Nonsurgical management of an extensive endodontic lesion in an orthodontic patient by calcium-enriched mixture apical plug

Saeed Asgary, Mahta Fazlyab[1]

Abstract

Periapical lesion is a general term used to describe the periapical inflammatory process that occurs in response to the invasion of micro-organisms in the root canal system as well as inflamed vital pulp. This phenomenon necessitates endodontic intervention and if the necrosis has occurred prior to tooth maturation, wide patency of the apical foramen requires some treatment modalities such as apexification or apical plug. Orthodontic treatment, on the other hand, is cautiously done for previously traumatized teeth due to increased risk for necrosis of the compromised tooth. This article tends to review the successful treatment process with calcium-enriched mixture (CEM) cement apical plug for an immature previously traumatized incisor tooth with an extensive periapical lesion, which was under orthodontic treatment as well.

Keywords: Apical periodontitis, apical plug, calcium-enriched mixture, CEM cement, open apex, orthodontic treatment, pulp necrosis

Introduction

Diagnosis, treatment planning, and treatment monitoring in endodontics, depend to a large scale on finding the true etiologic factor(s) of the current disease. The goal of endodontic treatment is to prevent and when required, to cure apical periodontitis (AP).[1] Like other diseases, AP can be resolved only if the etiological factor is eliminated or at least disabled.[1,2] As a basic rational, egress of microorganisms or their byproducts from the necrotic root canal system or the extension of pulp inflammation, are the main etiologies of AP.[2,3] In cases of a periapical lesion of a nonvital tooth, nonsurgical orthograde endodontic treatment is suggested. However, in some cases, despite root canal treatment, the AP persists, and the endodontic treatment is considered a failure which necessities apical surgery.[2] While root canal therapy is an attempt to exclude the irritants from the root canal system, in root-end surgery the theory is to attempt to confine them within the canal boundaries.[4]

A serious consequence of traumatic injuries of teeth with immature root formation is the contusion of the apical part of the pulp and severance of pulpal blood supply,[5] which can result in pulp necrosis, especially if the possibility of pulp revascularization is unlikely.[6] Anachoresis through the apical foramen and bacterial contamination of the periodontal ligament (PDL) appear to be the source of infection of the compromised pulp.[7] In cases of asymptomatic untreated pulp infection, occurrence of AP is inevitable which is frequently symptom-free and discovered primarily by the radiographic appearance.[8] On the other hand, the number of patients demanding for orthodontic treatment with history of traumatic injuries cannot be underestimated.[9] It is strongly emphasized that orthodontic treatment of previously traumatized vital teeth, especially in maxillary incisors, can lead to pulp necrosis and in case of already necrotic pulp associated with AP, it can worsen the situation.[9-12]

In cases of immature nonvital teeth, one-visit apexification has been defined as the nonsurgical placement of an endodontic biomaterial into the apical part of the root canal. As a result an artificial apical stop is created against which the obturation material can be condensed.[13] Many biomaterials with good sealing ability have been proposed for this treatment, with mineral trioxide aggregate (MTA) being the most frequent one.[14] Calcium-enriched mixture (CEM) cement has been introduced as a hydrophilic tooth-colored biomaterial with favorable sealing ability.[14] It is shown that PDL regeneration, cementogenesis, and dentinogenesis occur in contact with this biomaterial, like MTA.[14,15]

This article represents a report of a treatment case in an orthodontic patient with a large periapical lesion in anterior

Iranian Center for Endodontic Research (ICER),
[1]Dental Research Center, Research Institute of Dental Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Correspondence: Dr. Mahta Fazlyab,
Dental Research Center, Research Institute of Dental Sciences,
Shahid Beheshti University of Medical Sciences, Tehran,
Iran Postal Code 1983963113
E-mail: dr.mfazlyab@gmail.com

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segment of maxilla, which was diagnosed to be related to a necrotized immature tooth that had been traumatized before. It tends to review the etiology and treatment planning according to patient's history.

Case Report

A 16-year-old male patient was referred by his orthodontist with main chief complaint being a dull pain sensation in the upper maxillary region. According to his parents, his upper left central incisor (i.e., tooth no. 21) had been slightly discolored after a trauma during bicycle riding at the age of nine. His orthodontic treatment had started 2 months before referral and he had been experiencing this dull pain for the last 2 weeks.

