Case Report

Single Step Apexification using Mineral Trioxide Aggregate - A Case Report

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Abstract

Traumatic dental injuries to teeth with an immature apex results in pulpal necrosis and an open apex that pose a significant challenge for complete debridement, disinfection and three dimensional obturation of the root canal system. Apexification is a procedure to promote an artificial apical barrier across an open apex in a non-vital tooth to accommodate the filling materials within the confines of the root canal. Mineral Trioxide Aggregate (MTA) has emerged as a promising material owing to its biocompatibility and superior sealing ability. This is a report of two cases with immature apex treated successfully using MTA as an apical plug.

Key Words: Mineral Trioxide Aggregate, Apexification, Single Step Apexification.

Introduction

Traumatic dental injuries are more common in maxillary anterior teeth with immature apex that leads to pulp necrosis [1]. Studies have estimated that majority of dental trauma occurred before the age of 12 (86%) [2]. Injuries involving the immature permanent teeth renders the dental pulp non vital and if this occurs prior to the complete root formation and apical closure, it may affect the development of the roots of the involved teeth causing apical resorption or open apex [3] Immature teeth with open apices have thin dentinal walls that are prone for cervical root fractures thereby reducing the overall prognosis of the teeth [2][4].

The success of an endodontic treatment largely depends on proper apical and coronal seal [5]. Teeth with open apex often pose a challenge due to the lack of adequate apical seal during obturation. Historically the management of immature open apex in non-vital teeth was confined to custom fitting the filling materials, paste fills and apical surgery. Many authors have described the use of custom made gutta percha cones, however it is not advisable since the apical diameter is wider than the coronal diameter which makes condensation of gutta percha impossible [6].

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 [7] Calcium hydroxide has been the material of choice for apexification [6] It involved repeated changes of intra canal material over the course of 5-20 months [8]. Calcific barrier against the open apex was induced. Although calcium hydroxide has shown clinical success, it had its own drawbacks. This therapy required multiple appointments and a high level of patient compliance[9]. Furthermore, the lack of an appropriate coronal seal makes the tooth susceptible to re-infection [10]. During calcium hydroxide dressings at regular intervals, repeated use of intra canal irrigants like NaOCl and organic solvents like EDTA resulted in furthermore weakening of the dentin making the tooth more susceptible to fractures [11].

Morse et al (A) defined one visit apexification as a non-surgical condensation of a biocompatible material into the apical end of the root canal. Recently, various materials namely tricalcium phosphate, calcium hydroxide, freeze dried bone and free-dried dentin were proposed for apexification procedure and favorable outcomes have been reported in literatures[6]. Mineral trioxide Aggregate (MTA) introduced by Torabenajad in 1993 gained importance as a material of choice for single step apexification due to its superior properties of biocompatibility and adequate sealing ability that has shown to create a successful artificial calcific barrier against the immature open apices[9]. This article presents two cases with immature open apeices that was managed by single step apexification using MTA as an apical plug

Case Report

A 30 year old male patient reported to the Dept. of Conservative Dentistry and Endodontics, Sri Venkateswara Dental College and Hospital, Chennai with the chief complaint of fractured and discolored upper front tooth. Patient's history of presenting illness revealed that he had a traumatic incidence at the age of 8 years. The patient remained asymptomatic since then. Patient also gave a history of treatment for the same tooth three years back after which he failed to report for the subsequent appointments. Medical history of the patient was non-contributory. Intraoral examination revealed Ellis and Davey's class IV fracture with discoloration in left upper central incisor 21. Intraoral periapical radiograph revealed blunderbuss canal and periapical radiolucency in 21 (Fig.1). The concerned tooth did not respond to the pulp sensibility tests using cold test (Roeko Endo-

Frost, Coltene, Germany) and Electric Pulp testing (Digitest, Confident, Bangalore, India). Clinical examination, Radiographic examination and vitality tests led to the diagnosis of attempted root canal treatment in 21 with periapical pathology.

Fig 1- Pre-operative Radiograph

A nonsurgical method of root canal treatment with single step apexification using MTA was planned with the consent from the patient.

In the first visit the tooth was anesthetized using 2% Lignocaine with 1:80,000 adrenaline (Lignox, Indoco Remedies Ltd., India). Endodontic access cavity was refined using endo access bur (Maillefer, Dentsply, Ballaigues, Switzerland). Canal patency was checked with number 10 K-file (Mani, Inc.; Tochigi, Japan). Canal was copiously irrigated using 3% Sodium hypochlorite (Prime Dental Products, Thane, India). Working length was determined radiographically using Ingle's method. Chemo-mechanical preparation was carried out using 80size K-file (Mani, Inc.; Tochigi, Japan) in a circumferential filing motion to remove intracanal debris and necrotic pulp tissue. Root canal debridement was done using irrigants 3% NaoCl and Normal saline (Baxter, India pvt. Ltd., Tamilnadu, India) at regular intervals. The canal was dried using paper points and calcium hydroxide intracanal medicament (RC Cal, Prime dental products, Thane, India) was placed. The access cavity was temporized using Zinc oxide Eugenol (Deepak Enterprises, Mumbai, India). Patient was recalled after 1 week.

