Regenerative endodontic treatment (revascularization) for necrotic immature premolar

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ABSTRACT

Regenerative endodontic treatment may encourage continued root development and thus, is a suggested alternative technique for management of traumatized immature permanent teeth with pulp necrosis. On the other hand, ideal treatment method for necrotic immature premolar teeth has not yet been determined. Therefore, present article describes cases of successful revascularization in necrotic immature premolar, which had a lateral luxation injury from attempted extraction of wrong tooth by undergraduate dental student. The displaced tooth was manually repositioned and splinted to the neighboring teeth for 4 weeks using a semi-rigid splint. Two month after the traumatic injury, the next control was made, and the premolar was defined as necrotic and discoloration in the tooth was identified. The patient reported sensitivity to palpation and discomfort upon percussion. Revascularization therapy was performed over multiple appointments. Coverage over the access was intact and radiographic examination revealed the apexes appeared to be closing during subsequent visits over 24-month. The tooth had no mobility, no pain on percussion or palpation, and positive reaction to the cold test, during the recall period. In addition, the lamina dura and periodontal ligament were within normal limits at 24-month after the first intervention for revascularization treatment. The favorable results in this case of necrotic immature tooth show that regenerative endodontic treatment is a viable alternative to apexification or artificial apical barrier techniques for traumatized premolar teeth.

Key words: Immature teeth, Necrotic pulp, Premolar teeth, Revascularization

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INTRODUCTION

Treatment of an immature tooth with a necrotic root canal system and an incompletely developed root is a significantly challenge. Traditionally, management of endodontic treatment of permanent teeth with open apices has been achieved in the past by multiple-visit apexification procedures using calcium hydroxide. This treatment approach, however, requires long-term placement of calcium hydroxide inside the root canal to induce the formation of an apical hard tissue barrier.[1] In addition, with this technique, apical closure is unpredictable, and the tooth is susceptible to root fracture after long-term exposure to calcium hydroxide.[2] To overcome the disadvantages of the traditional calcium hydroxide ($Ca(OH)_2$)-based apexification procedure, this technique has been modified by the introduction of an artificial apical barrier using mineral trioxide aggregate (MTA). In this modified technique, the MTA can be placed as an apical plug with calcium hydroxide[3,4] or even as a root canal obturation material.[5] Although, obturation of open apices with MTA plugs significantly decreases treatment time and results in favorable healing of periradicular tissues, MTA plugs cannot stimulate physiologic apical closure and thickening of the radicular dentin, leaving the tooth's structural integrity compromised.

Revascularization is an emerging regenerative endodontic treatment approach that aims to allow continuation of root development.[6] Because periapical tissues around immature teeth have a rich blood supply and contain stem cells that have relative potential to regenerate in response to tissue injury,[7] revascularization of young permanent teeth is possible after necrosis.[8]

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After the root canal disinfection with sodium hypochlorite irrigation and antibiotic paste consisting of ciprofloxacin, metronidazole, and minocycline,[9] or $Ca(OH)_2$ therapy procedure, apical bleeding is induced to form a blood clot under the cemento-enamel junction (CEJ). The root canal hole is then covered with MTA. Finally, the crown is restored permanently. There is strong evidence in the literature to support the success of the revascularization procedure, with increased root length, thickening of the root walls, and desirable apical closure.[10-13]

This article describes a case of successful revascularization in necrotic immature premolar, which had a lateral luxation injury.

CASE REPORT

A health 9-year-old boy was referred to the Pediatric Dental Clinic of the Faculty of Dentistry, Erciyes University, Kayseri, Turkey, 30 min after a traumatic injury involving her permanent maxillary left second premolar from attempted extraction of wrong teeth by undergraduate dental student. Upon clinical and radiographic examination, the left premolar had an open apex and they showed lateral luxation. In radiographic examination, there was no fracture of the tooth [Figure 1]. The displaced tooth was manually repositioned and splinted to the neighboring teeth for 4 weeks using a semi-rigid splint. At the second appointment 1-month later, the flexible splint was removed. Two month after the traumatic injury, the next control was made, and nonresponsive to vitality testing with Endo Ice (Coltene Whaledent, Mahwah, N.J., USA) and Vitality Scanner (SybronEndo, Orange, Ca., USA) and discoloration was identified. The patient reported sensitivity to palpation and discomfort upon percussion. The tooth was treated with a revascularization protocol using 4% sodium hypochlorite irrigation followed by spontaneous repositioning and was dried with sterile paper points (Dentsply, Tulsa, Okla., USA). No instrumentation of the canal was performed. $Ca(OH)_2$ powder (Kalsin, Kalsin, Turkey) was mixed with sterile saline in a 3:1 ratio. The mixture was inserted into the pulp chamber and loosely packed into the coronal portion of the root canal with moist cotton pellets. Later, the access cavity was covered with temporary restorative material (Cavit, 3M ESPE, Seefeld, Germany). The patient was recalled 3 weeks later, for evaluation of the intra-canal medication.

