Aesthetic and Conservative Management of a Discoloured Maxillary Central Incisor with Pulp Necrosis: A Case Report

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Abstract

Background: Pulpal necrosis may present with discolouration of the affected tooth, often following trauma or extensive carious lesions. Although sometimes asymptomatic, advanced cases may be accompanied by persistent pain. Minimally invasive endodontic treatment combined with internal bleaching allows for functional and aesthetic rehabilitation without excessive removal of sound tooth structure.

Objective: To report a conservative approach for the endodontic and aesthetic treatment of a discoloured maxillary central incisor.

Case Report: A 25-year-old female presented with discolouration of tooth #21, which had progressively darkened over several years. The tooth had previously been restored with composite before sustaining multiple episodes of minor trauma. In recent months, the patient reported of continuous pain radiating to the head. Clinical examination revealed shade A3.5 discolouration, and radiographic evaluation showed tertiary dentine deposition partially obliterating the pulp chamber. The diagnosis was pulp necrosis with symptomatic apical periodontitis. Single-visit root canal treatment was performed using Reciproc Blue R25 in reciprocating motion. Internal bleaching was carried out for seven days using hydrogen peroxide, resulting in a shade improvement to A1. Calcium hydroxide was placed in the chamber for 14 days to neutralise pH prior to final restoration. The access cavity was restored using direct resin composite.

Conclusion: A conservative endodontic approach combined with internal bleaching and direct adhesive restoration can effectively restore both aesthetics and function in discoloured anterior teeth with pulpal necrosis.

Keywords:

Aesthetic restoration, Internal bleaching, Maxillary central incisor, Minimal invasive endodontics, Pulp necrosis

Introduction

Discolouration of anterior teeth is one of the aesthetic concerns frequently reported by patients and can have a significant psychosocial impact and influences the individual's aesthetic self-perception.[1] As a result, in modern dental practice, an increasing number of patients are seeking dental treatment to achieve whiter teeth.[2] When managing discolouration, in addition to considerations of appearance and aesthetics, the cause of discolouration must also be carefully identified and considered, especially if there is an underlying infection, as there are different approaches for vital teeth compared to non-vital teeth that have undergone endodontic treatment involving external or internal approaches.[1–3] Tooth discolouration can be classified as intrinsic, extrinsic, or a combination of both. Tooth colour is primarily determined by the colour of the dentin and is influenced by intrinsic and extrinsic factors. The main etiological factors causing discolouration include extrinsic influences such as food, beverages, tobacco use, mouthwash, and plaque accumulation. Intrinsic factors may be triggered by systemic causes such as medications and metabolic issues, as well as local causes primarily involving pulp necrosis, often associated with trauma intrapulpal haemorrhage and extensive caries.[3]

Teeth that have undergone trauma with intrapulpal hemorrhage often experience discolouration because blood components spread to the dentinal tubules. In addition, erythrocyte hemolysis releases iron, which combines with hydrogen sulfate to form ferric sulfide, often causing progressive discolouration to brown/red and black.[1,3] Another cause of discolouration is pulp canal obliteration (PCO), also known as calcification metamorphosis, which is a complication of dental trauma injury (TDI) that usually occurs in the anterior teeth of young adults. The American Association of Endodontists explains that PCO is the pulp's response to trauma, characterized by rapid deposition of hard tissue in the root canal and pulp chamber.[4] PCO is often found in 64% of dental trauma cases. The active deposition of tertiary dentin within the tooth aims to narrow the pulp chamber and reduce the risk of pulp necrosis.[5] In most cases, PCO is clinically diagnosed at least one year after the tooth has experienced trauma, which differs from pulp necrosis, which occurs at least three months after trauma.[4] PCO can lead to discolouration, which has the potential to cause aesthetic problems for patients and carries a risk of pulp necrosis in 27% of cases. Yellow discolouration is more common, although it can turn gray. This is caused by increased dentin thickening, which results in reduced crown translucency. The degree of calcification and discolouration tends to worsen over time.[3–5]

Discolouration management often involves a multidisciplinary approach and must treat both the pathological and aesthetic aspects, as well as establishing a diagnosis and a thorough

understanding of the etiology of the discolouration. Discolouration management may involve prosthodontic treatments such as composite resin and ceramic veneers and crowns to mask discolouration, but often requires significant reduction of tooth structure.[3,6] Minimally invasive endodontic treatment combined with internal bleaching offers a conservative and predictable approach that restores aesthetics while maintaining tooth structure. The internal bleaching procedure is a popular, cost-effective, minimally invasive, conservative, relatively simple, and economical method for improving dental and smile aesthetics compared to restorative alternatives such as crowns and veneers.[1,2,6] There are several internal bleaching techniques, the most commonly used being the walking-bleach technique, which was first developed by Spasser in 1961. Other internal bleaching techniques include the thermocatalytic technique and the inside-outside technique.[1]

