Management of a previously treated trauma induced discolored tooth with inadequate root canal obturation: case report

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ABSTRACT

Introduction: The goal of endodontic treatment is to obtain a three-dimensional seal, which relies on the proper preparation and obturation of the root canal system. One of the most common complications that occur during instrumentation is the formation of endodontic ledges, which can potentially lead to poor treatment outcomes. The procedure of bypassing a ledge in endodontic treatment, followed by intracoronal bleaching, is an option for improving the aesthetics of a discolored tooth. This case report aimed to present management of previously treated trauma induced discolored tooth with inadequate root canal obturation. **Case report:** A 24-year-old male presented with discoloration of the maxillary right central incisor. Radiographic examination revealed improper obturation, and the presence of a ledge was suspected. After complete removal of the previous root filling material, a pre-curved K-file #8 was used to negotiate the physiologic terminus until the tip of the file reached the original canal. Glide path preparation was then performed. A new working length was measured, followed by biomechanical preparation and obturation. After a three-dimensional seal was successfully obtained, intracoronal bleaching was performed. After satisfactory shade matching was achieved, both maxillary central incisors were restored. **Conclusion:** Initial canal negotiation with hand files is recommended and essential to avoid further procedural errors during root canal preparation, thereby facilitating disinfection to the apical terminus and contributing to improved endodontic treatment outcomes.

Keywords

Endodontic retreatment, ledge, hand file, intracoronal bleaching

Manajemen perawatan ulang saluran akar pada gigi diskolorasi karena trauma dengan obturasi inadekuat: laporan kasus

ABSTRAK

Pendahuluan: *Perawatan endodontik bertujuan untuk mendapatkan kekedapan secara tiga dimensi yang bergantung pada preparasi dan obturasi saluran akar yang tepat. Salah satu komplikasi yang paling sering terjadi selama instrumentasi adalah terbentuknya ledge yang dapat menyebabkan hasil perawatan yang buruk. Prosedur melakukan bypass ledge pada saluran akar diikuti dengan bleaching intrakoronal adalah pilihan perawatan untuk meningkatkan estetika pada gigi diskolorasi. Laporan kasus ini bertujuan untuk memaparkan manajemen perawatan ulang saluran akar pada gigi yang mengalami diskolorasi akibat trauma dengan obturasi saluran akar yang inadekuat.* ***Laporan Kasus:*** *Seorang pasien pria berusia 24 tahun dengan keluhan perubahan warna pada gigi depan kanan rahang atas. Pada pemeriksaan radiografi, ditemukan obturasi inadekuat dan diasumsikan adanya ledge. Setelah semua bahan obturasi dibersihkan, pre-curved K-file #8 digunakan untuk menegosiasikan ujung fisiologis sampai ujung file masuk ke apical terminus, kemudian glide path dapat dilanjutkan. Diikuti oleh pengukuran panjang kerja, preparasi biomekanik, dan obturasi. Ketika kekedapan tiga dimensi telah diperoleh, bleaching intrakoronal dilakukan. Setelah warna telah sesuai, dua gigi insisivus sentral rahang atas direstorasi.* ***Simpulan:*** *Negosiasi saluran awal dengan hand file direkomendasikan untuk menghindari kesalahan prosedural lebih lanjut selama preparasi, sehingga memfasilitasi desinfeksi sampai ujung apikal dan meningkatkan keberhasilan perawatan endodontik.*

Kata kunci

Retreatment endodontik, ledge, hand file, bleaching intra koronal

INTRODUCTION

Endodontic treatment involves chemo-mechanical disinfection of root canals followed by three-dimensional hermetic obturation.[1] The success or failure of this treatment is evaluated by clinical signs and symptoms, as well as radiological findings of the treated tooth. The survival of a tooth following root canal treatment is defined as the tooth remaining functional and free of symptoms.[2] The outcome of root canal treatment depends on pre, intra, and postoperative factors, such as preoperative periapical status, the apical extent of root filling, and the quality of obturation and coronal restoration.[3] In a study that assessed teeth with endodontic failures, 65% of the cases exhibited poor quality obturation.[4]