After 3 weeks, the tooth was asymptomatic. It was anesthetized using 2% mepivacaine (Citanest, AstraZeneca, UK) without a vasoconstrictor, isolated with a rubber dam, and reaccessed. The $Ca(OH)_2$ paste was removed with copious 4% NaOCl irrigation, and the root canals received final irrigation with 10 ml sterile saline, and then were dried. Apical bleeding was induced by gentle irritation using size 20 K-files. The blood was allowed to reach the level of the CEJ, where a blood clot was formed. MTA (Pro-Root MTA, Dentsply, Tulsa, Okla., USA) was mixed with distilled water and placed over the clot. The access opening was restored permanently with amalgam (Cavex Avalloy; Cavex BV, Haarlem, Netherlands).

In the 3-month follow-up appointment after the regeneration procedure, the patient was still asymptomatic. Coverage over the access was intact and radiographic examination revealed the apex appeared to be closing during subsequent visits over 24-month for maxillary left second premolar [Figures 2-5]. The tooth had no mobility, no pain on percussion or palpation, and positive reaction to the cold test. In addition, the lamina dura and periodontal ligament were within the normal limits at 24-month after the first intervention for revascularization treatment.

DISCUSSION

Lateral luxations in permanent premolars are very rare events. According to traditional treatment approach for

Figure 1: Radiographic view teeth of necrotic immature premolar

Figure 2: Mineral trioxide aggregate barrier placement at the cervical level after the blood clot was formed

Figure 3: Radiographic view of at 9-month follow-up

Figure 4: Radiographic view of at 15-month follow-up

Figure 5: The apex of left maxillary second premolar appeared to be closing at 24-month follow-up

luxation injuries, the injured tooth should be repositioned into its original location and stabilized with a flexible splint for 4 weeks. The pulpal condition should be monitored, and if the pulp becomes necrotic, a root canal treatment (with apexification) is indicated.[14]

Regenerative endodontic treatment may encourage continued root development and thus, is a suggested alternative technique for management of traumatized immature permanent teeth with pulp necrosis.[11,15] The main advantages of revascularization technique over the traditional apexification or artificial barrier technique in endodontic treatment of immature necrotic teeth include continuation of root development and strengthening the root structure.[6] Anatomical complexities in multirooted teeth make using the traditional techniques more difficult, and in some cases it is impractical.

Although, several case presentations and retrospective studies have reported the outcome of regenerative endodontic treatment on immature incisors, there is still no information available on immature necrotic premolar teeth treated with the revascularization protocol. In this case, we decided to use revascularization treatment instead of apexification with calcium hydroxide or artificial barrier technique because of the potential to gain the benefits of root development.

It is recommend that, during the revascularization therapy, infected root canals should be treated as conservatively as possible.[6,12] In the standard protocol, a root canal is irrigated with 2.5-5.25% NaOCl, and no instrumentation is applied. After canal disinfection, medicament is inserted into the root canal and is removed after 3-4 weeks. Although, previous studies have reported successful use of a triple antibiotic paste to eliminate infection in root canals of open apices teeth with apical periodontitis,[15] the antibiotic paste is not commonly used due to esthetic concerns, as the paste causes minocycline-induced tooth discoloration.[16]

It is reported that $Ca(OH)_2$ presents similar findings in terms of disinfection when used as an intra-coronal agent compared with triple antibiotic paste, and it also contributes to a significant increase in root length and wall thickness.[10] In the present clinical report, the tooth was asymptomatic after treatment with $Ca(OH)_2$: Root development continued, and symptoms of infection were absent at 24-month. In a long-term study, however, Chueh *et al*.[8] have reported that $Ca(OH)_2$ commonly caused progressive calcification of the root canal space when it was used as an intra-canal medicament in teeth, suggesting that root development induced by regenerative endodontic treatment may not follow a natural pattern. Although, there is no sign of root canal obliteration in the present case, the progressive periapical lesion occurred in the long-term.

The favorable results in this case show that regenerative endodontic treatment of pulpally involved traumatized necrotic immature tooth is a viable alternative to apexification or artificial apical barrier techniques, for permanent premolar teeth. However, more studies with longer follow-up should be

made to determine whether regenerative treatment is suitable for necrotic premolar teeth.

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