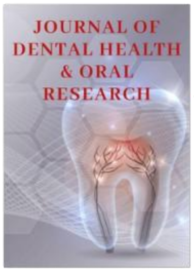

e-ISSN 3050-9432
Journal of Dental Health and Oral Research

ATHENAEUM SCIENTIFIC PUBLISHERS

Case Report

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In-Office Tooth Whitening Using 6% Hydrogen Peroxide: A Case Report Emphasizing Digital Shade Analysis and Optical Magnification

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Citation: Bourgi R, et al. In-Office Tooth Whitening Using 6% Hydrogen Peroxide: A Case Report Emphasizing Digital Shade Analysis and Optical Magnification. J Dental Health Oral Res. 2026;7(1):1-17.

https://doi.org/10.46889/JDHOR.2026.7102

Received Date: 15-12-2025

Accepted Date: 05-01-2026

Published Date: 11-01-2026

Abstract

Background: Tooth whitening using low-concentration hydrogen peroxide has gained increasing interest due to its balance between efficacy, speed and patient comfort. However, clinical success depends not only on the whitening agent but also on precise soft-tissue isolation, accurate shade assessment and long-term color stability.

Case Presentation: This case report describes an in-office whitening protocol using a Rapid 6% hydrogen peroxide bleaching material (Pols Office, SDI Limited, Bayswater, Victoria, Australia), documented through mobile dental photography (Smile Lite MDP, St-Imier, Switzerland). Gingival isolation was performed using a light-cured Southern Dental Industries (SDI) gingival barrier (SDI Limited, Bayswater, Victoria, Australia), placed under magnification with dental loupes (Carbon X Loupe, Xpedent Austria GmbH, Lustenau, Austria) to enhance precision and prevent unnoticed gingival exposure. Shade assessment was conducted using the Vita Classical Shade Guide and further validated with an objective digital shade measurement (Cobra Shade Scanner, Borea S.A.S, Limoges, France) to overcome the limitations of visual assessment. A post-treatment maintenance protocol was implemented (Pola Luminate, SDI Limited, Bayswater, Victoria, Australia) to enhance color longevity and enamel gloss.

Results: The 6% Hydrogen Peroxide (HP) (Pola Rapid, SDI Limited, Bayswater, Victoria, Australia) demonstrated rapid and effective whitening with no reported sensitivity. Use of magnification improved gingival barrier placement, minimizing transient gingival whitening. Digital shade analysis confirmed objective improvement beyond visual shade matching, supporting the combined use of conventional and digital shade tools. Maintenance (Pola Luminate, SDI Limited, Bayswater, Victoria, Australia) contributed to sustained color stability.

Conclusion: This case highlights the importance of integrating low-concentration hydrogen peroxide whitening, magnification-assisted gingival protection, digital shade analysis and structured maintenance protocols. Such an approach enhances safety, accuracy and long-term esthetic outcomes in contemporary whitening procedures.

Keywords: Bleaching; Color; Maintenance; Mobile Dental Photography; Shade Scanner

Introduction

The growing demand for esthetic dental treatments has positioned tooth bleaching as one of the most frequently requested procedures in contemporary cosmetic dentistry [1]. Patients increasingly associate dental appearance with social confidence and overall well-being, making the pursuit of a brighter smile a central objective of modern clinical practice [2]. Among available techniques, in-office bleaching has gained popularity due to its rapid results and clinician-controlled application, traditionally achieved using high concentrations of hydrogen peroxide [3,4]. However, despite its clinical effectiveness, conventional in-office bleaching is commonly associated with postoperative tooth sensitivity, reported in up to 60% of patients and remains the most prevalent adverse effect of the procedure [5-7].

Bleaching-induced tooth sensitivity is primarily attributed to the diffusion of hydrogen peroxide and its by-products through enamel and dentin toward the pulp, triggering inflammatory responses characterized by vasodilation, increased vascular permeability and oxidative stress at the cellular level [8-10]. In response to these biological concerns, various strategies have been proposed to mitigate sensitivity, including the use of desensitizing agents, pharmacological interventions, modified application protocols and the development of bleaching gels incorporating lower hydrogen peroxide concentrations [11-19]. Experimental and clinical evidence suggests that hydrogen peroxide concentrations around 6% may offer a favorable balance between whitening efficacy and biological safety, demonstrating reduced cytotoxic effects on pulp cells and lower disruption of cellular metabolism when compared to higher concentrations. Consequently, 6% hydrogen peroxide has emerged as a maximum allowable concentration in several regions, prompting manufacturers to adapt this formulation for both in-office and at-home applications [20-22].