Patients and dentists have high expectations for the aesthetic results of discoloured teeth, and along with that, there's growing public awareness about whiter teeth. This has led to a lot of research showing immediate efficacy in treating discolouration using different bleaching protocols.[3] This report describes the conservative management of a discoloured maxillary central incisor with pulp necrosis, performed with single-visit endodontics, laser-activated irrigation, internal bleaching with a protective barrier, calcium hydroxide dressing, and direct composite restoration.

Case Report

A 25-year-old female patient came to the Department of Conservation and Endodontics at RSGM Universitas Padjadjaran with a complaint of discolouration of her upper left front tooth for the past 4 years and pain that began about 5 months ago. Based on the history, the tooth initially had a small cavity, which was then left untreated and became larger. The tooth was finally filled 4 years ago. Since the filling, the patient has noticed her tooth gradually darkening. In addition to the cavity, the tooth sustained repeated minor trauma from accidental head bumps by her nephew. The patient feels the tooth is getting darker and has started experiencing spontaneous pain radiating to the head since 5 months ago. The patient has been experiencing migraines since the tooth ached. The patient has not done anything to relieve the pain. The patient wants her tooth treated and its colour corrected because it is disturbing her appearance.

Extraoral clinical examination was within normal limits. Intraoral clinical examination of tooth 21 revealed a discoloured composite filling in the distopalatal area (Figure 1). Cold vitality and percussion tests were negative, while percussion and pressure tests were positive. No tooth mobility or other soft tissue abnormalities were found. Radiographic examination revealed a radiopaque image in the distopalatal area of the crown extending to the depth of the dentin resembling a filling, the pulp chamber appeared smaller, the root was straight and one root canal was visible, and the periapical tissue was within normal limits (Figure 2).



Figure 1. Initial clinical condition of tooth 21



Figure 2. Initial radiograph of tooth 21

Based on subjective, clinical, and radiographic examinations, the American Association of Endodontists (AAE) diagnosed tooth 21 as pulp necrosis with symptomatic apical periodontitis. The treatment plan included a single-visit root canal treatment followed by internal bleaching with a direct composite restoration. The patient was then explained the results of the subjective examination, objective examination, supporting examinations, diagnosis, treatment plan, and potential complications before the procedure. The patient understood the explanation regarding the condition of her tooth and agreed to the treatment and publication of the case by signing an informed consent form.

In the first visit, pre-procedure anesthesia was performed using 2% lidocaine HCl with 1:100,000 epinephrine (Lignospan, Septodont Inc., USA). Tooth 21 was isolated using a rubber dam (Sanctuary, Perak, Malaysia). Minimally invasive cavity access preparation was

performed using an endo access bur (Dentsply Maillefer, Switzerland) until the roof of the pulp chamber was reached and the orifice was clearly visible (Figure 3A). The pulp chamber was irrigated using 3% NaOCl. Root canal exploration of tooth 21 was performed with a #10 stainless steel K-file (K File M-access, Dentsply Sirona, USA), and the working length was measured using an electric apex locator (Ai-Motor Yoshi Terauchi, DBA, China). The working length was 21 mm. The root canal was then prepared using a crown-down technique using a Reciproc Blue R25 file (VDW, USA) (Figure 3B). Root canal preparation was finished with a 25/~ file until the working length was reached. The preparation was accompanied by irrigation with 3% NaOCl, 17% EDTA, 2% chlorhexidine, and distilled water using a 5 mL syringe with a 31G side-vented needle (Dia-Dent, Netherlands). The irrigation fluid was then activated using passive sonic irrigation (PSI) and finished with diode laser disinfection using a SOGA ILASER I PLUS-3 (Shenzhen Soga technology Co., China) (Figure 3C). The root canal was dried using sterile paper points (Meta-Biomed, Korea). Root canal filling was performed using a single cone technique using gutta-percha and bioceramic sealer.

