CASE REPORT

The Successful Interdisciplinary Outcome of Blunderbuss Canal with an Open Apex Using MTA under Magnification: A Case Report

Prashant Bhasin[1], Bhavna G Saraf[2], Sachin Chauhan[3], Hemanshi Kumar[4], Palak Wahi[5], Vrinda Vats[6]

Abstract

Aim and objective: The present case report aims to describe the nonsurgical management of an anterior tooth with a blunderbuss canal and an open apex using mineral trioxide aggregate (MTA) under magnification.

Background: When pulp is traumatized before root formation, it results in pulpal necrosis, due to which dentin and root formation are interrupted. As a result, the canal remains broad due to thin and fragile dentin walls leading to the open apex. Therefore, root canal treatment is a big challenge currently. In such cases, we prefer MTA apexification to form the hard tissue apical barrier, which is a foreseeable treatment and has been used as another advanced method than calcium hydroxide ($CaOH_2$) apexification due to its superior properties.

Case description: A novel apexification technique was used by the Departments of Pediatric Dentistry and Conservative Dentistry and Endodontics for MTA placement in the central incisor with respect to 11 of a 9-year-old female patient. MTA was used to form an apical barrier using the micro-apical placement (MAP) system under a dental operating microscope (DOM). Following MTA hard set confirmation, obturation with bioceramic sealer and gutta percha with warm vertical condensation was done, followed by post-endodontic composite restoration.

Conclusion: This case describes the nonsurgical management of an open apex using MTA, MAP system, magnification, and bioceramics, which aided in the management of this endodontic enigma.

Keywords: Bioceramics, Case report, Magnification, Mineral trioxide aggregate, Open apex.

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Introduction

Injuries due to trauma to the anterior teeth, especially in the maxillary central incisors, are more common, affecting 13.80–15.10% of the population. When the situation is severe, it can lead to pulpal inflammation and, eventually, to the necrosis of the pulp.[1] Nowadays, regenerative endodontics is gaining more preference over apexification due to the continuous formation of length and thickness in the roots of the nonvital teeth, but there is no assurance that it will succeed. When sufficient root length is available, the clinician may opt for apexification. Apexification is defined as a "treatment method aimed at inducing apical repair as a hard tissue barrier across an open apex." This technique is typically used to manage pulpless permanent teeth with an open apex or "blunderbuss" canal.[2] calcium hydroxide ($CaOH_2$) has traditionally been used for apexification[3] despite having several clinical challenges such as lack of precise time for treatment, a long duration of treatment, unpredictable apical closure, and thin and easily fractured root walls,[4] all of which necessitate superior clinical conduct supported by modern bioactive materials to deliver long term beneficial treatment outcomes.[5] Recently, there has been more interest in the use of bioactive materials like mineral trioxide aggregate (MTA) for apexification due to its bioactivity, ability to produce a three-dimensional (3D) seal and antimicrobial properties.[1] The aim is to immediately create an apical barrier to fill the root canal system.[6] Apexification with MTA offers various advantages, one of which is that it is not resorbed, does not harm the dentin of the teeth, and also sets in a moist environment. MTA encourages cementogenesis and osteogenesis due to its basic pH and the release of phosphorus and calcium ions.[1] The use of a microscope in endodontics has become standard and has many advantages, such as direct high-intensity illumination of the working field, variable magnification, higher precision during work, and finally, providing a more comfortable working position for the dentist.[7] It influences the quality of marginal material adaptation and favors higher quality therapeutic procedures and anatomic structure visualization, making prognosis more predictable with a significant increase in success rate.[8] This case report demonstrates a novel approach to managing a blunderbuss canal with an open apex using MTA under magnification.

