CASE REPORT

Failed Regenerative Endodontic Case Treated by Modified Aspiration-irrigation Technique and Apexification

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Received on: 25 November 2023; *Accepted on:* 27 December 2023; *Published on:* 17 February 2024

Abstract

Aim: This report addresses the management of a large persistent discharging lesion in an 11-year-old boy. The report describes the use of aspiration-irrigation technique for the management of immature necrotic tooth with persistent discharge after a failed regenerative procedure.

Background: Regenerative endodontics aim to provide an increase in root canal width, length, and in apical closure. Alternative procedures, such as apexification, should be attempted when regeneration fails. If the canal cannot be dried to persistent discharge, the aspiration-irrigation technique can be used. The technique relies on using aspiration along with irrigation to remove pus from the periapical area.

Case description: This is a case for an 11-year-old patient who had trauma to tooth #11, which resulted in the complicated crown fracture. He had an emergency management that included pulpectomy and intracanal medication at another clinic. Two years later, the patient was presented to our clinic. Upon examination, the diagnosis was previously initiated therapy with asymptomatic apical periodontitis in immature tooth #11. Regeneration was attempted first but failed. The mineral trioxide aggregate (MTA) plug was removed, and the canal had persistent pus discharge. The canal was filled with intracanal medication, and then 2 weeks later, the canal was filled with triple antibiotic paste (TAP). Next visit, and due to continuous discharge, tooth #11 was treated conservatively with an intracanal aspiration-irrigation technique. An IrriFlex needle attached to a high-volume suction was used to aspirate the cystic fluid. Mineral trioxide aggregate plug apexification was performed in a later visit and the tooth was restored.

Conclusion: During the 3-month and 16-month follow-up, there was resolution of the symptoms, a decrease in the periapical lesion size, and soft tissues appeared within normal limits.

Clinical significance: Regenerative procedures are a good option for immature necrotic teeth. These procedures may fail due to persistent pus discharge from the root canals. The aspiration-irrigation technique is a good treatment option in cases of consciously discharging canals.

Keywords: Apexification, Aspiration-irrigation technique, Case report, Non-vital tooth, Open apex, Persistent cystic lesion.

The Journal of Contemporary Dental Practice (2024): 10.5005/jp-journals-10024-3601

Key Message

The aspiration-irrigation technique proved to be very beneficial in managing large periapical lesions with persistent discharge in immature necrotic teeth.

Introduction

Dental traumatic injuries in young patients may lead to the development of pulp necrosis, which in turn results in immature roots with open apices. Complicated crown fractures of upper anterior teeth are one of the most common traumatic dental injuries.[1,2] Early management of the pulp with vital pulp therapy procedures will help in the completion of root development and apical closure.[3] Delayed treatment will result in pulp necrosis and subsequently, cessation of root canal development. This leaves the root of the tooth with thin divergent walls and an open apex.

Regenerative endodontic procedure is considered to be one of the optimal modern treatment modalities for permanent necrotic immature teeth.[4,5] The purpose of this procedure is to increase the thickness and length of the root canal walls and to facilitate continuous root development as well as to restore the function of the damaged tooth.[6] Successfully revascularized teeth requires no further management in case there is continuous root development and absence of apical disease.[7] Failed regenerative endodontic procedures result in immature roots with open apex. Long-standing extra radicular infection, necrotic debris filling the apical canal, and bacteria colonizing the dentinal tubules have been considered the fundamental causative factors for regenerative endodontic treatment failure.[8–11] The treatment of nonvital permanent teeth with thin and divergent dentinal walls, large open apices, and periapical pathosis is challenging.[12]

Dentists usually tend to believe that large unhealed periapical lesions have a low tendency to heal after root canal treatment procedures, especially in cases with clear bony borders resembling periapical cysts radiographically.[13–15] Lesions of endodontic origin can be treated by nonsurgical root canal therapy procedures.[16–18]

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How to cite this article: Alsofi L, Almarzouki S. Failed Regenerative Endodontic Case Treated by Modified Aspiration-irrigation Technique and Apexification. J Contemp Dent Pract 2024;25(1):92–97.