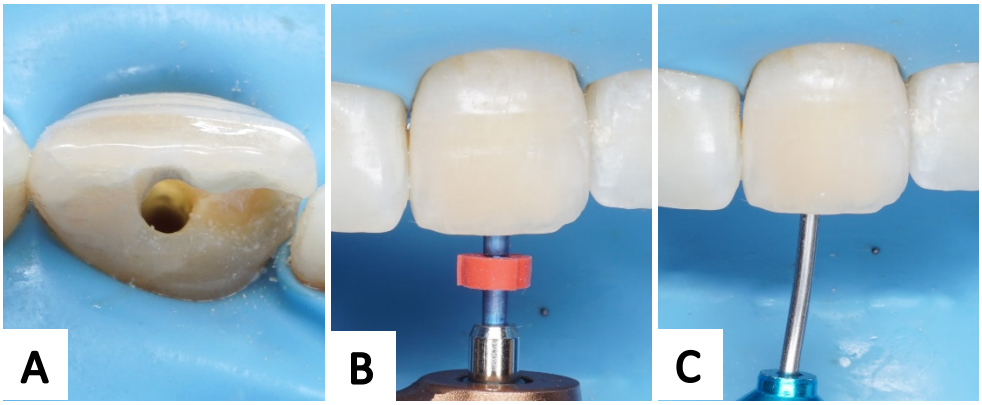


Figure 3 A, Access cavity preparation. B, Preparation with Reciproc Blue R25. C, Diode laser disinfection using a SOGA ILASER I PLUS-3

The second visit was a control visit one week after obturation. After the examination, tooth 21 was anesthetized, isolated using a rubber dam, and the temporary filling was cleaned. After ensuring good post-obturation control, an internal bleaching procedure using the walking bleach technique was performed. The colour of tooth 21 was confirmed using the Vita shade classic (VITA Zahnfabrik, Germany) shade guide with a shade of A3.5 (Figure 4A). The crown length of tooth 21 was measured using a probe to determine the orifice location, resulting in a result of 10 mm. The temporary filling was removed, and the *Smart Dentin Replacement* (SDR) cement base at the root canal orifice was removed. Gutta-percha was removed 2 mm below. *Resin Modified Glass Ionomer* (RMGIC) was applied as a barrier above the gutta-percha filling in the form of a 'Bobsled tunnel' to protect the cementoenamel junction (CEJ) and the cervical portion of the tooth from the bleaching agent (Figure 4B). 35% Hydrogen Peroxide bleaching paste (Opalescence™ Endo, Ultradent, USA) was applied to the pulp chamber and then sealed with RMGIC. The patient was instructed to come for a check-up 1 week later.

