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Noninvasive Aesthetic Rehabilitation of Discolored Teeth Using 37% Hydrogen Peroxide: A Clinical Case Report

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Himani Mehra [1], Sona J. Parvathy [1], Arpita Banerjee [1], Shilpa R [1], Shraddha G [1]

1. Department of Conservative Dentistry & Endodontics, All India Institute of Medical Sciences, Kalyani, Kalyani, IND

Corresponding author: Arpita Banerjee, appyban240898@gmail.com

Abstract

Dental bleaching is a conservative approach to managing tooth discoloration while preserving intact tooth structure. This case report describes the clinical management of generalized anterior tooth discoloration in a 25-year-old female patient using in-office vital bleaching. Clinical and radiographic examinations, including cold and electric pulp testing, confirmed pulpal health and supported the suitability of the teeth for vital bleaching. Following baseline shade documentation, a single-session bleaching protocol was performed using 37% hydrogen peroxide applied in three consecutive 15-minute cycles under light-emitting diode (LED) activation. A light-cured resin-based gingival barrier was carefully adapted to ensure soft-tissue protection during the procedure. Amorphous calcium phosphate gel was subsequently applied as an adjunctive post-bleaching intervention. At the 30-day follow-up, an improvement in tooth shade from 3L1.5 to 2L1.5 on the VITA 3D-Master shade guide (Vita Zahnfabrik H. Rauter GmbH & Co. KG, Baden-Württemberg, Germany) was observed, without patient-reported dentinal hypersensitivity or clinically detectable gingival injury. This case demonstrates the clinical feasibility of high-concentration in-office vital bleaching for managing generalized tooth discoloration in appropriately selected patients. Comprehensive preoperative assessment, meticulous soft-tissue isolation, and appropriate clinical monitoring remain essential considerations for achieving favorable clinical outcomes.

Categories: Public Health, Quality Improvement, Dentistry
Keywords: esthetic dentistry, gingival protection, hydrogen peroxide, in-office whitening, intrinsic tooth discoloration, tooth bleaching, vita 3d master

Introduction

Tooth discoloration is a common aesthetic concern that may adversely affect an individual's self-perception and social confidence. It may be classified as extrinsic, intrinsic, or a combination of both, depending on the origin and localization of chromogenic substances. Accurate identification of the underlying etiology is essential for selecting an appropriate treatment approach. Vital tooth bleaching is a conservative and minimally invasive option for managing discoloration in teeth with intact structure, offering aesthetic improvement while avoiding unnecessary tooth preparation associated with restorative procedures [1,2].

Hydrogen peroxide (H_2O_2) is widely used in professional bleaching because its decomposition generates reactive oxygen species that oxidize chromogenic molecules within enamel and dentin, thereby reducing their light-absorbing capacity [2,3]. Although high-concentration in-office formulations provide controlled application and shorter treatment duration, peroxide diffusion through dental tissues may induce transient pulpal irritation and dentinal hypersensitivity. Accidental contact with gingival tissues may also cause chemical injury, emphasizing the importance of appropriate case selection, preoperative pulpal assessment, and meticulous soft-tissue isolation [4-6]. Furthermore, the contribution of light activation to bleaching efficacy remains controversial, with evidence suggesting no consistent improvement in final color change [7].

This case report describes the management of generalized yellowish discoloration in a 25-year-old woman using a single-session in-office bleaching protocol with 37% H_2O_2 and light-emitting diode (LED) activation. Particular emphasis is placed on comprehensive preoperative assessment, meticulous gingival barrier application, and postoperative evaluation of tooth shade and sensitivity. The report highlights the clinical considerations involved in performing high-concentration vital bleaching while preserving natural tooth structure and minimizing treatment-related adverse effects.