Source of support: Nil

Conflict of interest: None

Patient consent statement: The author(s) have obtained written informed consent from the patient's parents/legal guardians for publication of the case report details and related images.

The aspiration-irrigation technique[11] and the decompression technique[19,20] help in reducing the lesion size by lowering the hydrostatic pressure. The use of decompression along with root canal therapy procedures provides a good approach for the treatment of large persistent periapical lesions.[21] This can be achieved due to the inflammatory nature of lesions of endodontic origin. The decompression technique involves penetration of both buccal and palatal mucosa with an 18-gauge needle to aspirate the cystic fluids followed by saline irrigation.[16] However, several drawbacks have been reported with these techniques, such as buccal and palatal wounds, acute or chronic infection, inflammation of the tissues, and patient discomfort.[22]

The aspiration-irrigation technique is described in the *ex vivo* model as a new technique to remove the smear layer in the apical region of the canal.[23] The technique relies on intracanal aspiration using both, aspiration needle and injection needle, to reduce irrigant extrusion through the apical foramen.[24] This case report aims to illustrate a case of persistent maxillary lesion that had been managed by a modified aspiration-irrigation technique through the infected root canal space using high-volume suction.

Case Description

An 11-year-old boy was referred to the Postgraduate Endodontic clinic at University Dental Hospital, King Abdulaziz University, Jeddah, in 2022 for the management of tooth #11. The patient's medical history was nonsignificant. Dental history showed that the patient came to the emergency clinics at University Dental Hospital, King Abdulaziz University, Jeddah, 2 years ago with a chief complaint of pain from cold drinks. His mother reported a history of a tooth fracture after a traumatic dental injury. According to the mother, emergency management was performed at that time and the patient did not have any follow-up visits.

When the patient reported to the Endodontics clinic, he did not complain of any symptoms, and no swelling or sinus tract could be observed. Clinical examination showed mild discoloration of tooth #11. The tooth was restored with composite restoration. Gingival tissue was healthy, periodontal probing did not show any abnormalities, and no mobility was observed. Sensitivity tests (heat, cold, and electrical pulp testing)[25] were negative for tooth #11. The tooth was not tender to percussion or palpation. Radiographic examination shows that the root canal was wide with an open apex. The filling inside the canal looked like calcium hydroxide. The radiograph also revealed a small lesion related to the area of the immature root (Fig. 1). The diagnosis was previously initiated root canal therapy (pulpectomy and intracanal medication) with asymptomatic apical periodontitis. It is possible that the periapical lesion was caused by improper disinfection of the root canal during the emergency management system that was performed 2 years ago. There was no previous periapical radiograph for the tooth to compare to the current radiograph.

The patient and his mother were concerned and wanted to keep the tooth considering its location as, an anterior tooth. Treatment options and outcomes, including revascularization/revitalization, apexification, no treatment, and extraction, were elaborately discussed with the patient and his guardian. Eventually, the patient's guardian opted for a regenerative endodontic procedure. Since the tooth had a wide canal and immature apex, we thought that this could be a good approach for the continuation of root maturation and apical closure.

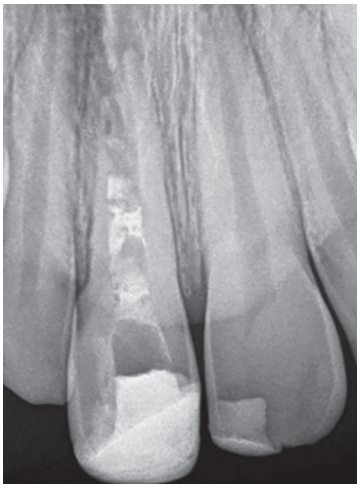
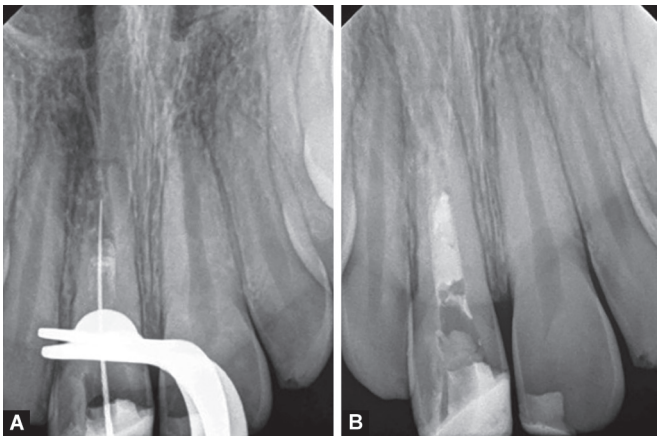


