Case Report

Apexification or regeneration? A case report of a short mineral trioxide aggregate apical plug: 8-year follow-up

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ABSTRACT

The management of an immature permanent tooth protocol aims to eliminate pulpal pathology, disinfection, and if possible, redevelopment of the root. The paper aimed to present a case report that a successful survival history of a seemingly inadequate mineral trioxide aggregate plug and its 8-year follow-up. In the presented case, all treatment goals such as the elimination of clinical symptoms/signs of infection, apical periodontitis healing, healthy lamina dura, and further root maturation were achieved; however, a formation was observed in an 8-year recall similar to regeneration-associated intracanal calcification. There was no way to clinically understand how the healing process occurred in the area histologically, but the follow-up showed that the relevant tooth met the healing criteria.

Keywords: Apexification, apical plug, endodontics, mineral trioxide aggregate, regenerative endodontics

INTRODUCTION

Pulpal damage to the immature teeth due to trauma or deep caries results in disruption of the root development process.[1] Because of thin walls and short roots, immature teeth have a greater fracture risk and reduced retention.[2] The management procedure aims to eliminate pulpal pathology, disinfection, and fill the root canal system hermetically, and if possible, redevelopment of the root. There are currently various treatment options to achieve these goals, such as calcium hydroxide apexification, mineral trioxide aggregate (MTA) apical plug, or regenerative endodontic treatment (RET) procedures.[3,4]

A conventional treatment option for immature permanent teeth such as apexification promotes the formation of an apical hard-tissue barrier after obturation of the disinfected empty canal space with root filling material.[2] MTA is also used for an artificial biocompatible barrier (apical plug) to the immature apex. Although the apexification success rate has been reported between 74% and 100%, abnormal root canal morphology, like the formation of calcified tissue inside the canal, may occur.[5] As a response, intracanal calcification has also been described after RET.[6] The calcification rate was reported by 62.1% of revascularization cases with long-term follow-up.[7] At this point, success criteria become essential. The prognosis should be considered in multiple ways to perceive it as a success or a failure. The purpose of this case report is to present an 8-year successful survival history of a seemingly inadequate MTA plug procedure.

CASE REPORT

A private practitioner referred a 9-year-old boy to the Department of Pediatric Dentistry for symptomatic maxillary

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left central incisor with a complaint of pain. A detailed history was taken from the patient's family, and no significant medical history was recorded.

The extraoral examination revealed no signs or symptoms, but tooth #21 had a crown fracture. The intraoral evaluation showed that the tooth was tender to percussion, and there was no palpation sensitivity, mobility, sinus tract, or swelling. The intraoral radiographs were taken. The radiographic evaluation revealed a periapical lesion and absence of lamina dura at the apical portion of tooth #21. Besides, it was observed that the root formation of the tooth was incomplete. The tooth demonstrated no response to the electric pulp test, whilst a positive response was recorded for teeth #12, #11, and #22. The treatment plan included an apical plug with MTA and a follow-up of the immature necrotic tooth. The treatment plan was told to the patient's family. Parents read the information and give consent for the child's treatment.

Following anesthesia, the tooth was isolated with rubber dam. The access cavity was prepared. The working length was determined using an electronic apex locator (Root ZX Mini, J. Morita, Tokyo, Japan), and confirmed radiographically [Figure 1a]. The working length was calculated as 1 mm short of the electronic and radiographic determination. The canal was instrumented gently with hand files to remove possible necrotic remnant tissue on dentinal walls. During instrumentation and cleaning procedures, the root canal was irrigated with 2.5% sodium hypochlorite. The canal was dried with sterile paper points and dressed with calcium hydroxide (Metapaste; Meta Biomed Co, Ltd, Chungbuk, Korea). The access cavity was sealed with temporary filling material (Cavit, 3M ESPE, Germany), and a second appointment was scheduled for 2 weeks later.

The tooth was asymptomatic until the second appointment, and the temporary filling was intact. The temporary filling and calcium hydroxide were removed. The final irrigation was performed with 2.5% sodium hypochlorite, 17% EDTA for 1 min to remove the smear layer. At the last step of the final flush, NaOCl did not use since dentinal erosion is more evident when irrigation with EDTA is followed by NaOCl, the root canal was rinsed with distilled water. All irrigation procedures were performed without pressure to prevent apical extrusion of solutions. The root canal was dried with sterile paper points, and white MTA (Angelus, Londrina, PR, Brazil) was prepared according to the manufacturer's instructions. The apical plug was planned of approximately 4-mm thickness at the working length, but MTA did not reach the apical portion of the tooth, and radiographically successful compact filling could not be obtained as planned. It was decided to follow-up due to the absence of symptoms between appointments, material biocompatibility, and removal difficulty. A wet cotton pallet was placed for 2 days. The canal was obturated with a resin-based root canal sealer (Dentsply/DeTrey, Konstanz, Germany), and gutta-percha cones using cold lateral compaction. The pulp chamber was cleaned to remove the excess of gutta-percha and sealer [Figure 1b]. At the further visit, the gutta-percha removed with gates glidden, and fiber-post was placed. After selective etching to the enamel, dentin-bonding agent (Scotchbond Multi-Purpose, 3M ESPE, 3M Dental Products, St. Paul, MN, USA) was applied, and the tooth was restored with composite resin (Filtek™ Z250, 3M ESPE, 3M Dental Products, St. Paul, MN, USA).