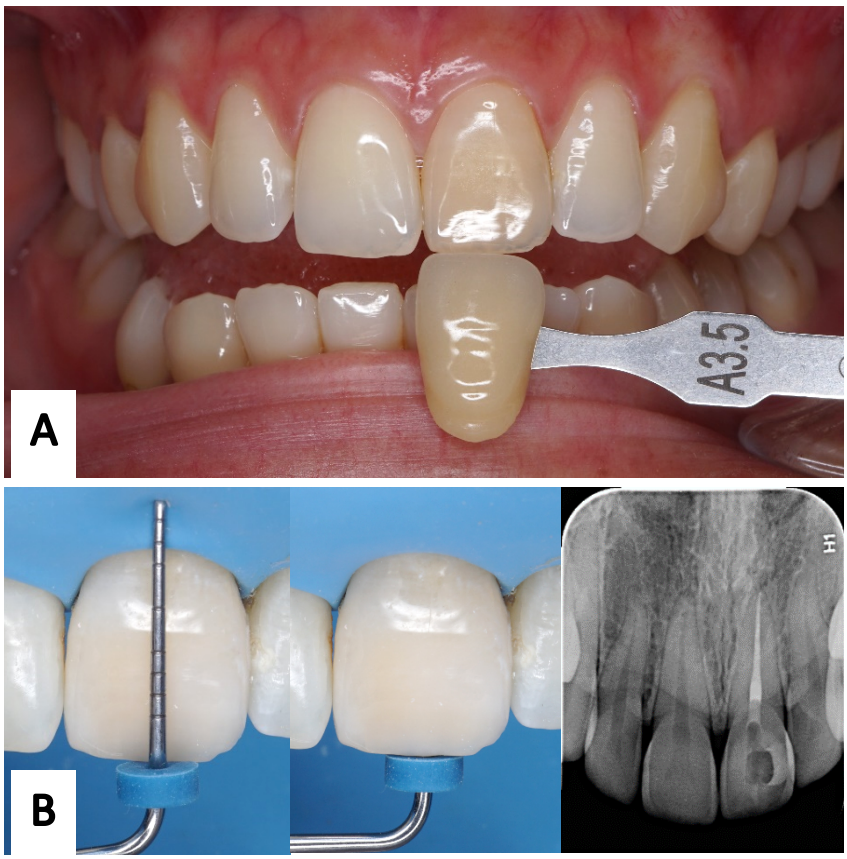


Figure 4 A, Initial shade guiding. B, Internal bleaching setup

The third visit was conducted 1 week after the bleaching application. The patient had no complaints, the percussion test was negative, and the surrounding tissue was normal. Clinical examination showed that the glass ionomer cement filling was still well attached. Examination using the Vita Master colour guide showed that the colour of tooth 21 changed 10 shades from its original colour A3.5 to A1, resembling the colour of the adjacent tooth (Figure 5A). The glass ionomer cement filling was removed and the 35% hydrogen peroxide paste in the pulp chamber was cleaned and dried. Afterward, Calcium Hydroxide paste (Calcipex II, Nippon Shika Yakuhin, Japan) was applied to the pulp chamber and a glass ionomer cement filling was placed (Figure 5B). The patient was instructed to return in 2 weeks.



Figure 5 A, Shade guiding after bleaching. B, Placement of calcium hydroxide.

The final visit took place two weeks after the last visit. The patient returned without any complaints, the percussion test was negative, and the surrounding tissue was normal. The VitaMaster colour-guided examination continued to show the same A1 colour as the previous visit. The RMGIC was removed, and the calcium hydroxide paste was cleaned and dried. A follow-up direct composite restoration was then performed.



Figure 6 Final result

Discussion

Tooth discolouration is a common complaint among patients who wish to improve their aesthetics, especially in the anterior teeth. Tooth discolouration can vary in etiology, location, severity, and its association with extrinsic, intrinsic, or a combination of both factors.[6,7]

Discolouration in this case was caused by multifactorial factors, including pulp necrosis, repeated trauma, and pulp canal obliteration (PCO).[5] Dental trauma occurs more frequently in maxillary central incisors, and post-traumatic complications can lead to aesthetic problems. Trauma symptoms that indicate a diagnosis of pulp necrosis may appear within weeks, months, or years after the tooth has been injured.[3,8] Pulp necrosis is a common complication that occurs in approximately 34% of teeth that have experienced trauma.[5] This is supported by the results of research by Moccelini et al., which revealed that there is a relationship between clinical signs of tooth discolouration and pulp necrosis in permanent teeth that have experienced trauma.[8] A thorough and specific understanding of the causes of discolouration is essential for determining an accurate diagnosis and the most appropriate treatment plan.[1,5]

Single-visit endodontics was chosen as the treatment in this case in order to control the infection efficiently while reducing the risk of reinfection and the burden on the patient. This single-visit endodontic treatment depends on consideration of its advantages and disadvantages.[9–11] The advantages of this treatment are convenience, efficiency, prioritizing patient comfort, reduced intra-appointment pain, economics, minimizes the fear and anxiety, reduces incomplete treatment, lesser errors in working length, and immediate placement of coronal restoration ensures effective coronal seal and aesthetics.[9,12] The disadvantages of this treatment are also taken into consideration because it is tiring for patient to keep mouth open for long duration dan some case cannot be treated by single visit, for example, cases with very fine, curved, calcified, multiple canals and teeth with weeping canals.[9,12] In cases requiring single-visit endodontics, the competence of the clinician, positive patient acceptance, and cooperation during treatment are criteria that must be met in order to provide good quality treatment.[9,10,12]

The success of root canal treatment largely depends on effective disinfection to eliminate microorganisms and biofilm from areas inaccessible to instrumentation. Conventional irrigation alone may be insufficient in achieving complete debridement, which can lead to persistent infection and postoperative pain. The adjunctive use of diode laser disinfection after chemo-mechanical preparation has shown superior outcomes in microbial reduction and patient comfort. Studies have demonstrated that irradiation of the canal using a 980 nm diode laser significantly reduces postoperative pain, particularly in teeth with apical periodontitis, and decreases the need for analgesics. This effect is attributed to the laser's photothermal and photobiomodulatory actions, which enable deep penetration into dentinal tubules—up to 500 μm—resulting in effective bacterial elimination and modulation of inflammatory mediators. Compared with conventional NaOCl/EDTA irrigation, diode laser application achieves higher bacterial reduction (up to 99.8%), improved smear layer removal, and enhanced sealer adaptation, particularly in the apical third. Its advantages include ease of use, cost-effectiveness, compact device size, and the ability to improve both disinfection efficacy and postoperative healing. In this case, diode laser disinfection was applied as a final adjunctive step to ensure optimal canal cleanliness and minimize postoperative discomfort.[13–15]