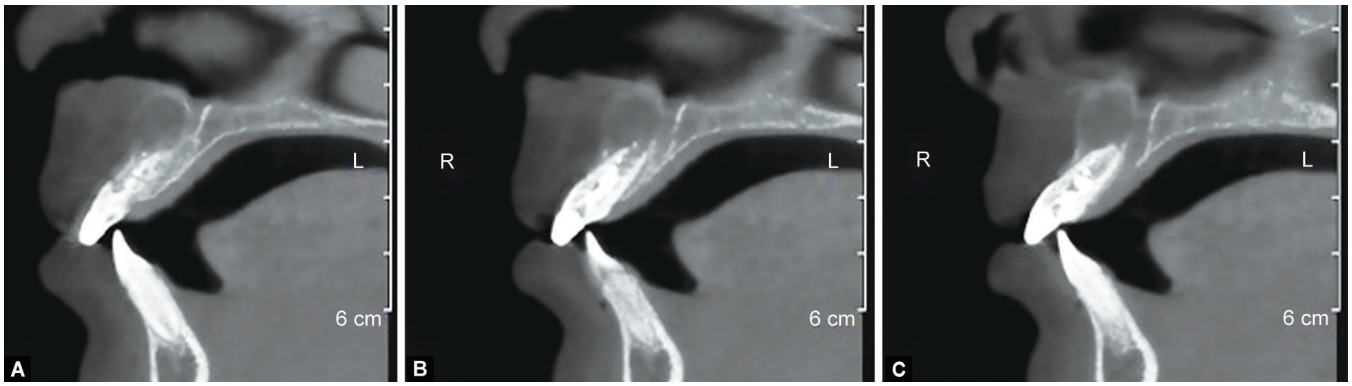
Fig. 1: Periapical radiograph of tooth #11 that has been endodontically initiated showing intracanal medication and restoration of the broken part of the crown. The root has an open apex, consistent with previous trauma. There is a well-defined radiolucent area noted apical to that tooth

Local anesthesia with 2% lidocaine containing 1:1,00,000 epinephrine (Novocol Pharmaceutical, Cambridge, ON, Canada) was administered, and a rubber dam was used to isolate the tooth. The temporary restoration and the cotton pellet were removed. The previous access cavity was adjusted by using an Endo-Z drill. In an attempt to disinfect the root canal, copious irrigation with 3% sodium hypochlorite (NaOCl) solution was done. Rotary file, Reciproc R25 (VDW, GmbH, Munich, Germany), was used to remove possible remaining tissue in dentinal walls. The final flush was performed using a plentiful volume of 3% NaOCl. Ultrasonic activation was used with the irrigation. The root canal was then dried with paper points. Calcium hydroxide (CH) paste (Metapex; Meta Biomed, Chungju, Korea), an intracanal medication, was applied to the canal. Temporization was done using cotton pellets and Cavit (3M, ESPE, Germany). The patient was scheduled to be seen after 2 weeks.

On the next visit, the patient did not complain of any symptoms after the initial procedure and the temporary restoration did not leak. Isolation of the tooth with rubber dam under local anesthesia was done. The temporary restoration was removed from the access cavity. The working length was measured using an apex locator (Root ZX; J Morita Co., Kyoto, Japan) and confirmed with periapical radiograph (Fig. 2A). Figure 2 also shows that the periapical lesion size was still the same. The intra-canal medicament was gently removed from the root canal with copious amount of 3% NaOCl along with ultrasonic activation 2 mm shorter than the working length. A two-minute 17% EDTA rinse was carried out. The final rinse with 3% NaOCl was done, and the canal was dried using paper points. Using a surgical operating microscope, a size 40 K-file was used to induce bleeding from the periapical area. Successfully, a blood clot was formed right below the cementoenamel junction. ProRoot mineral trioxide aggregate (MTA) (Dentsply Tulsa Dental, Tulsa, OK) was mixed with saline solution and applied. A moist cotton pellet was placed over the MTA plug and then covered with temporary restoration (Fig. 2B). One week later, the cotton pellet and the temporary filling were removed, and the tooth was then restored with permanent composite restoration. No periapical