[1,3–6]Department of Conservative Dentistry and Endodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India

[2]Department of Pedodontics and Preventive Dentistry, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India

Corresponding Author: Sachin Chauhan, Department of Conservative Dentistry and Endodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India, Phone: +91 9958464133, e-mail: Drsachinchauhan13@gmail.com

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Case Description

A 9-year-old female patient presented to the Department of Pediatric Dentistry in Sudha Rustagi College of Dental Sciences and Research complaining of mild pain and discomfort in her upper front tooth for the past 6 months. There was an 8-month history of trauma to the same tooth. The medical history was noncontributory, and the clinical examination revealed an Ellis class IV fracture in the permanent maxillary right central incisor with a sinus on the labial mucosa near the root apex (Fig. 1). The tooth was unresponsive to electric as well as thermal pulp sensibility tests and a thorough radiographic examination showed a large blunderbuss canal with associated periapical lesion and resorption on the mesial aspect of the tooth (Fig. 2). Based on the clinical history and radiographic findings, a provisional diagnosis, that is, periapical abscess wrt 11 was made. After discussing various treatment options with the patient, a mutual decision was made to proceed with the MTA (BioStructure, SafeEndo, India) apexification procedure using a dental operating microscope (DOM) (Labomed Dental Microscope Prima DNT, United States of America). As a result, the patient was referred to the Conservative Dentistry and Endodontics Department for apexification under magnification. Informed consent was obtained from the patient's family.

Rubber dam isolation was done, followed by access cavity preparation (Fig. 3), and working length determination was done with #60H file (Mani, Prime Dental Product Pvt. Ltd., India) (Fig. 4). The instrumentation was done with JIZAI rotary files (Mani, Tochigi, Japan). The canal was then meticulously cleaned mechanically using intracanal instruments. Copious irrigation with 2.5% sodium hypochlorite (NaOCl) (Bharat Chemical, India) was done 3 mm above the working length using a 30 G double-side vented needle (Master Clean, Amplemeds, India), followed by internal heating and activation 5 mm above the working length. After that, the canal was dried with sterile paper points (Diadent, Chungju, Korea) (Fig. 5). Triple antibiotic paste (containing minocycline, ciprofloxacin, and metronidazole) was placed in the root canal for 2 weeks.

On recall, the patient was asymptomatic. Triple antibiotic paste (TAP) was mechanically removed and rinsed out of the root canal

