Case Report

Apexification: A Conservative Approach for Managing Non-Vital Immature Teeth - A Case Report

Geetika Dixit[1], Shagun Chhikara[1], Sanjana Deka[1], Nida Naim[1]

Abstract-

Aim and Objectives- *This case report focuses on the nonsurgical treatment of a traumatized anterior tooth characterized by an open apex, utilizing mineral trioxide aggregate (MTA).Trauma to the pulp before root formation can cause pulpal necrosis, halting dentin and root development. This results in a broad canal with thin walls and an open apex, making root canal treatment challenging. MTA apexification is preferred over calcium hydroxide due to its superior ability to form a hard tissue apical barrier. Apexification was carried out to manage tooth left central incisor (21) in a 13-year-old female patient. An apical barrier was created using Mineral Trioxide Aggregate (MTA), and its hard set was confirmed before proceeding with obturation using a bioceramic sealer and gutta-percha. The treatment was then completed with a post-endodontic restoration.This case describes the nonsurgical management of an open apex using MTA and bioceramics, which aided in the management of this endodontic enigma.*

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

INTRODUCTION

Dental trauma occurs frequently and involves 5% of all injuries. The trauma takes place more with preschool children, where 18% of all injuries are involved. The traumatic injury could cause loss of pulp vitality, which could halt root development. Then, the root may remain in an immature status having an open apex.[1]

The treatment of this type of lesion, followed by the correct obturation of the canal, is very difficult to achieve under normal endodontic therapy conditions, requiring the intervention of some surgical methods. Considering, however, the fact that such cases are mainly encountered in very young patients with difficult cooperation, a method that allows the complete development of the apex is required as a therapeutic solution, the method called apexification.[2,3]

1. Post graduate student
Department of Pediatric and Preventive dentistry
Kothiwal dental college & research centre
Moradabad, Uttar Pradesh
Corresponding author
Geetika Dixit

Department of Pediatric and Preventive dentistry
Kothiwal dental college & research centre
Moradabad, Uttar Pradesh

According to American Association of Endodontists, Apexification is defined as a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp.[4]

Maxillary central and lateral incisors are often considered the easiest teeth to treat due to the uncomplicated anatomy of the root canal. The canal is usually straight with a crosssectional shape approximating the shape of the crown and root.[5,6]

The primary objective of apexification is to promote apical repair by forming a tissue barrier at the root apex. This barrier allows for safe root canal obturation using condensation techniques, minimizing the risk of extruding the filling material beyond the apex.[7]

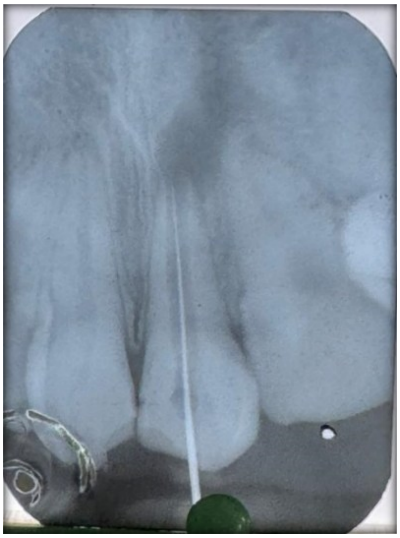
Successful endodontics aims at effective debridement of the root canal system and complete obturation of the root space. The anatomy of the root canal system sets the parameters within which root canal therapy will be performed and can directly affect the likelihood of success.[2,5] This case report demonstrates a approach to managing a blunderbuss canal with an open apex using MTA.

CASE REPORT

A 13-year-old female patient presented to the Department of Pediatric Dentistry at Kothiwal Dental College and Research Centre, complaining of mild pain and discomfort in her upper front tooth for the past six months. She had a history of trauma to the same tooth three years ago. Her medical history was noncontributory, and extraoral findings were unremarkable. Clinical examination revealed a uncomplicated crown fracture with discoloration in the upper left central incisor (21) and an uncomplicated crown fracture in the permanent maxillary right central incisor (11) (Fig. 1). Both teeth were not tender on percussion. On thermal pulp sensibility test and electric pulp test 21 was unresponsive whereas 11 was sensitive to both the test. On radiographic examination 21 showed an open apex with associated periapical lesion. Based on the clinical history and radiographic findings, a provisional diagnosis, that is, irreversible pulpitis and Ellis class IV fracture w.r.t 21 and Ellis class II fracture w.r.t 11 was made (fig.2). After discussing various treatment options with the patient, a decision was made to proceed with the MTA (BioStructure, SafeEndo, India) apexification.