Underfilled root canals may occur due to the loss of working length, typically caused by ledges, canal blockages, and apical transportation.[5] According to several authors, the presence of ledges in root canals reduces the success rate of endodontic treatment and is considered a contributing factor to the need for endodontic retreatment.[6] Loss of working length is a common error observed during chemomechanical root canal preparation, often due to incorrect determination of the working length and blockage of the root canal with dentine chips caused by inadequate irrigation, which prevents complete cleaning and shaping of the root canal system.[7,8] When an endodontic ledge forms, bacteria may remain in the apical portion of the root canal, which can lead to apical periodontitis and result in an unfavorable outcome of endodontic treatment.[7,9]

In cases requiring endodontic retreatment to remove an existing root canal filling, the possible presence of a ledge should be considered if the current filling is at least 1 mm shorter than the ideal working length or if it appears to have been placed in a position that is deviated from the natural pathway of the root canal.[10] The crucial step during root canal retreatment is to bypass the ledge to achieve patency at the canal terminus.[6] Bypassing an endodontic ledge involves navigating past the obstruction with instrumentation to allow obturation at a newly established working length.[7,11]

In the literature, several techniques have been proposed to manage ledges using manual, rotary, or reciprocating instruments.[6] Clinically, the accuracy of canal preparation can be assessed through tactile feedback by inserting a hand instrument into the root canal and ensuring that the instrument can smoothly reach the full working length of the canal.[11] Retreatment of the root canal can be performed nonsurgically and involves the removal of previous filling materials, followed by cleaning, shaping, and filling the canals.[1] Root canal retreatment is normally indicated when the existing root filling is technically deficient and a new restoration is required.[12]

Discoloration of a non-vital tooth can occur due to various factors, such as dental trauma, the presence of necrotic tissue or debris in the dentinal tubules and pulp horns, insufficient irrigation during treatment, or remnants of filling materials left in the pulp chamber or on its walls.[13] Teeth that have experienced a traumatic injury resulting in intrapulpal hemorrhage often exhibit discoloration due to the diffusion of blood components into the dentinal tubules.[14] Intracoronal tooth bleaching is a minimally invasive procedure that can significantly enhance dental aesthetics at a relatively low cost while preserving tooth structure in non-vital teeth.[15]

This clinical report describes a young man who experienced trauma-induced discoloration and root canal treatment failure in his upper right central incisor. The tooth had been previously treated inadequately, and the inadequate root canal treatment contributed to treatment failure.[16] Root canal retreatment was successfully performed, followed by intracoronal bleaching and direct restoration. After 6 months, the outcome was favorable, with evidence of healing and an improved appearance of the tooth.

Although nonsurgical endodontic retreatment and intracoronal bleaching are well-established treatment options, reports describing their combined use in managing

trauma-induced discolored teeth with inadequate root canal obturation and suspected ledge formation are limited. This case report aims to present the conservative management of this condition using ledge bypass with pre-curved stainless-steel hand files, nonsurgical retreatment, intracoronal bleaching, and direct composite restoration to restore both function and aesthetics.

CASE REPORT

A 24-year-old male patient presented with a chief complaint of an unaesthetic appearance of his upper anterior teeth, particularly one tooth that was noticeably darker than the adjacent teeth. He reported experiencing dental trauma 12 years ago due to a traffic accident, which resulted in the tooth becoming necrotic and subsequently undergoing root canal treatment. However, the tooth began to darken approximately 6 years ago (Figure 1). Although the affected tooth had never caused any pain, the patient was concerned about its appearance.

Extraoral examination revealed no facial swelling, facial asymmetry, or other abnormalities. Intraoral examination showed discoloration of tooth 11 with negative responses to pulp vitality, percussion, and palpation tests. Radiographic examination demonstrated inadequate root canal obturation with suspected ledge formation (Figure 1).

The diagnosis for tooth 11 was previously treated asymptomatic apical periodontitis, based on the history of previous root canal treatment, the absence of spontaneous pain, swelling, tenderness to percussion, and tenderness to palpation, together with radiographic evidence of inadequate root canal obturation and suspected ledge formation. Previously treated symptomatic apical periodontitis was excluded because the patient reported no pain or discomfort, and no clinical signs of acute periapical inflammation were observed.