At the recall visit, the access cavity was reopened and the calcium hydroxide paste was removed using 3% NaOCl and saline. The canal was dried using paper points. Mineral Trioxide Aggregate (MTA) [Angelus Industria de produtos odontologicos, Londrina, Brazil] was mixed according to the manufacturer's instructions to a wet sandy consistency. MTA mix was carried into the root canal and condensed into the apical portion using hand pluggers of appropriate size. Increments of MTA were then placed and condensed using the same technique till adequate thickness of 3-4 mm at the apical end was achieved. Moist cotton was then placed and the tooth was temporized. Patient was recalled after 2 days.

In the next visit, the set of MTA was confirmed clinically as a hard stop in the canal using a hand plugger and radiographically by an intraoral periapical radiograph (Fig.2).

Fig 2 - Apical Plug of MTA

Following this, the root canals were dried with paper points (Maillefer, Dentsply, Ballaigues, Switzerland) and obturated with 2% gutta-percha (Maillefer, Dentsply, Ballaigues, Switzerland) and AH plus resin sealer (Maillefer, Dentsply, Ballaigues, Switzerland) by cold lateral condensation technique. A postoperative radiograph was taken to confirm the same (Fig.3)

Fig 3 - Obturation Radiograph

The access cavity was sealed with glass ionomer cement (GC Gold label, Japan). In subsequent appointments the core was built up using composite resin (Denfil, Vericomco. LTD, Korea) following which crown preparation was done. Impressions were recorded with Elastomeric impression material (Aquasil, Denstply, Germany). Casts were made and sent to laboratory for fabrication of final prosthesis. Final prosthesis of porcelain Fused metal (PFM) crown was then cemented using luting type glass ionomer cement (GC Corporation, Tokyo, Japan). Patient was reviewed after 3 months for clinical and radiographic healing (Fig.4). Patient was found to be asymptomatic.

Fig 4- Post-operative Radiograph

Discussion

Endodontic treatment of teeth with open apex is always a challenge to the endodontist. An immature open apex has a wide apical diameter that poses significant difficulty in canal debridement, disinfection and obtaining a three dimensional obturation. For a successful endodontic treatment in a tooth with an immature apex, cleaning and disinfecting the canal is more important than shaping the canals. Over instrumentation could weaken the tooth since the canals of an immature teeth has thin dentinal walls.

Literature search revealed a number of options for the management of a traumatized vital immature open apex that includes various revascularization protocols with subsequent follow up for apical closure and permanent prosthetic restoration of the tooth, multiple visits with calcium hydroxide apexification, single step apexification using MTA or extraction followed by subsequent replacement with removable, fixed or implant prosthesis [12].

Though the clinical success rates of calcium hydroxide apexification are high, the risk of reinfection and root fracture has made the clinician to resort to other methods. With the advent of Mineral Trioxide Aggregate, a better alternative to $Ca(OH)_2$ was identified. MTA is a powder consisting of fine hydrophilic particles that binds in the presence of moisture. It consists of tricalcium silicate, tricalcium oxide and silicate oxide. It has superior properties of biocompatibility, low solubility, adequate apical sealing ability and hydrophilic nature. The pH of MTA is 12.5 which is similar to that of $Ca(OH)_2$ which might impart some antimicrobial properties[13] Because of its superior biological properties, MTA has proven to be the material of choice for creating an artificial apical plug in an open apex tooth[14]. The adequate thickness of the apical plug of MTA varied from 3mm to 5mm. MTA barrier of 5mm is significantly stronger and shows less leakage than 2mm barrier [15].

Regeneration is the ideal desirable outcome for any restorative procedure. Though novel method of using MTA for single step apexification reduces the patient's treatment time yet there is always a search for materials that would successfully regenerate the odontogenic tissues. This technique using MTA reduces the radiation exposure, chances for root fracture and susceptibility to re-infection. The choice of treatment regimen for teeth with open apices always depends on the individual case and operator experience and familiarity with handling the various materials [16].

Conclusion

Single visit apexification using MTA has been followed successfully over the last 10 years as a suitable alternative to Calcium Hydroxide. MTA has proved to be the future of endodontics and a new boon in an effective management of teeth with immature apex by achieving a good periradicular seal.

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