(Fig1: Ellis class IV fracture w.r.t 21 and Ellis class II fracture w.r.t 11)

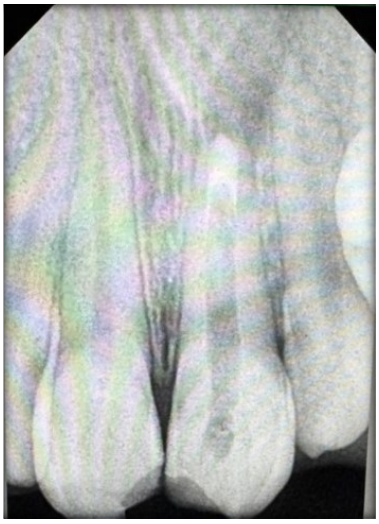
(Fig2: Radiograph revealing an open apex and radiolucency w.r.t 21)



(Fig3: Working length determination)

Access cavity preparation and working length determination was done with #20 kfile (Mani, Prime Dental Product Pvt. Ltd., India)(Fig.3). 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, After that, the canal was dried with sterile paper points. Triple antibiotic paste with calcium hydroxide was (containing, minocycline, ciprofloxacin, and metronidazole) was placed in the root canal for 3 weeks so that periapical region can heal.

On recall after 21 days, the patient was asymptomatic and radiograph also showed the signs of periapical healing. Triple antibiotic paste (TAP) was mechanically removed and rinsed out of the root canal using copious irrigation with 2.5% NaOcl , followed by 17% ethylenediaminetetraacetic acid (EDTA) for the removal of the smear layer. After drying the root canal, MTA was introduced and placed in the apical third of the root canal and 3mm apical plug was made(fig:4). After which access cavity was sealed with moist cotton and temporary restoration and after 24 hrs visit. Obturation was done using gutta percha and bioceramic sealer and the post endodontic restoration with GIC restoration was also completed on the same visit(fig.5)(fig.6). On follow-up recall after 10 days, the tooth was asymptomatic so crown cutting and PFM crown was delivered w.r.t 21 and composite restoration was done w.r.t 11 (fig.7) and postoperative radiographs showed significant healing of the periapical lesion.



(Fig4: Radiograph confirming 3mm MTA plug)

(Fig5: Master cone)

(Fig6: Obturation followed by the post-endodontic restoration)

(Fig7: PFM crown was delivered w.r.t 21 and composite restoration was done w.r.t 11)

DISCUSSION

"Apexification is a widely used treatment for immature teeth with open apices, aiming to promote the formation of a hard tissue barrier for effective root canal obturation.[8]

A detailed history and documentation of any injury are of prime importance from both a diagnostic and treatment points of view.[9] Cautious case assessment and precise pulpal diagnosis are significant in the treatment of immature teeth with pulpal injury. A full history of subjective symptoms, a complete clinical and radiographic examination, and the administration of diagnostic tests are all necessary for the clinical assessment of the pulpal state.

Confirmation from objective tests is necessary. These include visual examination, percussion testing, and thermal and electric pulp testing. Radiographic interpretation can be difficult. An immature tooth with a healthy pulp is typically surrounded by a radiolucent region where the open apex is still forming. It may be difficult to differentiate between this finding and a pathologic radiolucency resulting from a necrotic pulp. Comparison with the periapex of the contralateral tooth may be helpful.[10]

In the past, techniques like custom fitting the filling material, paste fills and apical surgery were used for the management of non-vital immature teeth. Later the investigations focused on inducing apical closure using antibiotic and antiseptic pastes.[11,12]

There are various products for inducing apical closure such as calcium hydroxide, biodentine and MTA etc. From which Calcium hydroxide was previously the most widely used and accepted material for apexification. Its popularity stemmed from its ability to induce hard tissue formation at the apex, providing a biological barrier for root canal obturation. Despite its effectiveness, the material has

limitations, including a prolonged treatment duration, dependency on the size of the open apex, potential for reinfection due to temporary restorations, and an increased risk of root fracture due to prolonged exposure. These challenges have led to the preference for more advanced materials like mineral trioxide aggregate (MTA) in modern apexification techniques.[13]

Mineral trioxide aggregate: Mineral trioxide aggregate (MTA) was first developed by Torabinejad and members at the Loma Linda University, California, USA. Initially it was used as a root-end filling material in endodontic treatment.[14] It is a mixture of dicalcium silicate, tricalcium silicate, tricalcium aluminate, gypsum, tetracalcium aluminoferrite and bismuth oxide.[13]

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.[14] MTA promotes cementoblastic or osteoblastic activity, which is enhanced by phosphorus and calcium ions.[15] 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.[16]

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 free.[17] Matt et al. evaluated that a 5 mm thickness of MTA was significantly stronger and had less microleakage than a 2 mm thickness.[18] 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.[18] 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.[19] 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. In a similar study, MTA apexification was associated with a high rate of healing and apical closure. 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, we believe Apexification with MTA and Bioceramics is a treatment with a good prognosis.[20]

Conclusion

"Apexification is the preferred approach for managing non-vital immature teeth with wide-open apices due to its efficiency, predictability, and immediate results. Modern materials like MTA and bioceramics have revolutionized the treatment of immature teeth, offering enhanced outcomes. This technique provides a reliable solution with a reduced treatment duration, high success rates, and improved patient compliance."

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