Beyond immediate whitening outcomes, the long-term stability of tooth color represents a critical determinant of treatment success. Following bleaching procedures, enamel surfaces may exhibit increased roughness and superficial defects, facilitating the adhesion of chromogenic pigments and predisposing teeth to relapse discoloration [23]. For this reason, bleaching maintenance protocols play a pivotal role in preserving esthetic results. Contemporary maintenance strategies include the use of remineralizing and protective agents such as nano-hydroxyapatite, casein phosphopeptide-amorphous calcium phosphate fluoride formulations, antioxidants, fluoride-based products, arginine-containing pastes, blue covarine toothpastes and adjunctive therapies such as CO_2 laser applications, all of which have demonstrated varying degrees of efficacy in maintaining enamel color stability over periods extending up to 12 months [24].

Accurate documentation and objective monitoring of bleaching outcomes are essential for both clinical evaluation and scientific reporting. In recent years, digital photography has become an indispensable tool in dentistry, particularly for treatment documentation, patient communication and outcome tracking [25-27]. The COVID-19 pandemic further accelerated the adoption of digital and remote communication technologies, emphasizing the value of reliable photographic records within telehealth frameworks [28]. Mobile dental photography, enabled by advances in smartphone camera technology, has emerged as a practical alternative to traditional Digital Single-Lens Reflex (DSLR) systems due to its accessibility, reduced cost, portability and rapid learning curve, while still providing high-quality images suitable for clinical documentation and longitudinal assessment [29-31].

Shade assessment remains another critical component in the evaluation of whitening efficacy. Visual shade guides, such as the VITA Classical Shade Guide, are widely used in clinical practice but are inherently subjective and influenced by lighting conditions, operator experience and visual fatigue [32]. The CIELAB color system, introduced by the International Commission on Illumination, provides an objective framework for color measurement based on three parameters: lightness (L*), red-green chromaticity (a*) and yellow-blue chromaticity (b*) [33]. Spectrophotometers and digital shade scanners, which measure spectral reflectance across wavelengths, have demonstrated superior precision and reproducibility compared to visual methods and are increasingly recommended for objective shade tracking [32]. Devices such as the VITA Easyshade® spectrophotometer (VITA Zahnfabrik, Bad Säckingen, Germany) and the Cobra Shade Scanner (Borea S.A.S, Limoges, France) allow quantitative monitoring of tooth color changes throughout bleaching and maintenance phases, thereby enhancing diagnostic accuracy and scientific validity [34,35].

Equally important to bleaching safety and predictability is meticulous gingival protection. The application of gingival barriers under magnification and adequate illumination significantly enhances the clinician's ability to detect subtle gingival exposure

that may not be visible to the naked eye. Dental loupes improve visual acuity and precision, particularly during barrier placement and light-curing procedures, thereby reducing the risk of chemical gingival irritation and transient tissue whitening [36-38].
This case report presents the clinical application of an in-office whitening protocol using the gentle bleaching material: Pola Rapid 6% hydrogen peroxide (SDI Limited, Bayswater, Victoria, Australia), combined with mobile dental photography (Smile Lite MDP, St-Imier, Switzerland), dual shade assessment using a conventional shade guide and a digital spectrophotometric scanner and a structured maintenance protocol with Pola Luminate (SDI Limited, Bayswater, Victoria, Australia),. Gingival isolation (SDI Limited, Bayswater, Victoria, Australia), was performed under magnification loupes (Carbon X Loupe, Xpedent Austria GmbH, Lustenau, Austria) to optimize soft tissue protection. The case highlights the integration of low-concentration hydrogen peroxide whitening with objective color tracking, enhanced visual control and maintenance strategies to achieve rapid, sensitivity-free whitening outcomes with sustained color stability.

Case Presentation

A healthy adult patient presented with dissatisfaction regarding tooth discoloration and requested a conservative esthetic whitening treatment. Clinical examination revealed intact enamel surfaces, healthy periodontal tissues and no contraindications for bleaching. As part of the assessment, extraoral photograph was taken to document the progression of the discoloration before the treatment. The concept of Smile Lite Mobile Dental Photography (MDP) was developed to replicate the light conditions using smartphones. For this purpose, an initial photograph was taken using the Smile Lite MDP2 (Smile Line, Switzerland) and the S22 Ultra smartphone. To achieve optimal lighting, six Light Emitting Diodes (LEDs) on each lateral light and eight LEDs on the central light were activated and covered with a white diffuser, ensuring soft illumination for accurate color representation (Fig. 1).

Figure 1: Initial situation. Extraoral photograph before cleaning.

The initial photograph, depicting teeth in occlusion with retractors, was also taken using the Smile Lite MDP2 at maximum intensity. An intraoral photograph was taken, emphasizing the indispensable role of such images in dental documentation. This type of photograph is essential for accurately evaluating oral health, diagnosing dental issues and strategizing treatment plans (Fig. 2).