Case Presentation

A 25-year-old female patient presented to the department with generalized yellowish tooth discoloration and a desire to improve her smile through a conservative, non-invasive treatment approach. The patient reported that the discoloration had been present for the last five years. Her medical history was non-contributory, with no known drug allergies, including hypersensitivity to peroxide compounds or resin-based materials. Her dental history revealed no previous tetracycline exposure or history suggestive of

dental fluorosis. She denied tobacco use in any form. Regarding oral hygiene practices, the patient reported brushing twice daily, using a desensitizing dentifrice containing potassium nitrate and stannous fluoride during one brushing session and a conventional fluoride-containing toothpaste during the other.

Extraoral examination revealed no clinically significant abnormalities. Intraoral examination demonstrated generalized, relatively uniform yellowish discoloration involving the maxillary and mandibular anterior teeth, without clinically evident enamel pitting, surface defects, or characteristic banding patterns (Figure *1A*-*1B*). The baseline tooth shade was recorded as 3L1.5 using the VITA Toothguide 3D-MASTER (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Baden-Württemberg, Germany) under standardized daylight-equivalent illumination (5500 K), following 10 seconds of visual adaptation (Figure *1C*). The patient reported moderate consumption of tea, coffee, and carbonated beverages, without other regular exposure to known chromogenic substances. Oral hygiene status was generally satisfactory, although mild plaque accumulation was observed in the mandibular lingual region. No active carious lesions, defective restorations, or anterior composite restorations were identified in the aesthetic zone. The gingival tissues exhibited healthy contours, with no evidence of gingival recession or exposed cervical dentin. The gingival index score was 0, indicating clinically healthy gingival tissues [8].

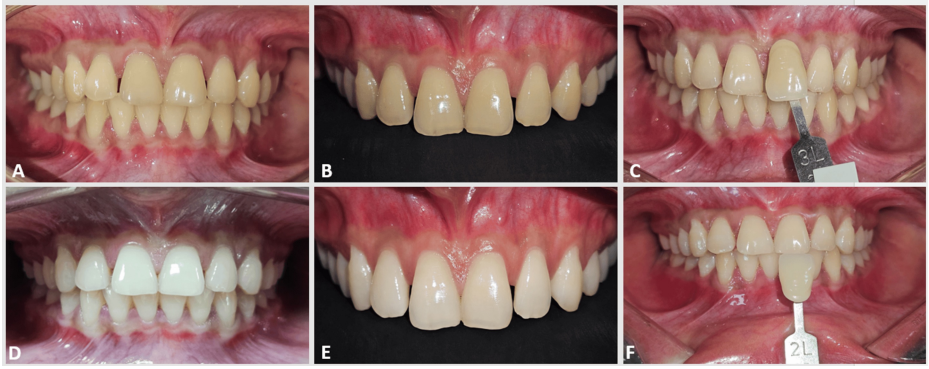


FIGURE 1: Preoperative and postoperative clinical photographs demonstrating the outcome of in-office tooth bleaching

A: Preoperative frontal intraoral view showing generalized yellowish discoloration of the maxillary and mandibular anterior teeth; B: preoperative frontal view of the maxillary anterior arch; C: preoperative shade assessment using the VITA Toothguide 3D-MASTER shade guide ((Vita Zahnfabrik H. Rauter GmbH & Co. KG, Baden-Württemberg, Germany)), demonstrating the initial shade (3L1.5); D: postoperative frontal intraoral view demonstrating improved tooth color following in-office bleaching; E: postoperative frontal view of the maxillary anterior arch; F: postoperative shade assessment using the VITA Toothguide 3D-MASTER shade guide, demonstrating the achieved shade (2L1.5).

Professional prophylaxis was done, including ultrasonic scaling followed by rubber-cup polishing, to remove plaque, calculus, and superficial extrinsic deposits. However, the generalized yellowish discoloration persisted following prophylaxis, indicating that the discoloration was not attributable solely to superficial extrinsic deposits. A comprehensive preoperative endodontic assessment was subsequently performed on all maxillary and mandibular anterior teeth using thermal (cold) testing and electric pulp testing (EPT). All examined teeth demonstrated responses within normal physiological limits, with no lingering response following cold stimulation, indicating no clinical evidence of symptomatic pulpal inflammation. Periapical radiographs of the maxillary and mandibular anterior teeth demonstrated intact pulp chambers, without radiographic evidence of periapical radiolucency or other detectable periapical abnormalities. Collectively, the clinical, endodontic, periodontal, and radiographic findings supported the teeth's suitability for external vital bleaching as a conservative aesthetic treatment.