Figs 2A and B: (A) Periapical radiograph of tooth #11 showing working length determination after removal of intracanal medication and before revascularization procedure; (B) Immediate postoperative periapical radiograph of tooth #11 showing the placement of MTA plug. Four-mm MTA plug was placed on top of blood clot to facilitate regenerative procedure



Figs 3A to C: Show different sagittal sections of the CBCT scan taken 1 month after the initiation of the regenerative procedure. The scan was taken after the removal of the MTA plug and the placement of the intracanal medication. The images show distinct radiolucency related to the tooth. The root has open apex, consistent with previous trauma. There is a well-defined radiolucent area apical to that tooth. There is thinning and displacement of the labial cortical plate

radiograph was taken during this visit. The patient was scheduled for a follow-up examination.

Tooth #11 had been asymptomatic for 3 weeks. However, the patient developed symptoms of pain and localized buccal swelling that revealed acute apical abscess at the periapical area approximately 1 month after the revascularization procedure. At this point, it was explained to the patient guardian that the regenerative procedure had failed, and different options should be discussed. The patient's guardian agreed that the tooth must open again.

Since the patient's symptoms were mild, the patient was not given any medication, and an emergency appointment was scheduled for immediate treatment. The tooth was isolated with a rubber dam, and an access cavity was made after administering infiltration anesthesia. Meanwhile, under copious sterile saline irrigation, the MTA was removed with an ultrasonic tip. After that, transparent drainage was observed. The canal was irrigated with 3% NaOCl solution using positive syringe irrigation. A calcium-hydroxide paste was then placed inside the canal. After that, a cone-beam computed tomography (CBCT) radiograph was requested (Fig. 3). Three sagittal sections (A, B, and C) show distinct radiolucency related to the tooth. The root had an open apex, consistent with previous trauma. There was a well-defined radiolucent area apical to that tooth. There was thinning and displacement of the labial cortical plate. The canals were filled with calcium hydroxide medication at this point.

Two weeks later, the swelling was resolved. The affected canal was re-accessed, and calcium hydroxide was carefully washed out of the canal with generous amounts of 3% NaOCl. Because the canal was still draining, triple antibiotic paste (TAP) (metronidazole 500 mg/mL, ciprofloxacin 500 mg/mL, and minocycline 200 mg/mL) was used as an intracanal dressing.

Two weeks after the previous visit, the patient did not suffer from any symptoms. Local anesthesia was administered, and a rubber dam was placed. The temporary filling was removed. Although a TAP was placed inside the canal, it was still draining. Accordingly, 3% NaOCl irrigation was used to remove (TAP). Then, IrriFlex (flexible root canal irrigation needle) 0.3 mm (30G) (Dental Tribute, Andover, MA, USA) was adjusted to be inserted 2 mm beyond the working length, then it was placed on a high-volume suction to aspirate the lesion contents within the root canal through the apex of the affected tooth. Aspiration was continued until

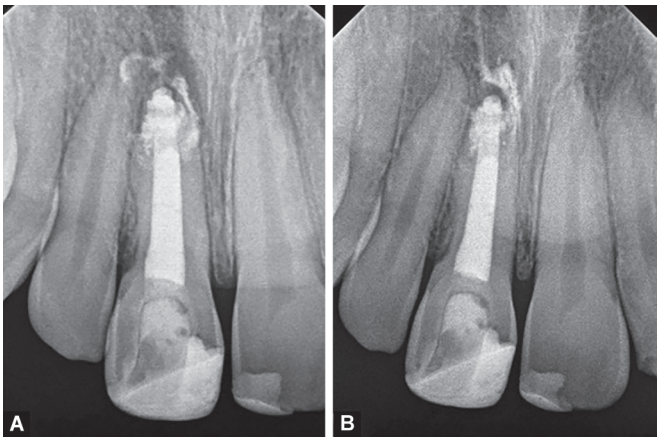
bleeding was observed. When the drainage partially stopped, calcium hydroxide was placed, followed by Cavit to seal the access cavity.