Figure 2: Initial situation. Intraoral photograph before cleaning.

Moreover, the Smile Lite MDP2 facilitates patient education and enhances case presentations, ultimately leading to improved patient satisfaction and better treatment outcomes [39,40]. The initial frontal view, captured using the Smile Lite MDP2, provides a comprehensive visual record of the patient's dental status (Fig. 3).

Figure 3: Initial situation. Intraoral photograph with retractor before cleaning.

A professional dental cleaning was performed as the initial step prior to the whitening procedure, as effective plaque and stain removal is essential to ensure optimal bleaching efficacy and uniform color change. Professional prophylaxis is a well-established prerequisite for improving oral hygiene, enhancing enamel surface cleanliness and achieving predictable esthetic outcomes. In the present case, supragingival debridement was carried out using ultrasonic instrumentation equipped with compatible tips from the Xpedent range, which are designed to fit scaler and surgical units from leading manufacturers (Xpedent ultrasonic tips, Xpedent Austria GmbH, Lustenau, Austria). Ultrasonic scaling was followed by air-polishing using a dedicated prophylaxis device (Chair-Side Micro Etching Master 2-in-1, Xpedent Austria GmbH, Lustenau, Austria) employing a sodium bicarbonate-based polishing powder with lemon flavor (Xpedent Air Fly Prophy Powder; composition: sodium bicarbonate; Xpedent Austria GmbH, Lustenau, Austria) to effectively remove extrinsic stains and biofilm while preserving enamel integrity (Fig. 4,5).

Figure 4: Initial situation. Intraoral photograph with retractors after cleaning with sodium bicarbonate-based polishing powder.

Figure 5: Initial situation. Intraoral photograph with contrastor after cleaning sodium bicarbonate-based polishing powder.

The initial tooth color was determined using the VITA Classical Shade Guide under standardized lighting conditions (Fig. 6). An edge-to-edge photograph was obtained with the Smile Lite MDP2 to visually compare color discrepancies between the natural tooth structure and the selected shade tabs. Based on this assessment, the baseline shade recorded for this case was D2 according to the VITA Classical system.

Figure 6: Shade assessment using the VITA Classical Shade Guide demonstrating an initial recorded tooth color of D2, clearly evident when compared with the B1 tab prior to whitening.

Due to the inherent subjectivity and limitations of visual shade selection, baseline color was additionally documented using a digital spectrophotometric device (Cobra Shade Scanner) to obtain objective and reproducible measurements [34,35]. Shade analysis was performed on the maxillary right central incisor (tooth 11), lateral incisor (tooth 12) and canine (tooth 13) to confirm the color map and verify the transition toward a B1 shade across adjacent teeth (Fig. 7-9).

The Cobra Shade Scanner employs multispectral spectrophotometric analysis to measure the spectral reflectance of dental tissues and expresses color values using the CIE L*a*b* and L*C*h color systems [35]. By eliminating environmental variables such as ambient lighting, operator perception and surrounding colors through auto-calibrated measuring tips, the device provides highly precise, objective and repeatable shade recordings. Its compact and lightweight ergonomic design, touch-screen interface and sterilizable tips facilitate seamless chairside integration while maintaining optimal hygiene standards. Furthermore, the system allows digital archiving, comparison of shade changes over time and generation of bleaching reports, enhancing traceability, patient communication and educational value during esthetic consultations [34,35].

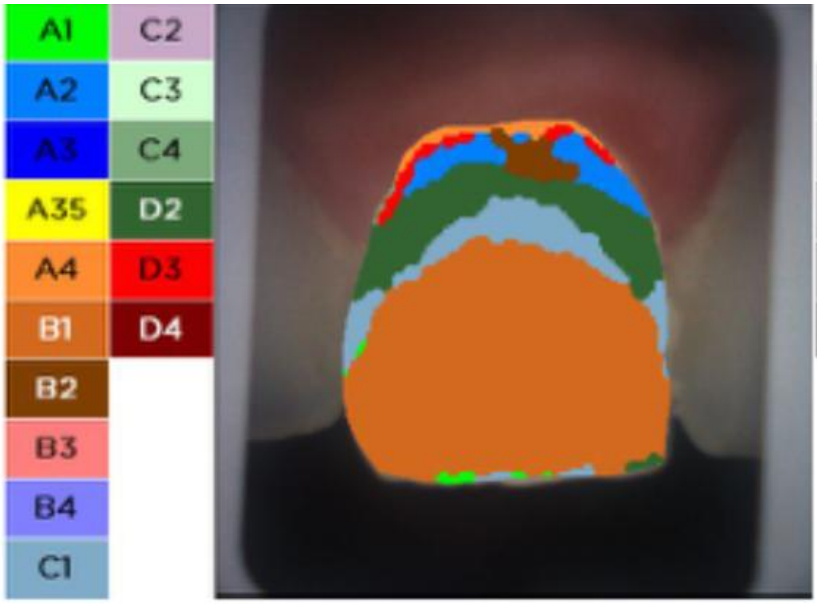

Figure 7: Digital shade assessment of the maxillary right central incisor (tooth 11) using the Cobra Shade Scanner, confirming the shade through objective spectrophotometric analysis.