The differential diagnosis included dental fluorosis, tetracycline-associated discoloration, and pulpal necrosis-related discoloration. Fluorosis was considered unlikely because of the absence of characteristic enamel opacities, white striations, or surface pitting and the patient's history. Tetracycline-associated discoloration was excluded based on the absence of relevant antibiotic exposure during tooth development and the lack of characteristic grey-brown cervical banding. Pulpal necrosis-related discoloration was considered unlikely because the staining was generalized rather than localized to an individual tooth, all anterior teeth responded normally to cold and electric pulp testing, and radiographic examination revealed no associated periapical pathology. The overall clinical findings were consistent with generalized yellowish discoloration with a predominantly intrinsic component, to which long-term dietary chromogen exposure may have contributed.

Following clinical assessment, the patient was considered suitable for professional in-office bleaching. The treatment options, expected aesthetic improvement, potential limitations, and possible adverse effects,

including transient dentinal sensitivity, pulpal irritation, and gingival chemical injury, were explained. Written informed consent was obtained before treatment.

A surgical-grade cheek and lip retractor (Philips Zoom IsoPrep Retractor; Koninklijke Philips N.V., Amsterdam, Netherlands) was positioned to provide adequate exposure and soft-tissue isolation (Figure *2A*). A light-cured gingival barrier (OpalDam, Ultradent Products Inc., South Jordan, Utah, United States) was subsequently applied along the cervical margins of the teeth scheduled for bleaching. The barrier extended approximately 1 mm onto the enamel surface and 4-5 mm over the attached gingiva (Figure *2B*). Particular attention was given to the interproximal regions, where the material was carefully adapted and scalloped to minimize the possibility of H_2O_2 leakage and subsequent soft-tissue injury. Vitamin E acetate (tocopherol) oil was additionally applied to exposed soft-tissue surfaces not covered by the gingival barrier as a supplementary protective measure.

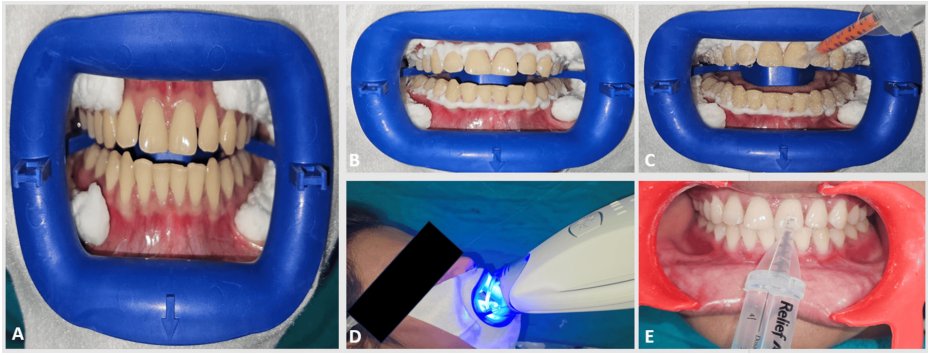


FIGURE 2: Clinical sequence of in-office tooth bleaching using the Philips Zoom whitening system

A: Retraction and soft-tissue isolation achieved using an isoprep retractor and cotton rolls; B: application of a light-cured gingival barrier (liquid dam) around the marginal gingiva to enhance soft-tissue protection and prevent bleaching gel contact; C: application of Philips Zoom whitening gel (Koninklijke Philips N.V., Amsterdam, Netherlands) containing 37% hydrogen peroxide in an approximately 1-mm-thick layer over the labial tooth surfaces; D: photoactivation of the bleaching gel using the Zoom accelerator (Koninklijke Philips N.V.) with the light-guide limiter positioned over the treatment area; E: application of amorphous calcium phosphate (ACP) gel following completion of the bleaching procedure to support post-treatment enamel remineralization.