One week later, the canal was re-accessed, and calcium hydroxide was flushed with a plentiful amount of 3% NaOCl. Finally, the root canal was completely dry. Mineral trioxide aggregate apical plug (4 mm thick) was placed and adapted to the root canal using a plugger. The remaining part of the canal was backfilled with injectable thermoplasticized gutta-percha and AH-plus sealer. Composite resin was used to restore the tooth (Fig. 4A).

The 3-month follow-up clinical examination revealed an asymptomatic tooth with a slight discoloration. The 16-month follow-up clinical and radiographic examination revealed an asymptomatic tooth with healthy soft tissue (Fig. 4B). Cone-beam computed tomography was taken at the 16-month follow-up, and it shows almost complete resolution of the periapical radiolucency related to tooth #11 (Fig. 5).

Discussion

This report presented a case of traumatic dental injury to the upper anterior tooth, which was managed initially by pulpectomy and placement of intracanal medication. The crown of the tooth was restored with composite restoration. Since we started treating the case 2 years after the initial treatment and based on the tooth condition, we can assume that the trauma was a complicated crown fracture. Failure of the patient to continue the treatment may have resulted in the formation of apical radiolucency since the root canal was not disinfected nor filled.



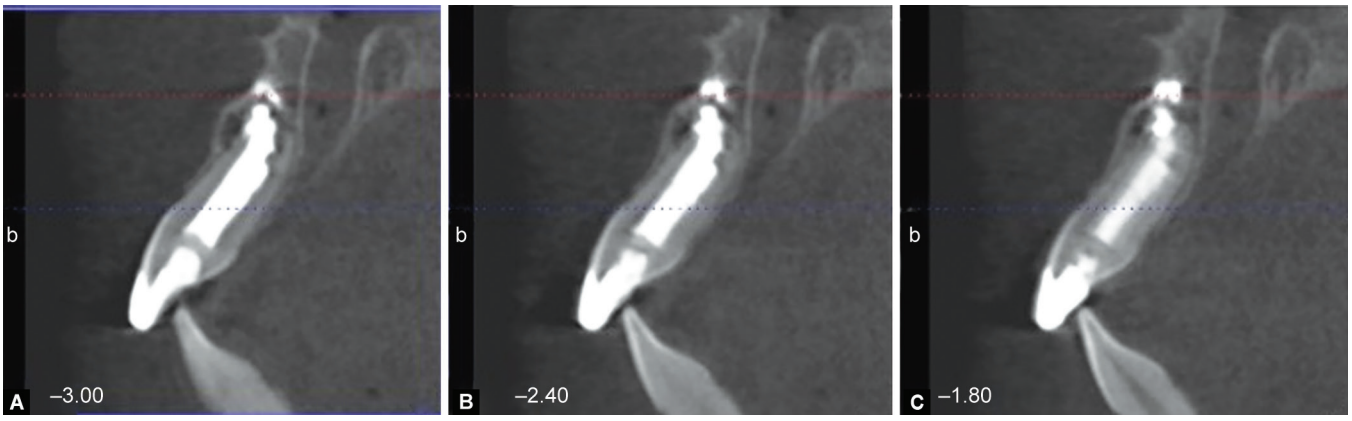
Figs 4A and B: (A) Shows immediate postoperative periapical radiograph of tooth #11 after the placement of MTA plug during apexification procedure. The rest of the canal was filled with gutta percha and sealer; (B) Shows 16 months follow-up periapical radiograph

The primary cause of the initial treatment failure could be due to the intra-radicular microorganism persisting inside the root canal after the disinfection procedure. It has been asserted that persistent or reintroduced microorganisms are the main element of post-treatment disease.[22,26] Bacteria along with other intracanal microorganisms can penetrate from the main root canal and survive inside the dentinal tubules, accessory canals, most apical part of the root canal, and other canal irregularities and resist mechanical preparation.[26–31] Moreover, based on culturing techniques, the effect of calcium hydroxide in eradicating bacteria from the root canal system is limited.

