize the critical role of establishing an orifice barrier and ensuring an effective sealing restoration following intracoronal bleaching to minimize complications.[28-30]

Several studies have evaluated the effects on enamel and dentin, reporting no significant changes in enamel surface morphology following bleaching with low-concentration solutions, as well as with 35% hydrogen peroxide and 35% carbamide peroxide at high concentrations.[31-33] Nevertheless, the issue remains controversial, with any potential effects believed to be temporary. Studies indicate that bleaching with 30–38% hydrogen peroxide or 10% carbamide peroxide does not significantly alter the calcium-phosphate ratio in dentin or induce notable collagen degradation.[33,34]

### *Complications*

Among the adverse effects associated with the internal bleaching technique are external cervical root resorption and a reduction in the adhesive strength of the dental structure. External cervical root resorption is an inflammatory external resorption of the root caused by trauma or intracoronal bleaching.[35] The estimated incidence ranges from approximately 1% to 46%. The mechanism behind this effect is not fully clear, but it has been proposed that the bleaching agent reaches the periodontal tissue via the dentinal tubules, triggering an inflammatory response.[36-38]

The acidic environment created by the low pH of hydrogen peroxide favors osteoclastic activity, leading to bone resorption. This is typically an asymptomatic complication, detectable only via routine radiographs. Occasionally, swelling may be observed in the papilla, or the tooth may exhibit sensitivity to percussion. The prognosis for treatment depends primarily on the extent of the resorption process. Radiographic follow-up is recommended within the first-year post-treatment to diagnose potential cervical resorption as early as possible.[7]

Another complication associated with dental bleaching is the reduction in the adhesive strength of resin restorations to the tooth structure, which may result from residual peroxide on the dental surface interfering with resin bonding and inhibiting complete polymerization. Multiple studies have demonstrated that optimal adhesive strength can be attained by delaying the adhesive procedure following bleaching.[38] Internal bleaching serves as a conservative treatment option for teeth with intrinsic discoloration of local etiology. It is advisable to conduct radiographic monitoring due to the potential for color relapse and for early detection of possible external root resorption. Extensive research indicates that the success of the treatment hinges on meticulous initial planning and management. Nonetheless, some studies suggest that additional discoloration following bleaching may be attributed to restoration degradation and the absorption of food stains on the tooth, rather than the chemical reduction of oxidation products.[30]

## CONCLUSION

Since ancient times, healthy, white teeth have symbolized good health. Discoloration may arise from local or systemic causes. Internal, or intracoronal, bleaching is primarily employed to treat intrinsic discoloration of local origin. This minimally invasive aesthetic procedure involves applying various peroxides within the pulp chamber of teeth with root canals. The impact of bleaching agents on enamel remains a subject of debate. Internal bleaching constitutes a key technique for managing non-vital teeth, with success rates largely dependent on the discoloration's etiology.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: Not required*

## REFERENCES

1. Patzer G. Improving self-esteem by improving physical attractiveness. JERD. 1997;9(1):44-6.
2. Van Der Geld P, Oosterveld P, Van Heck G, Kuijpers-Jagtman Am. Smile attractiveness: self-perception and influence on personality. Angle Orthod. 2007;77(5):759-65.
3. Artigas A, González M, Saavedra CM, Guerra RE, Rivera CA. Recromía in non-vital teeth: A case report. Revista Latinoamericana de Endodoncia. 2018;22(4):757-65.
4. Zimmerli B, Jeger F, Lussi A. Bleaching of nonvital teeth. A clinically relevant literature review. Schweiz monatsschr zahnmed. 2010;120:306–20.
5. Maylen GJ, Elena GHM. Caracterización clínico epidemiológica de pacientes con discromía dental. Revista Cubana de Medicina Militar. 2020;49(4):200640.
6. Lukez a, pavlic a, trinajstic zrinski m, spalj s. The unique contribution of elements of smile aesthetics to psychosocial well-being. J oral rehabil. 2015;42(4):275-81.
7. Cahuantico Carhuapoma Y, Cheng AL, Noborikawa Kohatsu AK, Tay LY. Internal bleaching: A case report. Revista Estomatológica Herediana. 2016;6(4):244-54.
8. Carey CM. Tooth Whitening: what we now know. J. Evid. Based dent. Pract. 2014;(14):70-6.
9. Lippert, F. An introduction to toothpaste—its purpose, history and ingredients. Monogr Oral Sci. 2013;23:1–14.
10. Greenwall-Cohen J, Greenwall LH. The single discoloured tooth: vital and non-vital bleaching techniques. Br Dent J. 2019;226:83949.
11. Marin PD, et al. Pulp revascularization and color regression. Dent traumatol. 2020;36(2):123-30.
12. Ahmed HM, Abbott PV. Discolouration potential ofendodontic procedures and materials: a review. Int Endod J. 2012;45:883-97.
13. Gasmi Benahmed A, Gasmi A, Menzel A, Hrynovets I, Chirumbolo S, Shanaida M, Lysiuk R, Shanaida Y, Dadar M, Bjørklund G. A review on natural teeth whitening. J Oral Biosci. 2022;64(1):49-58.
14. Rasimick Bj, Nekich M, Hladek Mm, Musikant B, Deutsch AS. Interaction between chlorhexidine digluconate and edta. J endod. 2008;34(12):1521–3.
15. González-López S, Camejo-Aguilar D, Sánchez-Sánchez P, Bolaños-Carmona V. Efecto de chx sobre el efecto descalcificante del ácido cítrico al 10%, ácido cítrico al 20% o edta al 17%. J endod. 2006;32(8):781-4.
16. Ferracane J. Resin composite-state of the art. Dent mater. 2011;27(1):29–38.
17. Attin T, Paqué F, Ajam F. Review of the current status of tooth whitening with the walking bleach technique. Int Endod J. 2003;36:313–29.
18. Suchetha A, Khawar S, Mundinamane D, Apoorva S, Bhat D, Govindappa. All about dental stains: a review (part 1). Ann Dental Special. 2016;4(2):41–6.
19. Aoba T, Fejerskov O. Fluorosis dental: química y biología. Crit Rev Oral Biol Med. 2002;13(2):155-70.