On clinical evaluation, the periradicular region of the upper left central incisor was tender on palpation. An orthoradial periapical radiograph revealed a periapical lesion with its epicenter being the apical foramen of the tooth no. 21 [Figure 1a]. The extent of the lesion was ~10 × 13 mm. The tooth was nonresponsive to vitality tests using cold as well as electric pulp testing (Vitality Scanner, Model 2006, Analytic Technology, Redmond, WA).

According to patients medical and dental history a presumptive diagnosis of pulp necrosis of traumatic origin associated with extensive AP was established. Considering the history of trauma and the apical size of the canal in tooth no. 21, which was assessed to be ~1 mm and taking into account the fact that for a tooth to be labeled as mature, the size of apical foramen needs to be less than 1 mm wide in direct periapical radiographs,[16] it was assumed that the process of apical closure had ceased prior to tooth maturation, due to pulp necrosis. In other words, the necrotic pulp was a consequence of previous traumatic injury. This phenomenon was independent of orthodontic treatment and could be cured without having to unload the tooth. The treatment plan consisted of single-visit orthograde endodontic intervention and placement of an apical plug. The patient's parents signed an informed consent regarding the treatment strategy.

On a subsequent visit, after local anesthesia with 2% lidocaine containing epinephrine 1:80000 (DarouPakhsh, Teharn, Iran), the root canal therapy was done using the RaCe rotary files (RaCe, FKG Dentaire SA, Switzerland) to # 50/0.04 with simultaneous 5.25% NaOCl irrigation. Then the canal was dried using paper points (Ariadent, Tehran, Iran). CEM cement powder and liquid (BioniqueDent, Tehran, Iran) were mixed according to the manufacturer's instructions and a ~5 mm plug was placed in the apical area of the canal. The opacity and length of the plug was confirmed with a periapical radiograph, a prefabricated metal post was cemented in the canal and the tooth was restored using composite resin (Herculite Ultra Flow and OptiBond Solo, Kerr, Orange, CA) [Figure 1b]. The patient was put on a regular follow-up plan. By the end of the 1st week all the symptoms faded away; the 4 month postoperative radiograph revealed the incomplete bone replacement process starting from the periphery of the lesion, as the sign of healing [Figure 1c] and progressed to the 7th month [Figure 1d]. [Figure 1e], shows the 2-year follow-up radiograph which shows the complete bone healing. An outstanding finding beyond the apical end of the CEM plug was the increase in root length, which was radiographically visible from the 3th month; and was also surrounded by PDL in the final cliché [Figure 1e].

Discussion

This case report represented the treatment challenges of an exacerbated large periapical lesion in a maxillary left incisor due to orthodontic load, the etiology of which was assumed to be a previous trauma. The treatment was

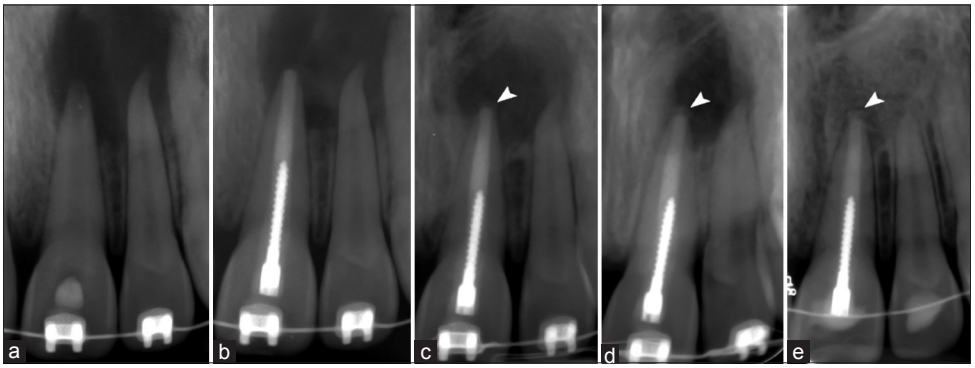

Figure 1: (a) Pretreatment radiograph; note the extensive lesion around the apex of tooth no. 21, also consider the 1 mm wide apical foramen and the otherwise healthy crown. (b) The posttreatment radiograph showing the ~5 mm calcium-enriched mixture (CEM) plug and the restoration of the tooth. (c) 4-month radiography indicating the bone healing process starting from the periphery of the lesion toward the center. Note the hard tissue formation in contact with CEM (white arrowhead). (d) seven-month radiograph still indicates the progression of bone healing and a slight increase in root length (white arrowhead). (e) two-year follow-up; the lesion has perfectly healed and the new hard tissue in the most apical part of the root, beyond the CEM plug is surrounded by periodontal ligament (white arrowhead)

based on a single-visit root canal therapy with emphasis on reduction of bacterial load as well as establishment of a three-dimensional seal using CEM apical plug. Nonsurgical endodontic treatment was conducted simultaneous with orthodontic treatment. The 24-month follow-up revealed not only the perfect bone healing, but also a slight increase in root length, beyond the CEM plug.