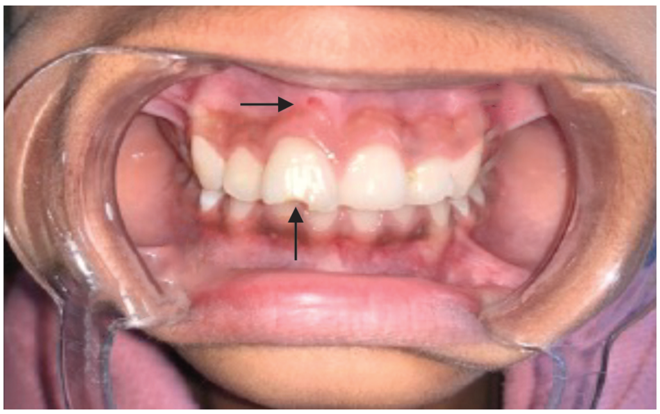

Fig. 1: Ellis class IV fracture with a sinus

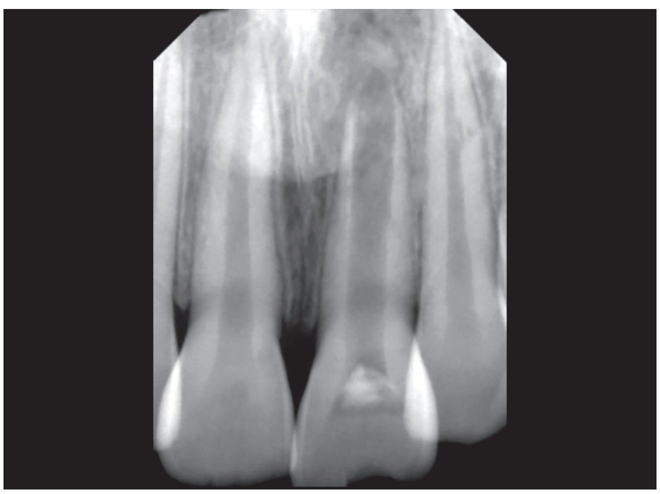

Fig. 2: Radiograph revealing a large blunderbuss canal

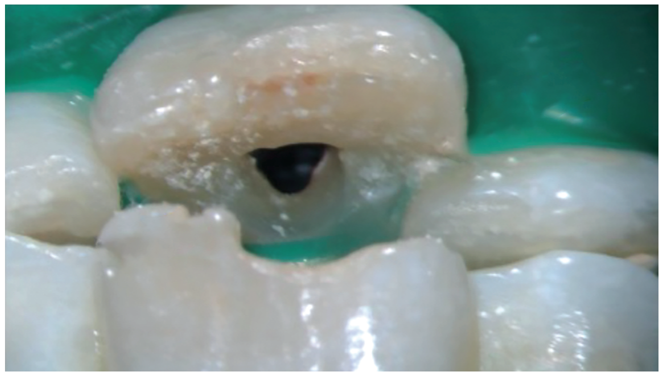

Fig. 3: Access cavity under rubber dam isolation

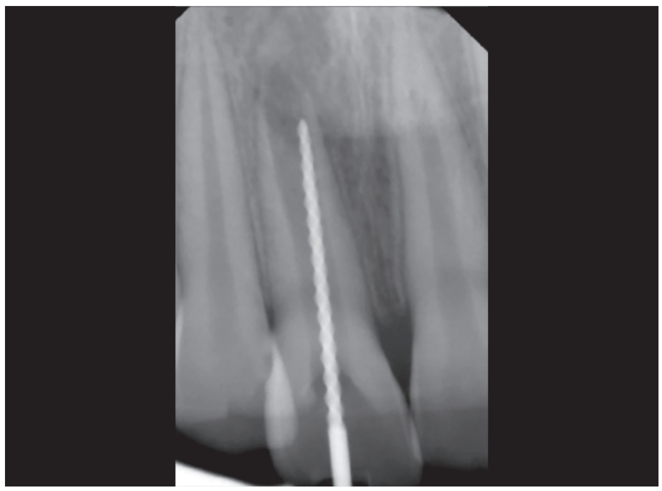

Fig. 4: Working length determination

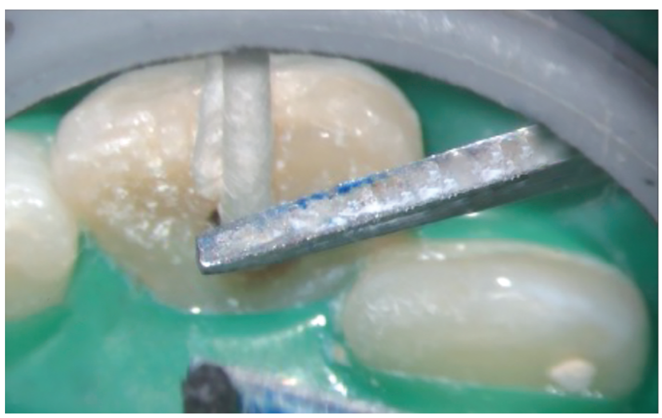

Fig. 5: The canal was dried with a sterile paper point

using copious irrigation with 2.5% NaOcl (Bharat Chemical, India), followed by 17% ethylenediaminetetraacetic acid (EDTA) for the removal of the smear layer. After drying the root canal, with the help of an endodontic condenser (Meta Biomed, Chungcheongbuk-do, Korea), a small fragment of hemostatic collagen sponge (Hemospon; Technew, Rio de Janeiro, Brazil) was introduced and placed in the apical third of the root canal with the help of a prefitted plugger until the working length (Fig. 6). MTA (BioStructure, SafeEndo, India) was mixed into a putty-like consistency immediately after the collagen sponge (Hemospon, Technew, Rio de Janeiro, Brazil) was compacted. The mixture was carried to the canal using the micro-apical placement (MAP) system (Produits Dentaires SA, Vevey, Switzerland) (Fig. 7) under magnification which was placed increment by increment and each increment was condensed with paper point (Diadent, Chungju, Korea) and a prefitted plugger (Meta Biomed, Chungcheongbuk-do, Korea) to create the 5 mm plug (Fig. 8). A radiograph was taken to check the precise placement of MTA at the apex (Fig. 9). After the initial set, the master cone was taken using the inverted cone technique (Fig. 10) and the canal was obturated using bioceramic sealer (Ceraseal, Meta Biomed, Chungcheongbuk-do, Korea) and gutta-percha (Diadent, Chungju, Korea) with warm vertical condensation to create the 3D seal and the post endodontic composite (Tetric N-Ceram, Ivoclar Vivadent, Schaan, Liechtenstein) restoration was also completed on the same visit (Fig. 11). On follow-up recalls, the tooth was asymptomatic and the 6 and 9 months of postoperative radiographs showed significant healing of the periapical lesion (Fig. 12).