The differential diagnosis was previously treated symptomatic apical periodontitis. The prognosis was considered favorable because nonsurgical retreatment and adequate restoration were expected to restore both function and aesthetics. The proposed treatment plan for tooth 11 included root canal retreatment followed by intracoronal bleaching. Additionally, both teeth 11 and 21 were planned to receive composite restorations using an indirect mock-up technique to achieve optimal aesthetic outcomes.



A B C

Figure 1. Preoperative images. (A) Initial clinical photograph; (B) Discolored tooth 11; (C) Initial radiographic image

During the initial visit, a comprehensive examination was conducted, including obtaining informed consent and providing dental health education. The tooth color was assessed using the Vitapan Classical Shade Guide, and recorded as shade C4. Subsequently, a rubber dam was placed for isolation. The existing restoration was then accessed using an endo access bur #2 (Dentsply), followed by removal of gutta percha using a retreatment file (Dentsply) with a solvent agent. The root canal was then irrigated with 5.25% sodium hypochlorite (NaOCl). Further examination revealed that a K-file #80 could not reach the apical terminus, suggesting the presence of an obstruction (Figure 2).

Ledges typically form on the outer curvature of a canal, while the inner curvature is usually free of obstructions. First, a stainless-steel K-file #8 was pre-curved and carefully guided toward the inner curvature of the canal until it engaged the original canal pathway and reached the physiologic terminus. The canal was irrigated after the ledge was detected to remove debris that may obstruct the canal and lead to canal blockage (Figure 2).

Ultrasonic activation was used to enhance irrigation. Following this, the ledge was prepared with hand files up to K-file #15, each pre-curved in a similar way. The working length was then determined using an apex locator and confirmed with radiographs, resulting in a working length of 25 mm. Root canal preparation was carried out with ProTaper Ultimate (Dentsply) up to the file 25.08, and irrigation was performed with 5 mL of NaOCl 5.25% at each needle change. The canal was then medicated and sealed with a temporary filling.

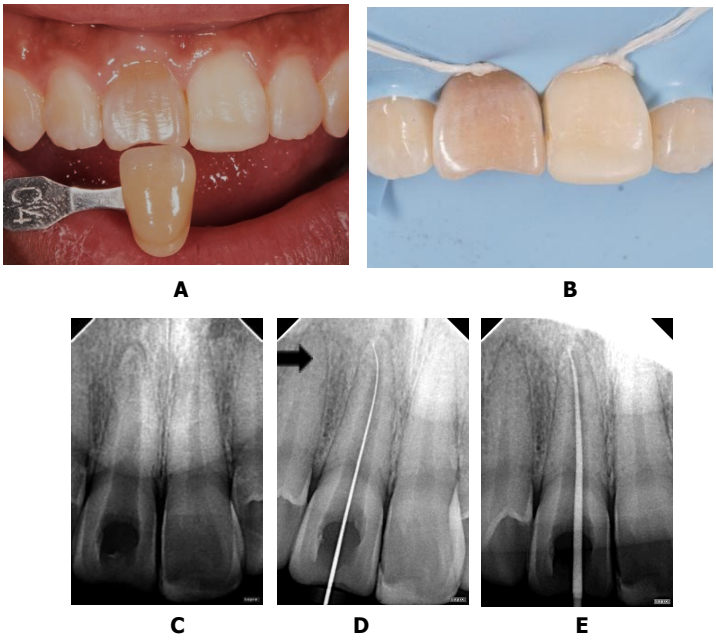


Figure 2. Clinical procedures during nonsurgical retreatment. (A) Initial shade assessment (C4); (B) Rubber dam isolation; (C) Removal of previous root filling material; (D) Establishment of new working length after successful ledge bypass; (E) Master apical file verification.