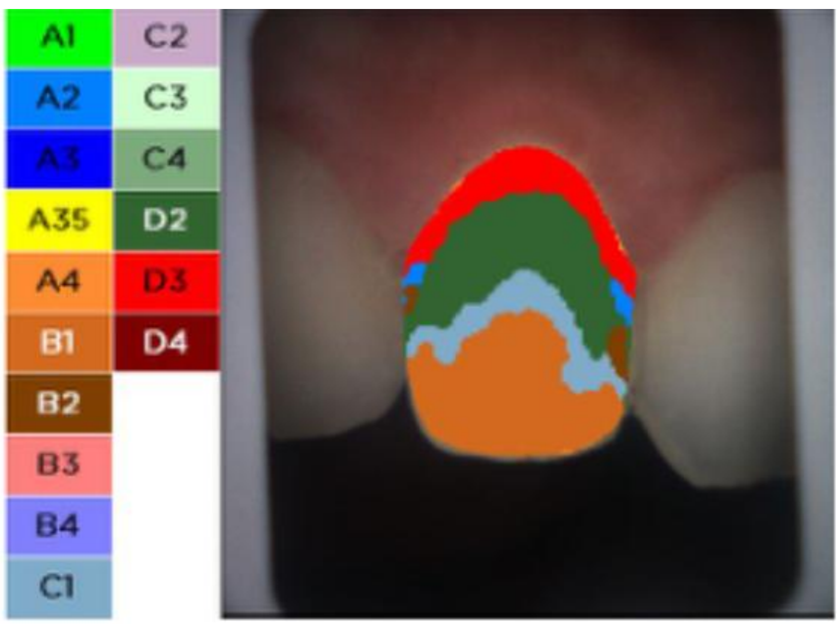

Figure 8: Digital shade assessment of the maxillary right lateral incisor (tooth 12) using the Cobra Shade Scanner, demonstrating the shade in the esthetic zone.

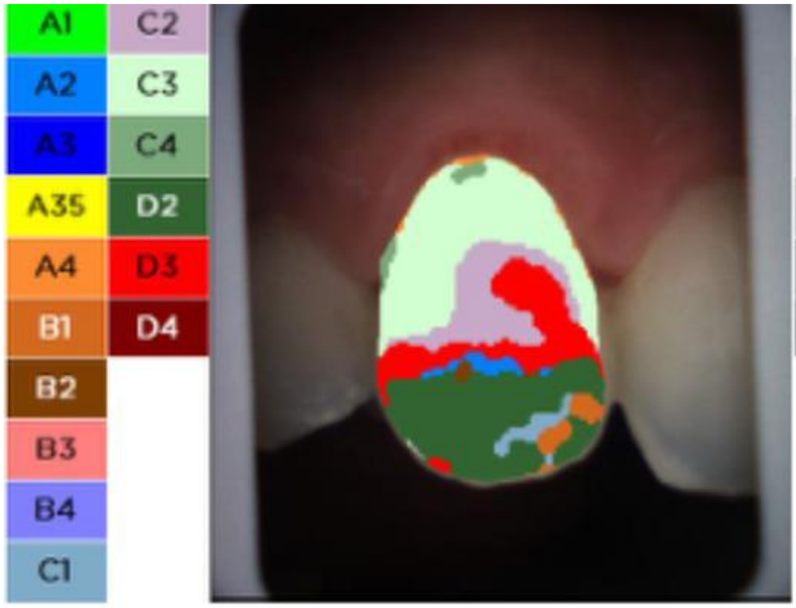

Figure 9: Digital shade assessment of the maxillary right canine (tooth 13) using the Cobra Shade Scanner, confirming the color.

In-office whitening was performed using Pola Rapid 6% hydrogen peroxide (SDI Limited, Bayswater, Victoria, Australia), according to the manufacturer's instructions (Fig. 10).

Figure 10: Pola Rapid 6% hydrogen peroxide with SDI gingival barrier for safe and effective in-office whitening.