Following confirmation of adequate isolation, a uniform 1 mm layer of 37% H_2O_2 bleaching gel was applied to the labial surfaces of the maxillary and mandibular anterior teeth (Figure *2C*). The bleaching procedure was performed using the activation unit (Zoom Blue LED Light-Activation Unit, Koninklijke Philips N.V.) having an emission wavelength of 480-520 nm (Figure *2D*). Three consecutive bleaching cycles of 15 minutes each were completed, with fresh bleaching gel applied before every cycle. At the completion of each cycle, the bleaching gel was carefully aspirated, and the tooth surfaces were thoroughly rinsed before subsequent application.

After completion of the third cycle, the remaining bleaching material was removed, and the gingival barrier was carefully detached. The treated surfaces and surrounding soft tissues were thoroughly rinsed. Amorphous calcium phosphate (Philips Zoom Whitening Kit, Koninklijke Philips N.V.) gel was then applied to support post-treatment enamel remineralization (Figure *2E*). Immediately following the procedure, the tooth shade was reassessed using the same shade guide and standardized assessment conditions. An improvement from the initial shade of 3L1.5 to 2L1.5 was recorded (Figure *1D*-*1F*). The patient tolerated the procedure without reporting any sharp or electric-like pain during treatment.

The patient was evaluated at 24 hours, seven days, and 30 days following the bleaching procedure. At the 24-hour assessment, the patient reported no postoperative tooth sensitivity or discomfort. The seven-day clinical examination revealed healthy gingival tissues with normal pink coloration, firm consistency, and stippled appearance. No evidence of chemical burns, epithelial sloughing, ulceration, or gingival recession was observed. The gingival index remained 0. At the 30-day follow-up, the achieved tooth shade was maintained at 2L1.5 according to the VITA 3D-Master shade guide, demonstrating a clinically observable improvement from the pretreatment shade of 3L1.5. The patient continued to report an absence of postoperative sensitivity, and no clinically apparent adverse effects were identified. Furthermore, the patient expressed satisfaction with the aesthetic outcome and reported improved confidence when smiling and participating in social interactions.

Discussion

Vital tooth bleaching is a conservative treatment option for managing discoloration in structurally intact

teeth. In the present case, the persistence of generalized discoloration following professional prophylaxis, together with the absence of developmental enamel defects or clinically evident pulpal pathology, supported the selection of an in-office bleaching approach. As emphasized by Kahler [1], identifying the underlying etiology of discoloration is essential for appropriate treatment selection. The preservation of natural tooth structure was particularly relevant in this case, as aesthetic improvement could be achieved without irreversible restorative intervention.

H_2O_2 produces its bleaching effect through the generation of reactive oxygen species that oxidize organic chromogenic molecules within enamel and dentin, reducing their light-absorbing capacity [2]. However, peroxide diffusion through dental tissues may also expose the pulp to oxidative stress and inflammatory responses [3]. Donato et al. reported inflammatory changes and superficial areas of pulpal necrosis following exposure to high-concentration H_2O_2 formulations, particularly those containing 35-38% peroxide [9]. These findings highlight the importance of cautious clinical application, as the absence of postoperative symptoms does not necessarily exclude subclinical pulpal alterations. Furthermore, evidence suggests that lower-concentration H_2O_2 formulations may reduce bleaching-associated sensitivity without substantially compromising whitening efficacy [10,11]. Therefore, peroxide concentration and exposure duration should be considered carefully when balancing aesthetic outcomes against potential biological effects.

Preoperative pulpal assessment is an important component of patient selection for vital bleaching. Cold and electric pulp testing, interpreted alongside clinical examination and radiographic findings, provide complementary information regarding pulpal sensibility and the presence of associated pathology [12]. In the present case, normal sensibility responses and the absence of radiographically detectable periapical abnormalities supported proceeding with bleaching. Nevertheless, these diagnostic findings cannot establish histological pulpal normality. Dentinal hypersensitivity, a frequently reported adverse effect of bleaching, is associated with peroxide penetration and subsequent pulpal inflammatory responses [3,9]. Although no sensitivity was reported in this case, the patient's habitual use of a potassium nitrate- and stannous fluoride-containing dentifrice may have contributed to this favorable outcome. Previous investigations have examined the potential role of potassium nitrate-containing agents in reducing bleaching-associated sensitivity [5,6,13]. However, its independent contribution cannot be established in the present case.