Regenerative endodontic treatment is used in necrotic permanent teeth with immature apices. This treatment option would help in apical tissue healing, continuous root maturation, and thickening of the dentine wall of the immature root. This will result in roots with increased length and thickness and less fracture susceptibility. It provides superior outcome compared to apexification procedures.[32,33] The initial fundamentals of regeneration were established in the early 1960s by Östby,[34] but the main concepts came later from traumatic dental injury cases. Regeneration success requires the abscess of bacteria inside the root canal and the presence of an ischemic/necrotic root canal system to act as a scaffold into which the tissues can grow.[35]

Aspiration of large periapical lesions was first reported by Hoen et al.[16] helped in lowering the hydrostatic pressure, which resulted in the reduction of lesion size. However, it was not recommended due to its creation of palatal and buccal wounds and the pain it inflicts on the patient. Fernandes and De Ataide reported the use of fluid aspiration in the treatment of large periapical lesions in upper anterior teeth without the creation of buccal and palatal wounds. The technique minimizes the patient's discomfort and aids in decreasing the hydrostatic pressure inside the bony cavity.[36]

The technique used in this report prevents the possibility of causing any injury or wound to the tissues; it is also more comfortable for the patient. In their study, Fernandes and De Ataide employed a 24-gauge metal irrigation needle and performed



Figs 5A to C: Show different sagittal sections of 16 months follow-up CBCT image. The images show that the periapical lesion has decreased in size to almost complete resolution compared to the previous CBCT images in Figure 3

manual aspiration of the lesion content through a closed apex, despite violation the apical foramen.[36] Conversely, in this particular case, a flexible root canal irrigation needle was connected to a high-volume suction and utilized to aspirate the content of the lesion in an open apex.

The bleeding after aspiration may indicate the destruction of the cystic epithelial lining, which might help in the activation of the healing mechanism. In this reported case, the apical diameter of the maxillary central incisor was very wide since it is an immature root (ISO 60). The final apical diameter (ISO 90) allowed the insertion of the tip of the aspirating needle 30-gauge equal to (ISO 30) beyond the apical foramen, and that made the aspiration-irrigation technique feasible. Fernandes and De Ataide[36,37] reported almost complete healing of a periapical lesion after 1.6 months of follow-up using the same technique.

In the modified aspiration irrigation technique, careful consideration of case selection is crucial due to the requirement of an open-apex or a wide apical foramen in order to facilitate the insertion of the aspirating needle. Furthermore, this technique may not be suitable for thin roots as it necessitates extensive preparation, nor for severely curved canals, as it restricts the passage of the aspirating needle. As a result, its applicability may be restricted to wide, straight-root canals.

No reports have been made insofar as repetition of failed regenerative endodontic procedures after initial failure is concerned. Consequently, apexification is the ultimate alternative treatment used in the case of regenerative endodontic therapy failure.[38] Moore et al.[39] reported a successful clinical outcome of apexification using MTA apical plug.

From the patient's perspective, considering the age of the patient, it was important to maintain this tooth for functional as well as esthetic reasons. At this age, the only possible replacement in case of extraction will be a flipper denture, which will be not as natural as the patient's tooth. We think that the outcome was excellent, all complications considered.

Conclusion

Management of teeth with an open apex should be directed toward increasing root width, length, and apical closure. Based on the aforementioned case, the aspiration-irrigation technique proved to be very beneficial in the case of a large periapical lesion. When resorting to this technique, case selection as well as the diameter of the apical foramen must be seriously considered. However, further studies must be performed in order to assess the impact of high-volume suction aspiration on facilitating the healing process of large periapical lesions.

Authors' Contributions

Sara Almarzouki contributed to the patient's care, follow-up, and writing the manuscript. Loai Alsofi contributed to editing and reviewing the manuscript.

Data Availability Statement

The data supporting the findings of the present study are available from the corresponding author upon request.

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