The whitening gel was carefully applied to the tooth surfaces, while gingival protection was achieved using a light-cured SDI gingival barrier (SDI Limited, Bayswater, Victoria, Australia). Application was performed under magnification with Xpedent dental loupes to ensure complete coverage of the soft tissues, including cervical and interproximal areas that might be overlooked by the naked eye. This approach allowed for a safe, effective and rapid whitening procedure with minimal risk of postoperative sensitivity (Fig. 11,12).

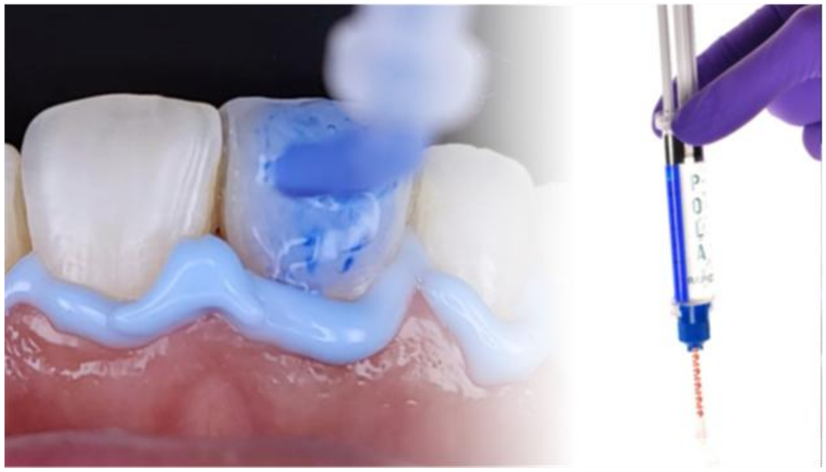

Figure 11: Proper application of the SDI gingival barrier under magnification with loupes, with Pola Rapid 6% hydrogen peroxide applied on the teeth, showing safe and effective isolation.

Figure 12: Example of failed gingival barrier application without the use of magnification, highlighting areas of exposed gingiva that could be at risk of chemical irritation during whitening.

Following gingival barrier application, Pola Rapid 6% hydrogen peroxide (SDI Limited, Bayswater, Victoria, Australia) was applied in a single in-office session lasting 15 minutes. A curing light was used during the procedure; however, it has been demonstrated in the literature that light activation does not significantly influence the whitening efficacy of hydrogen peroxide-based bleaching agents and comparable outcomes can be achieved with or without light activation [41]. Following completion of the in-office whitening protocol, a marked improvement in tooth color was observed. Final shade assessment revealed a shift from the initial D2 shade to B1, as confirmed using the VITA Classical Shade Guide under standardized lighting conditions. The post-treatment evaluation demonstrated a uniform and clinically perceptible whitening outcome, with improved brightness and chroma reduction across the anterior teeth, consistent with a successful bleaching response (Fig. 13).

Figure 13: Pre- and post-whitening documentation using mobile dental photography with the VITA Classical Shade Guide. A clear shade improvement from D2 to B1 is visually evident. Objective color enhancement was further confirmed using the Cobra Shade Scanner, providing digital, reproducible shade measurements beyond visual assessment.

However, to achieve a more objective and reproducible evaluation of internal tooth color enhancement, digital shade analysis using the Cobra Shade Scanner was additionally employed. This approach minimized the subjectivity inherent to visual shade matching and allowed precise documentation of color changes within the dental tissues [32,34,35]. Objective digital shade analysis performed using the Cobra Shade Scanner demonstrated a significant improvement in tooth color following the whitening procedure. The measurements confirmed an increase in the proportion of B1 shade characteristics and a corresponding reduction in D2 shade values (for the teeth 11 and 12), indicating effective whitening and internal color enhancement beyond visual perception alone. This objective assessment validated the clinical findings obtained with the VITA Classical Shade Guide and reinforced the reliability of the whitening outcome (Fig. 14,15).