Post-bleaching application of amorphous calcium phosphate (ACP) was incorporated as an adjunctive remineralizing measure. Although remineralizing agents have been proposed to support mineral recovery following bleaching, their clinical effectiveness depends on the formulation and application protocol [3]. As enamel mineral content and surface properties were not objectively assessed in this case, the protective contribution of ACP cannot be confirmed. Similarly, although LED activation was included in the bleaching protocol, systematic reviews have not demonstrated a consistent additional improvement in color change with light activation of H_2O_2 gels [7,14]. Consequently, the observed shade improvement should be attributed to the overall bleaching protocol rather than to LED activation alone.

At the 30-day follow-up, the tooth shade improved from 3L1.5 to 2L1.5 on the VITA 3D-MASTER scale, without reported dentinal hypersensitivity or clinically evident gingival injury. Nevertheless, visual shade assessment is influenced by illumination, tooth hydration, and observer variability. Instrumental spectrophotometric evaluation using the CIE $L^*a^*b^*$ color system (International Commission on Illumination, Vienna, Austria) would have provided a more objective assessment of color change. Santos et al. demonstrated that bleaching-associated color improvement may undergo partial rebound during longer-term follow-up [15]. Therefore, the present findings establish short-term aesthetic improvement rather than long-term color stability.

Despite the favorable short-term aesthetic outcome, this report is limited by its single-patient design, absence of a comparative group, reliance on visual shade assessment, and subjective evaluation of postoperative sensitivity. Furthermore, subclinical pulpal changes cannot be excluded, and the 30-day follow-up is insufficient to establish long-term color stability or biological safety. Nevertheless, vital bleaching represents a conservative alternative to restorative intervention when preservation of natural tooth structure is a primary treatment objective. Prospective clinical studies incorporating spectrophotometric color assessment using the CIE $L^*a^*b^*$ color space, standardized sensitivity evaluation, appropriate pulpal monitoring, and extended follow-up are warranted to establish the long-term clinical effectiveness and biological safety of high-concentration in-office bleaching protocols.

Conclusions

In-office bleaching with high-concentration H_2O_2 demonstrated favorable short-term aesthetic outcomes in appropriately selected vital teeth while preserving natural tooth structure. The clinical outcome underscores the importance of comprehensive preoperative pulpal assessment, appropriate case selection, and meticulous soft-tissue isolation to minimize treatment-related complications. Although no postoperative sensitivity or clinically detectable gingival injury was observed, the possibility of subclinical pulpal responses cannot be excluded. Therefore, these findings should be interpreted cautiously, and further studies with objective outcome measures and extended follow-up are necessary to establish the long-term clinical effectiveness and biological safety of high-concentration vital bleaching.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Acquisition, analysis, or interpretation of data: Arpita Banerjee, Shilpa R

Critical review of the manuscript for important intellectual content: Arpita Banerjee, Shilpa R, Shraddha G

Concept and design: Himani Mehra, Sona J. Parvathy, Shraddha G

Drafting of the manuscript: Himani Mehra, Sona J. Parvathy

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **AI use statement:** The authors used ChatGPT (GPT-6) (OpenAI Group PBC, San Francisco, California, United States) as follows: language polishing in the report. The AI-generated content was verified by the authors for scientific accuracy, clinical relevance, and consistency with the documented patient records. All factual statements, clinical details, statistical information, and bibliographic references were independently cross-checked against the original clinical records and relevant peer-reviewed literature. Any inaccuracies or inappropriate suggestions were corrected or excluded. The authors confirm that they have reviewed and verified all AI-assisted content and take full responsibility for the work. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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