Discussion

Apexification is the most commonly used treatment for an immature tooth with an open apex.[4] The aim of this treatment is to stimulate the development of a hard tissue barrier, allowing for optimal root canal obturation. The most significant issue with $CaOH_2$ apexification is the prolonged treatment procedure,[9] which is dependent on factors like the diameter of the open apex, questionable apical closure, constant instrumentation, temporary restoration leading to reinfection, and also predisposing the tooth to fracture.[4] The artificial formation of the apical plug technique is a more efficient and favored treatment method for overcoming the drawbacks of traditional $CaOH_2$ apexification,[10] such as increased number of appointments, the risk regarding poor patient compliance, failure to return for scheduled appointments, and coronal seal failure due to temporary restoration.[11] This protocol allows the root canal system to be filled right away.

Nowadays, a variety of materials, including tricalcium phosphate (MTA), have been proposed for this purpose.[5] When used as an apexification material, MTA binds with the cement and the tooth. During MTA maturation, an appetite-like 3D barrier formed, filling the space made during contraction and enhancing the fracture strength of the root canals.[11] MTA promotes cementoblastic or osteoblastic activity, which is enhanced by phosphorus and calcium ions.[12] The mechanism of action of these bioactive cements is to release calcium ions, which activate cell attachment and proliferation while also creating an antibacterial environment due to the high pH.[13]

The clinical efficacy of the MTA barrier was affected by its thickness as well as the material used. A 5 mm thick apical MTA plug has been shown to be significantly stronger and microleakage-