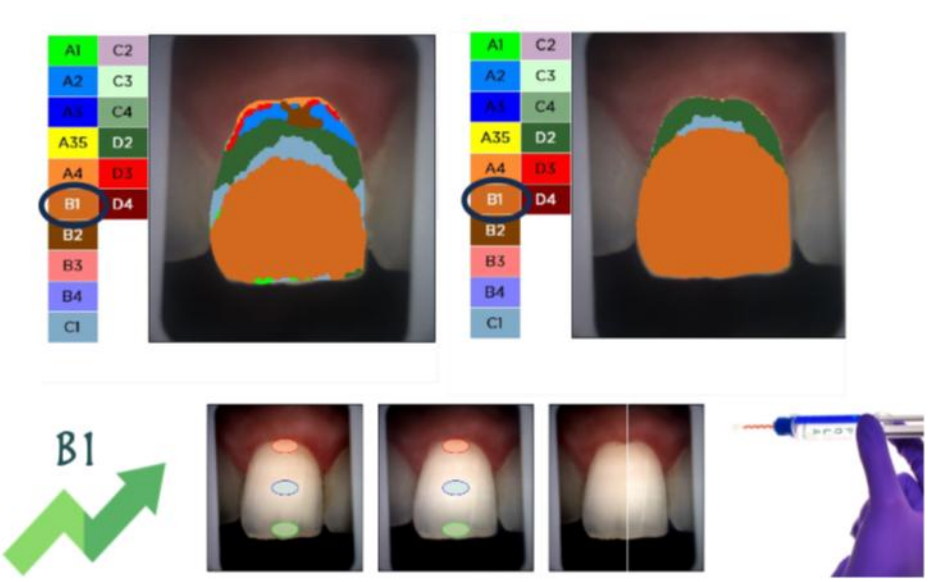

Figure 14: Post-whitening digital shade analysis using the Cobra Shade Scanner. Objective measurements demonstrate an increase in B1 shade values and a decrease in D2 shade components for the tooth 11, confirming effective tooth whitening and enhanced color stability beyond subjective visual evaluation.

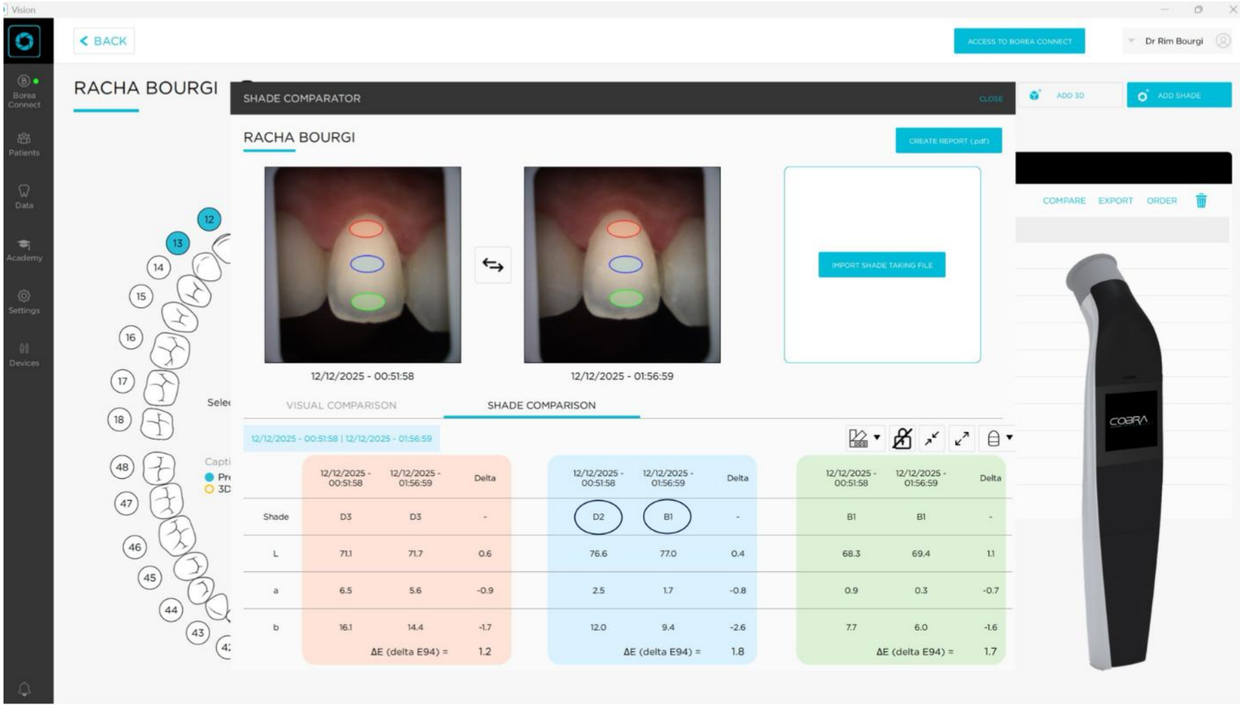

Figure 15: Before-and-after digital shade analysis of tooth 12 using the Cobra Shade Scanner. Pre-whitening measurements demonstrated a predominance of D2 shade characteristics, while post-whitening analysis revealed a marked increase in B1 shade values with a corresponding reduction in D2 components (The blue part). This objective spectrophotometric assessment confirms the effectiveness of the whitening protocol at the individual-tooth level, providing precise documentation of internal color change beyond subjective visual evaluation.