The patient was reviewed at a-month and every 3 months until 1 year expired, then once a year until today after the treatment procedure [Figure 1]. Periapical healing could be observed radiographically from the 6-month follow-up appointment [Figure 1c]. It was observed that the apical region was closing in the 18th month [Figure 1d], and the barrier was formed entirely in the 4th year follow-up [Figure 1e]. Core and coronal restorations were performed again due to the filling compatibility deterioration. Although radiographically, there was a gap between the MTA

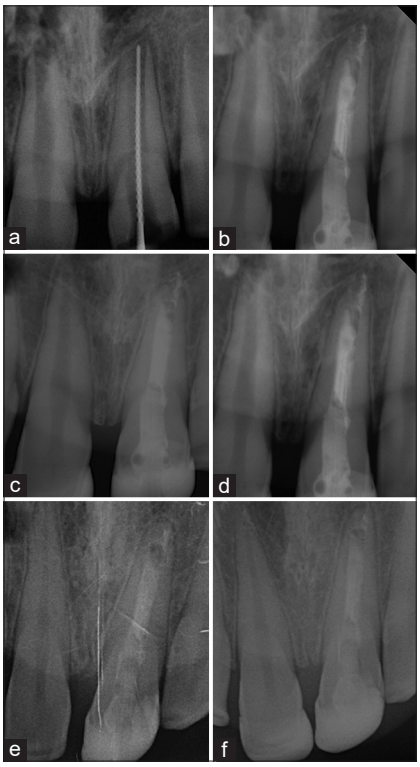

Figure 1: (a) Radiographic determination of the working length. (b) Postoperative radiograph after root canal obturation. (c-f) Postoperative radiograph after treatment at 6-months, 18-months, 4- and 8-years recall

and the apical barrier, it was noticed that it was decreased over time in the 8th year. The lamina dura was healthy, and no clinical symptoms were observed during the entire 8-year follow-up period [Figure 1f].

DISCUSSION

Management of an immature permanent tooth has revealed different clinical protocols.[2-4] All of the treatment options have advantages and disadvantages compared to each other.[8,9] The American Association of Endodontists (AAE) suggested different treatment protocols for immature permanent teeth at different root development stages.[9] In the present case report, the tooth was at stage 4 based on Cvek's root development classification. According to the AAE, the immature permanent tooth at stage 4 protocol was MTA apical plug or RET. The apical plug technique was preferred as appropriate management for this patient, considering the patient's clinical cooperation and the postendodontic restoration of the tooth.

Clinical management is always challenging in pediatric patients. It may sometimes lead to deviations in the planned treatment procedure, mainly because MTA manipulation is a clinical application that requires skill and experience.

According to the 8-year follow-up results, it can be concluded that the incomplete placement of MTA did not suppress the periapical healing and hard tissue formation. When the literature was evaluated, there were some studies about extrusion of MTA in the apical plug technique, however, no evidence and clinical outcome was found about placement at the apical region's coronal level.[10,11]

Kahler *et al*.[12] published a case report of an 8-year follow-up of two teeth treated with RET procedure. The treatment protocol applied to the teeth was different from the present case. A triple antibiotic paste was applied to the immature permanent teeth, and apical bleeding was achieved. In the present case, routine endodontic treatment, irrigation, and medication procedures were used. However, during 8 years, similar radiographic development of the root was observed with the case report of Kahler *et al*. At the end of 8 years, calcification was observed at the empty root canal in all cases.

Song *et al*.[7] described calcification after RET as more prevalent when apical bleeding was achieved (69.6%) than with cases without bleeding (33.4%). The calcification was also higher in cases with calcium hydroxide medication (76.9%) than antibiotic paste medication (46.2%). In the present case report, since the MTA plug was planned, no bleeding was created in the apical region, and triple antibiotic paste was not applied. The tooth was medicated with calcium hydroxide for 2 weeks.

In the present case, maturation and healing may be explained by the fact that a regenerative process had occurred in the apical region where the gap remained because the apical pathology of the tooth was at the initial level. The lesion was noticed before it progressed. Hertwig's epithelial root sheath (HERS) probably did not suffer major damage. As is known, the health status of HERS is important for the continuity of root development.[13,14]

All treatment goals, such as eliminating clinical symptoms/signs of infection, apical periodontitis healing, healthy lamina dura, and further root maturation, were achieved in the presented report. Besides, a formation was observed in an 8-year recall similar to regeneration-associated intracanal calcification. Irrigation protocol, calcium hydroxide medication, emplacing impermeable MTA, and the patient's immune response may have been sufficient to eradicate bacterial colonization in the root canal and for the hard tissue formation.

CONCLUSION

Procedural differences and incidents do occur during treatment due to the degree of difficulty. However, the treatment prognosis can be successful when the appropriate treatment protocol is selected according to the case, and the biological steps are applied correctly. For regeneration, success also may be achieved without apical bleeding in appropriate circumstances. There is no way to clinically understand how the healing process occurred in the area histologically, but an 8-year follow-up showed that the relevant tooth meets the healing criteria.

Acknowledgments

The authors deny any conflicts of interest related to this study.

Declaration of patient consent

The authors certify that they had obtained all appropriate patient consent forms. In the form, the patients family have given their consent for the images and other clinical information to be reported in the journal. The patients family understand that name and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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