Typically, from a histological point of view, the radiolucent periapical lesions of endodontic origin can be granuloma or to a lesser incidence, cysts.[2,17] Traditionally, lesions larger than 10 mm were considered cysts; and many clinicians held the view that all cysts do not heal by nonsurgical root canal therapy.[18] It should be pointed out with emphasis that based on radiographs, apical lesions cannot be differentially diagnosed into cystic and noncystic lesions.[2] In 1998, Nair made it clear that "there are cysts and cysts".[19] He pointed out two distinct categories of radicular cysts, namely those containing cavities completely enclosed in epithelial lining (true cysts) and those containing epithelium-lined cavities that are open to the root canals (bay/pocket cysts).[17,19-21] It is also stated that bay cysts tend to response to nonsurgical endodontic intervention, while those few cysts categorized as true, have to be surgically removed.[17,19] Strong evidences suggest that subsequent to removal of etiologic factors, immunological system contributes to the breakdown of epithelial cyst linings.[17,19,21]

The low prevalence of true cysts (<10%)[20,22] and the favorable potential outcome of root canal treatment, with AP prevented or resolved in ~80% of treated teeth[2,22] are significant considerations in clinical management of apical lesions.[17,21,22] In other words, the majority of apical lesions whether cysts or granuloma heal without surgery; only those few lesions that may be true cysts in histology need surgery.[5] Nonsurgical approach in cases of AP is the first treatment option, based on the current concept of treatment decision making;[23] and in case of persistent symptoms the surgical removal of the lesion is considered as the next step.[19,20,22] The treatment outcome for this patient, confirms this statement that although the lesion responded favorably to nonsurgical treatment, the possibility for surgical intervention was kept in mind in case it did not.

The treatment plan was scheduled to be single-visit with effective canal disinfection, without ceasing the orthodontic load. Current evidence indicates the nonsuperiority of single- or multiple-visit root canal treatment in cases of artificial apical stop (i.e., Apical plug).[14] The success of treatment for this case was based on appropriate asepsis and filling of the root canal, without increasing the chair-side treatment sessions and thus the chances of canal re-infection.[24] Moreover, although orthodontic treatment for vital teeth with history of trauma can lead to pulp necrosis,[12] in this case the size of apical foramen revealed the occurrence of tooth necrosis to be before root maturation and thus there was no need to unload the tooth.

During the posttreatment follow-up, in the absence of symptoms, if radiographs still suggest the same disease, this should not be considered a satisfactory outcome.[1,5] In other words, even after a 1-year posttreatment follow-up the lesion may decrease in size, probably due to initial decrease in the irritants within the canal, but it still might be radiographically detectable which is interpreted as treatment outcome being unfavorable.[1] Nonendodontic disease, true apical cysts,[2] and healing in progress,[25] should all be carefully considered as a differential diagnosis, the latter putting an emphasis on importance of pulp vitality testing prior to conducting root canal therapy. In this regard, the case history is reviewed, noting previous radiographs and the time elapsed since previous treatment (to recognize healing in progress and thus avoid premature diagnosis).[25] For the presented case the 2-year follow-up revealed the complete healing of the lesion.

Last but not least, is the increased root length in this case, which started 4 months posttreatment. In an animal study, cementum formation was reported in contact with MTA and CEM cement and over the dentinal surface of the resected root ends in all samples which showed entrapped cementoblasts and insertion of PDL fibers.[15] The hard-tissue inducing ability of CEM is proved in many articles.[15,26] This phenomenon can be due to its sealing ability,[27] biocompatibility,[28,29] high alkalinity,[30] and antibacterial effect.[31] In the current case, it can be assumed that the increase in root length beyond the CEM plug, which was surrounded by PDL [Figure 1e], may be due to new cementum formation.

Conclusion

When used as an apical barrier, CEM cement shows desirable properties in terms of induction of hard tissue formation. Whatever the nature of the apical lesion, in the current case, nonsurgical root canal therapy was favorably able to heal the large lesion. If the orthodontic treatment is not the cause of AP, its continuing has no interference with the endodontic treatment.

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