For the maxillary canine (tooth 13), digital shade analysis using the Cobra Shade Scanner demonstrated a clinically relevant color improvement, shifting from an initial D3 shade to a final C2 shade, corresponding to an overall increase of three VITA Classical shade levels. This change reflects a substantial enhancement in tooth lightness and chromatic balance following the whitening protocol (Fig. 16).

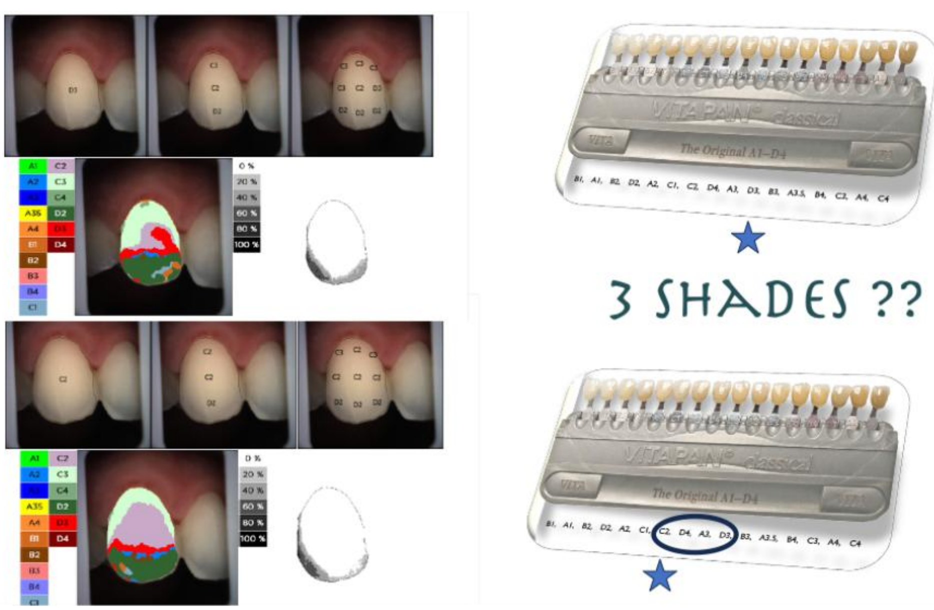

Figure 16: Before-and-after spectrophotometric shade assessment of the maxillary canine (tooth 13) performed with the Cobra Shade Scanner. Baseline measurements indicated a D3 shade, whereas post-whitening analysis revealed a transition to C2, representing an overall improvement of three shade units. This objective evaluation confirms the effectiveness of the in-office whitening protocol on teeth with inherently higher chromatic saturation, such as canines.

Following treatment, no tooth sensitivity was reported. In addition, standardized before-and-after photographs were obtained using mobile dental photography with a dental contrastor to eliminate background interference and enhance visualization of tooth color changes. The use of the contrastor allowed for precise comparison of chromatic differences by isolating the teeth from surrounding soft tissues, thereby improving the reliability of visual assessment (Fig. 17) [29].

Figure 17: Before (lower) and after (upper) intraoral photographs obtained using mobile dental photography with a dental contrastor. The contrastor isolates the teeth from surrounding tissues, allowing clear visualization of the whitening effect achieved after one session of in-office bleaching with Pola Rapid 6% hydrogen peroxide.

An artistic final photograph was taken under standardized lighting conditions to highlight the level of whiteness achieved after treatment. This image emphasizes the uniformity, brightness and natural appearance of the enamel following the complete whitening protocol (Fig. 18).

Figure 18: Artistic final extraoral photograph illustrating the enhanced brightness and homogeneity of tooth color following in-office whitening with Pola Rapid 6% hydrogen peroxide. The image highlights the high level of whiteness and natural esthetic outcome obtained at the end of treatment.

A maintenance protocol using Pola Luminate (SDI Limited, Bayswater, Victoria, Australia) was implemented following the in-office whitening session to enhance enamel brightness and support long-term color stability [42]. This step aimed to prevent early discoloration, remineralize the enamel and prolong the esthetic results achieved with the initial treatment (Fig. 19,20) [22].

Figure 19: Application of Pola Luminate for post-whitening maintenance, showing uniform coverage of the enamel surface to enhance brightness and color stability.

Figure 20: Final outcome after Pola Luminate maintenance, highlighting the sustained improvement in tooth whiteness.

The patient was satisfied and happy with the result. Some tips were given to the patient to preserve the bleaching effects (Fig. 21).

Figure 21: The significance of pairing an appropriate whitening product with an effective maintenance solution becomes evident. Both the patient and the dentist expressed satisfaction with the result. It is noteworthy that adherence to a white diet during maintenance is not crucial; rather, the key focus lies on the maintenance itself [43].