Fig. 6: Hemostatic collagen sponge in the apical third of the root canal at 25×

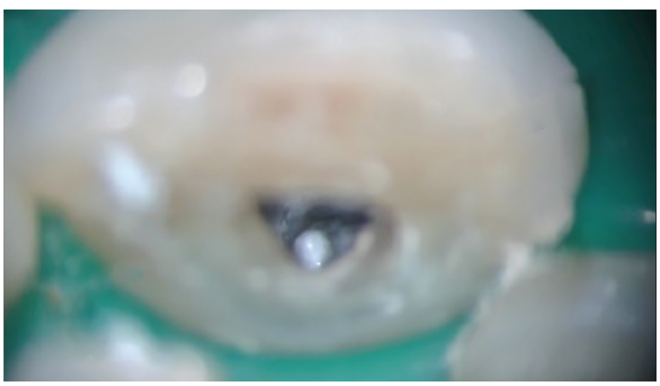

Fig. 7: Clinical picture showing MTA's first increment at 25×

Fig. 8: Clinical picture showing 5 mm MTA plug at 16×

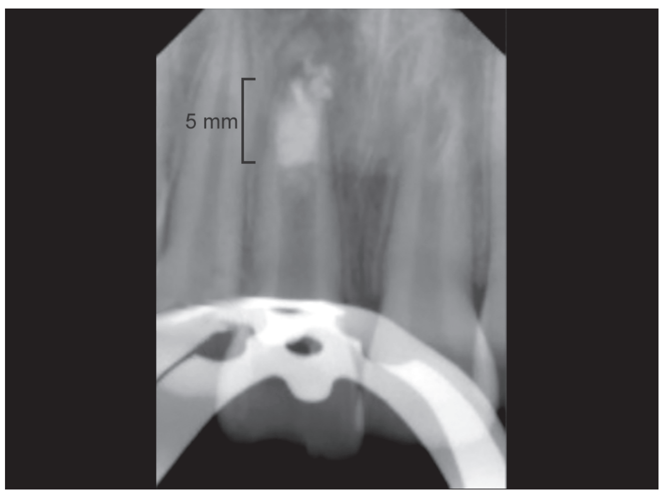

Fig. 9: Radiograph confirming 5 mm MTA plug

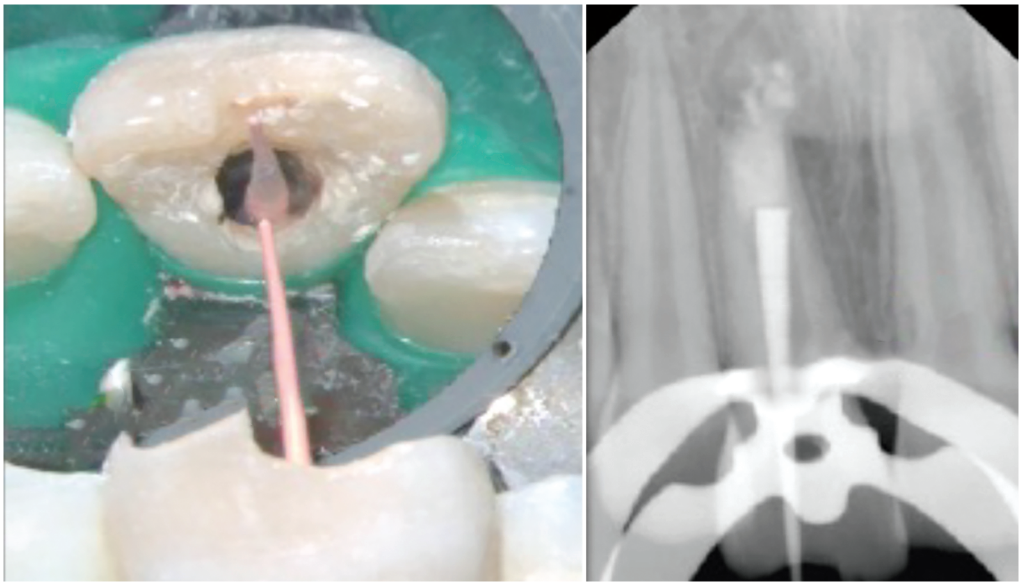

Fig. 10: Master cone using the inverted cone technique

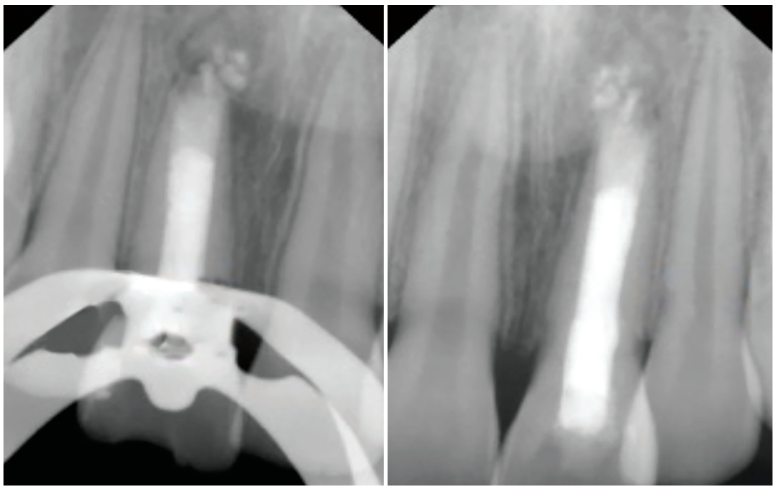

Fig. 11: Obturation followed by the postendodontic composite restoration

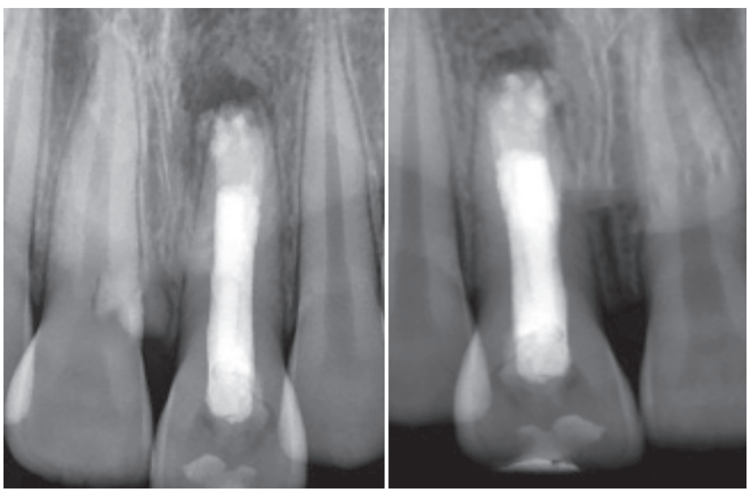

Fig. 12: The 6- and 9-month follow-up showing periapical healing

free.[14] Matt et al. evaluated that "a 5 mm thickness of MTA was significantly stronger and had less microleakage than a 2 mm thickness."[15] Hachmeister et al. investigated the displacement of MTA in a tooth with an open apex as an apical plug material and found that a 5 mm thick apical plug provided more displacement resistance than a 1 mm thick apical plug.[16] Aminoshariae, in a study, compared the hand and the ultrasonic condensation for placement of MTA and found that hand condensation provided better adaptation and lesser voids of MTA than ultrasonic condensation.[17] As a result, manual condensation, that is, paper points and hand plugger were used to condense MTA at the apex in this case. Several studies have shown that MTA has the ability to induce odontoblastic and cementoblastic differentiation, better radiopacity, low solubility, high alkaline pH, expansion after setting, and antimicrobial activity.[18–20] In a similar study, MTA apexification was associated with a high rate of healing and apical closure.[21]