The subsequent treatment was performed after the patient reported no complaints noted during both subjective and objective examinations. The root canal was obturated using the warm vertical compaction technique, followed by the placement of a wing-shaped barrier, which was confirmed radiographically. After that, intracoronal bleaching was performed using a 35% hydrogen peroxide gel bleaching agent (Opalescence Endo, Ultradent), and the access cavity was sealed with a temporary filling (Figure 3).



A B C D

Figure 3. Obturation and intracoronal bleaching procedures. (A) Access cavity after retreatment; (B) Radiographic evaluation of obturation; (C) Placement of the cervical barrier; (D) Application of the intracoronal bleaching agent.

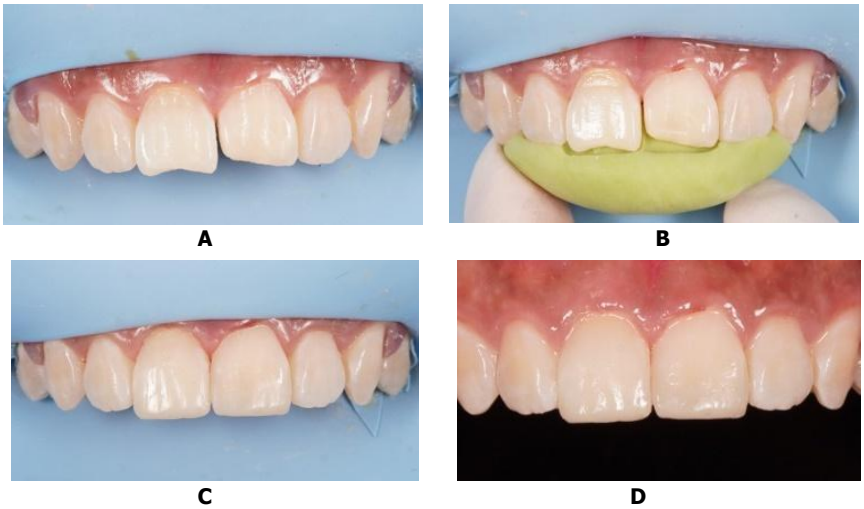
Following 7 days, the next treatment was conducted after an objective examination, which revealed that the color of tooth 11 had become similar to that of the adjacent teeth. Tooth 11 had changed to shade A2. The cavity was then cleaned and calcium hydroxide was applied, followed by the placement of a temporary filling. The patient was instructed to return 1 week later for the final restoration (Figure 4).



A B

Figure 4. Intracoronal bleaching outcome A. Tooth 11 exhibits shade A2; B. The result of intracoronal bleaching

The final restoration was completed 7 days later. To enhance the aesthetic results, a palatal silicone index was made, and final restorations for teeth 11 and 21 were completed (Figure 5).



A B C D

Figure 5. A. Preparation on tooth 11 and 21; B. Silicone index; C. Final restoration of tooth 11 and 21; D. Tooth 11 and 21 after finishing and polishing.

At the six-month follow-up, the patient remained asymptomatic. Clinical and radiographic examinations demonstrated satisfactory healing and stable aesthetic results (Figure 6).



A B C

Figure 6. Six-month-follow-up Images. A, B. Clinical photographs; C. Radiographic photo

DISCUSSION

Dental trauma occurs most frequently in the maxillary central incisors and may lead to aesthetic complications, such as crown discoloration.[17] Dental trauma can cause hemorrhage by disrupting the neurovascular supply to the pulp. This may result in the accumulation of hemoglobin and other blood breakdown products, such as hemin, hemosiderin, hematoidin, and hematoporphyrin, within the dentinal tubules. As these blood components degrade, they release iron ions that react with hydrogen sulfide, forming iron sulfide, a dark compound responsible for tooth discoloration.[18,19]

Additionally, the discoloration may result from the breakdown of proteins in necrotic pulp tissue. During the proteolytic process, amino acid compounds are released, which can cause further degradation and bacterial invasion, thereby intensifying the discoloration.[18] In the present case, the patient experienced trauma 12 years earlier and gradually developed discoloration of tooth 11, which is consistent with previous reports regarding trauma-induced discoloration in non-vital teeth.