Discussion

Tooth whitening remains one of the most conservative and frequently requested esthetic dental procedures. Hydrogen peroxide-based systems achieve predictable color improvement through oxidative degradation of chromogenic molecules within enamel and dentin [44,45]. Recent evidence has emphasized that low-concentration hydrogen peroxide formulations can provide clinically acceptable whitening outcomes while minimizing adverse biological effects, particularly postoperative sensitivity and pulpal irritation [46], when compared with conventional in-office bleaching agents containing 36-38% hydrogen peroxide [47]. The present case supports this evidence, as a 6% hydrogen peroxide in-office protocol achieved a clinically significant shade improvement without patient-reported sensitivity, despite the use of a single 15-minute application. This finding reinforces the concept that whitening efficacy is not exclusively concentration-dependent but also influenced by formulation and exposure time, supporting a more biologically conservative approach.

Accurate shade assessment is essential for objectively documenting whitening efficacy and monitoring color stability over time. Although visual shade guides such as the VITA Classical Shade Guide remain widely used, they are inherently subjective and influenced by lighting conditions, operator experience and visual fatigue [48,49]. For this reason, a spectrophotometric method was incorporated in the present case. The Cobra Shade Scanner was specifically selected because it is a spectrophotometer-based device, which offers higher precision, reproducibility and traceability than colorimetric systems that rely on simplified tristimulus values [34,50]. The use of spectrophotometric analysis enabled quantitative monitoring of color changes across multiple teeth and time points, strengthening the scientific validity of the recorded whitening outcomes [34,35].

In addition to instrumental shade analysis, standardized photographic documentation is a key component of esthetic evaluation. Mobile dental photography was performed using the Smile Lite MDP system, which was selected because it is widely used and consistently reported in peer-reviewed scientific literature as a reference device for smartphone-based dental photography. This system enables standardized image acquisition under controlled and reproducible illumination conditions, facilitating reliable visual comparisons between baseline, post-treatment and follow-up stages. Beyond documentation, mobile dental photography supports longitudinal monitoring and remote follow-up, making it particularly relevant for contemporary esthetic workflows and teledentistry applications [29,30,32].

Soft tissue protection remains a critical safety factor during in-office bleaching procedures. Even with low-concentration agents, inadequate gingival isolation may result in transient chemical irritation or gingival blanching [51]. In the present case, gingival isolation was performed under magnification to enhance visual control and ensure precise placement of the protective barrier, particularly in cervical and interproximal regions. The use of high-quality magnification loupes, such as those provided by Xpedent, offers optimized optical clarity, appropriate working distance, and ergonomic stability, allowing clinicians to accurately delineate the gingival margins and monitor material adaptation in real time. Enhanced magnification has been associated with improved procedural precision, reduced operator fatigue, and a lower risk of iatrogenic soft tissue injury, thereby contributing to safer, more controlled, and more predictable esthetic outcomes [52]. Moreover, the consistent visual access afforded by magnification supports adherence to safety protocols throughout the bleaching procedure, particularly during barrier placement and removal.

Long-term maintenance protocols play an essential role in preserving whitening results and delaying color relapse. At-home maintenance strategies using low-peroxide or remineralizing formulations have demonstrated effectiveness in stabilizing shade changes when appropriately prescribed and monitored [24]. In this case, a structured maintenance regimen contributed to sustained whitening results. The combination of spectrophotometric tracking and standardized photographic documentation enabled objective assessment of color stability during the maintenance phase, providing measurable feedback and reinforcing patient compliance.

Overall, this case highlights the importance of integrating biologically conservative whitening protocols, objective spectrophotometric shade analysis, standardized mobile dental photography and magnification-assisted gingival protection. Such an integrated approach enhances safety, measurement accuracy, documentation quality and long-term outcome predictability, reflecting current evidence-based standards in contemporary tooth whitening practice.

Conclusion

This case report demonstrates that Pola Rapid 6% hydrogen peroxide is an effective and well-tolerated in-office whitening agent, providing rapid esthetic improvement with minimal risk of sensitivity. The combined use of mobile dental photography, visual and digital shade assessment and magnification-assisted gingival isolation enhances diagnostic accuracy, clinical safety and documentation quality. Additionally, the implementation of a structured maintenance protocol with Pola Luminate supports long-term shade stability. These findings highlight the value of a comprehensive, technology-enhanced approach in modern tooth whitening procedures to optimize clinical outcomes and maximize patient satisfaction.

Conflict of Interest Statement

All authors declare that there are no conflicts of interest.

Informed Consent Statement

Informed consent was taken for this study.

Authors' Contributions

All authors contributed equally to this paper.

Financial Disclosure

The authors received no external financial support for this study.

Data Availability Statement

Not applicable.

Ethical Statement

Not applicable.

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