In this case, the canal was disinfected with 2.5% NaOCl and 17% EDTA after cleaning and shaping, and TAP dressing was used as an intracanal medicament. The main drawback of MTA is that it is difficult to handle and must be placed precisely in a wide-open apex,[22] so MTA was placed using a MAP system, condensed using paper points and endodontic pluggers under magnification, and obturated with a bioceramic sealer. With the help of a high magnification factor, we can see up to the apex because there is a good depth of view in such cases where the clinical placement of each increment of MTA in the correct location can be seen to create the 3D seal under magnification. Based on previous studies[1,2,5,12] and the clinical outcome of this case report, we believe Apexification with MTA and Bioceramics under magnification is a treatment with a good prognosis.

Conclusion

Apexification is the appropriate management for the treatment of a nonvital immature tooth with a wide-open apex because it consumes less time, and is more predictable, and yields immediate results. MTA, bioceramics, and magnification are the new boons in the treatment of teeth with an immature apex, which aided in the management of this endodontic enigma. This novel technique is predictable with a shortened treatment span, high success rate, and positive patient compliance.

Clinical Significance

Adequate infection control through mechanical debridement and irrigant use in conjunction with intracanal medicaments aids in the nonsurgical treatment of chronic lesions and promotes regression and healing. Under magnification, an apical plug with MTA produces superiorly condensed apical plugs by reducing the problems associated with conventional techniques and producing a better apical seal.

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