20. Álvarez Rodríguez J, Clavera Vázquez TJ, Hernández Varea JC. Compendio de endodoncia. 2da ed. La habana: icbp victoria de girón. 2015.
21. Mamer. Intracoronal tooth bleaching: a review and treatment guidelines. Australian Dental J. 2023;68:(1):141–52.
22. Tam Le, Cho W, Wang By, De Souza G. Effect of bleaching treatment on fatigue resistance and flexural strength of bovine dentin. J Esthet Restor Dent. 2015;27(6):374-82.
23. Ge C, Green Cc, Sederstrom D, Mclaren Ea, White Sn. Effect of porcelain and enamel thickness on porcelain veneer failure loads in vitro. J Prosthet Dent. 2014;111(5):380-7.
24. Rotstein I, Zalkind M, Mor C, et al. In vitro efficacy of sodium perborate preparations used for intracoronal bleaching of discolored non-vital teeth. Endod dent traumatol. 1991;7:177–80.
25. Nutting EC, Poe GS. A new combination of bleaching teeth. J calif dent assoc. 1963;2:289–91.
26. Ariadne Charis Frank, Philipp Kanzow, Tina Rödig, Annette Wiegand. Comparison of the bleaching efficacy of different agents used for internal bleaching: a systematic review and meta-analysis. JOE. 2022;48 (2):171-8.
27. Kwon Sr, Wertz Pw. Review of the mechanism of tooth whitening. J Esthet Restor Dent. 2015;27(5):240–57.
28. Amato A, Caggiano M, Pantaleo G, Amato M. In-office and walking bleach dental treatments on endodontically-treated teeth: 25 years follow-up. Minerva Stomatol. 2018;67(6):225-230.
29. Howell RA. The prognosis of bleached root-filled teeth. Int Endod J. 1981;14(1):22–6.
30. Abbott PV, Heah SY. Internal tooth bleaching: An analysis of 255 teeth. Australian Dent J. 2009;54(4):326-33.
31. Duschner H, Gotz H, White DJ, Kozak KM, Zoladz JR. Effects of hydrogen peroxide whitening strips on dental surface color, microhardness, surface and subsurface ultrastructure, and microchemical composition (Raman spectroscopy). J Clin Dentis. 2006;17(3):72-8.
32. Cobankara FK, Unlu N, Altinoz HC, Fusun O. Effect of home whitening agents on the roughness and surface morphology of human enamel and dentin. International Endo J. 2004;54(4):211-8.
33. Worschech CC, Rodrigues JA, Martins LR, Ambrosano M. In vitro evaluation of the surface roughness of human dental enamel whitened with 35% carbamide peroxide and subjected to abrasive brushing with toothpaste. Pesquisa Odontológica Brasileira. 2003;17(4):342.
34. Titley K, Torneck CD, Smith D. The effect of concentrated hydrogen peroxide solutions on the surface morphology of human dental enamel. J Endodont. 1988;14(2):69-74.
35. Plotino G, Buono L, Grande MN, Paneijer CH, Somma F. Nonvital tooth bleaching: A review of the literature and clinical procedures. J Endod. 2008;34:394-407.
36. Dahl JE, Pallesen U. Tooth bleaching-a critical review of the biological aspects. Crit Rev Oral Biol Med. 2003;14(4):292-304.
37. Amaral C, Jorge A, Veloso K, Erhardt M, Arias V, Rodrigues JA. The effect of in-office in combination with intracoronal bleaching on enamel and dentin bond strength and dentin morphology. J Contemp Dent Pract. 2008;9(5):17-24.
38. Feiz A, Khoroushi M, Gheisarifar M. Bond strength of composite resin to bleached dentin: effect of using antioxidant versus buffering agent. J Dent (Tehran). 2011;8 (2):60-6.


**Cite this article as:** Portillo FRL, Urias AEV, Arredondo TG, Valenzuela JG, Guerrero FMM, Angulo IFM, et al. Internal tooth bleaching: a review. Int Surg J 2025;12:1053-9.