Intracoronal bleaching was selected as the treatment of choice because it is a conservative and minimally invasive procedure that preserves tooth structure while improving aesthetics.[18] The walking bleach technique, using 35% hydrogen peroxide resulted in a change in tooth shade from C4 to A2 within one week. This result is in agreement with previous studies reporting that intracoronal bleaching is effective for managing discoloration in endodontically treated teeth caused by trauma or pulp necrosis.[18,20,21] The patient also expressed satisfaction with the final aesthetic outcome after bleaching and composite restoration.

Nonsurgical root canal retreatment remains a treatment option for failed endodontic cases, particularly when failure is associated with inadequate obturation.[15,16] In this case, radiographic examination revealed inadequate root canal obturation and suspected ledge formation, which likely contributed to inadequate cleaning and disinfection of the apical region. Previous studies have demonstrated that inadequate obturation is strongly associated with endodontic failure because residual microorganisms may persist within the root canal system and lead to apical periodontitis.[1,4]

Therefore, retreatment was performed to eliminate the previous filling material, re-establish the working length, and achieve a hermetic three-dimensional seal. The objective of root canal retreatment is to eliminate the source of irritation by removing root canal filling materials from the root canal system and disinfecting the infected root canal using irrigants and medicaments.[1] Gutta-percha remains the most widely used and accepted root canal filling material despite the development of other materials in recent years.[24]

The removal of gutta-percha was performed using retreatment rotary files combined with solvent and irrigation. Although several retreatment techniques have been proposed, including hand files, ultrasonic devices, and rotary instruments, complete removal of filling materials from the apical third remains challenging.[25,26] In the present case, ultrasonic activation and continuous irrigation with sodium hypochlorite were used to improve canal cleanliness and facilitate canal negotiation.

Ledge formation is a procedural error characterized by deviation from the original canal anatomy, commonly resulting from improper instrumentation or inadequate irrigation.[8,27] This condition may lead to loss of working length and incomplete canal debridement. In the current case, a pre-curved stainless-steel K-file #8 was carefully directed toward the inner curvature of the canal to bypass the ledge and regain access to the apical terminus. Hand files provide superior tactile feedback during canal negotiation and remain essential in managing procedural complications such as ledges or canal blockages.[6,10,27] The successful establishment of the working length in this case indicated that the ledge could be bypassed conservatively without surgical intervention.

Several glide path techniques have been described to minimize procedural errors during canal negotiation, including the follow, smooth, envelope, and balanced force techniques.[28] Previous studies have shown that the balanced force technique may reduce transportation and ledge formation by allowing controlled dentin removal while maintaining the original canal curvature.[29,30,31] The successful management of this case supports previous evidence emphasizing the importance of manual canal negotiation and tactile control during endodontic retreatment procedures.

The favorable six-month follow-up demonstrated satisfactory clinical and radiographic outcomes, with the patient remaining asymptomatic and the tooth exhibiting a satisfactory aesthetic appearance. These findings suggest that appropriate management of procedural errors, combined with adequate obturation and aesthetic rehabilitation, may contribute to functional and aesthetic outcomes in previously treated discolored teeth.

From a clinical perspective, this case demonstrates that conservative management of teeth with inadequate obturation and suspected ledge formation can potentially avoid surgical intervention when careful manual canal negotiation is performed. Successful retreatment followed by intracoronal bleaching provides a conservative approach to restoring both function and aesthetics while preserving the natural tooth. The limitations of this report include the relatively short follow-up period and the inclusion of only a single clinical case, which limits the generalizability of the findings. Further studies with longer observation periods and larger case series are needed to evaluate the long-term success of ledge bypassing and intracoronal bleaching procedures.

CONCLUSION

Conservative nonsurgical retreatment combined with meticulous ledge bypass using pre-curved stainless-steel hand files allowed re-establishment of the original canal pathway and allowed adequate cleaning, shaping, and three-dimensional obturation. Subsequent intracoronal bleaching and direct composite restoration restored both function and aesthetics, resulting in favorable clinical and radiographic outcomes after six months. The implication of this case is that careful manual canal negotiation may be important for managing procedural complications during endodontic retreatment.

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