Discolouration treatment in modern dentistry is currently based on the concept of minimal invasive. Bleaching procedures and restoration of natural tooth colour can help

preserve tooth tissue and provide an alternative solution to crowns or veneers.[3,7,16,17] The study by Pasenda Mulyadi revealed that a combination of single-visit endodontic treatment and internal bleaching using the walking-bleaching technique can be a good option for treating discolouration in non-vital teeth.[11] Regardless of the technique used, internal bleaching is a popular, cost-effective, minimally invasive, conservative, relatively simple, economical procedure with good aesthetic results in the treatment of discolouration in non-vital teeth.[1,2,6,7] The bleaching procedure for teeth that have undergone endodontic treatment is based on dentin permeability, which allows oxidative agents to penetrate directly into the pigments in the dentin, eliminating or alleviating discolouration problems. Oxidative chemical agents remove intrinsic stains through chromogenic degradation and by breaking down larger pigments into smaller ones, resulting in a brighter tooth colour.[1,7,11]

The most commonly used dental bleaching agents are hydrogen peroxide and carbamide peroxide, which are used in high concentrations for non-vital teeth, but the mechanism of action remains the same in all cases. In this case, oxidation occurs in organic pigments, and the decomposition products of these chemical agents are used.[6,7,17–19] Internal bleaching results are more predictable in teeth that have discolouration due to trauma or pulp necrosis.[3,6,20] The prognosis for internal bleaching is uncertain and depends on several factors, such as the cause of discolouration, the bleaching technique, and the materials used. Discolouration caused by necrosis or trauma typically has a good prognosis. This is because the colour changes resulting from pulp degradation and blood products generally respond positively to the bleaching process. The prognosis for whitening also depends on the type of endodontic filling material, the timing of the colour change, and the time elapsed since endodontic treatment was performed.[1,6,7,17–19,21]

The cervical barrier is a standard of care in internal bleaching techniques and should be used.[1] An adequate barrier layer must be created before performing the internal bleaching procedure.[17,22] Placing a 2 mm thick barrier over the obturation material can minimize the risk of cervical root resorption by closing the dentinal tubules and protecting the periodontal ligament and alveolar crest. This procedure is also performed to avoid further pigmentation and to ensure proper coronal sealing, which reduces fracture resistance and prevents cervical resorption. The protective layer should be white or tooth-coloured.[1,6,7,17] Study performed by Ordoñéz-Aguilera et al. recommended the use of GIC as an internal bleaching barrier because it has good sealing ability and can be used as a base for final restoration. In this case, the placement of RMGIC as a base is very important to protect the cervical area of the tooth, and the ski-slope design can reduce peroxide leakage.[23]

After internal bleaching, Aschheim et al., and Gartshore et al., recommend the use of calcium hydroxide paste as a temporary dressing in the pulp chamber to reduce the possibility of external root resorption. Because of its pH buffering potential, calcium hydroxide can prevent pH reduction at the cementoenamel junction after internal bleaching procedures, thereby inhibiting osteoclast activity.[5,24] Consideration to delay final bonding for several days after internal bleaching was also made in this case.[25] This decision is based on the results of studies by Seto et al., Bhasker et al., and Mena-Serrano et al., which recommend that delaying final bonding for 1 week after internal bleaching can increase bond strength and allow for

optimal adhesion recovery because residual oxygen radicals can interfere with resin polymerization and bond strength after the bleaching procedure. [26–28] In some cases with minimal structural damage, direct composite restoration is a reliable and conservative option that is minimally invasive, preserves tissue, and achieves satisfactory function and aesthetics, especially in anterior teeth.[11,29]

Regarding restoration, the placement of a coronal seal provided by post-endodontic final restoration in this case is an important factor in preventing infection and endodontic treatment failure. The absence of an appropriate post-endodontic coronal seal can lead to coronal leakage and reinfection.[12,30] This is supported by an in vitro study by Torabinajed et al., which states that the absence of a coronal seal can cause reinfection of the canal with Staphylococcus species 19 days after obturation.[12] In some cases with minimal structural damage, direct composite restoration is a reliable and conservative option that is minimally invasive, preserves tissue, and achieves satisfactory function and aesthetics, especially in anterior teeth.[11,29] Composite resin can be applied using the layering technique, which is a simple and conservative approach and can minimize damage to the tooth structure. The use of direct composite restoration after endodontic treatment not only provides an adequate seal, but can also restore the strength of the tooth to that of healthy tooth tissue. [3,11,23,29]

Conclusion

A conservative protocol—single-visit RCT with LAI, internal bleaching with a 2-mm RMGIC ski-slope barrier, interim $Ca(OH)_2$, delayed bonding, and direct composite restoration—successfully restored function and aesthetics while preserving tooth structure. This sequence is aligned with current evidence and is suitable when cavitation and structural loss are limited.

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