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An interesting healing outcome of a replanted immature permanent tooth: a case report

CASE REPORT

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Abstract – A case of an avulsed upper left central incisor that was replanted after 3 h in a 7-year-old girl is presented. The tooth showed signs of an acute periapical abscess at 2 weeks after replantation. Apexification with mineral trioxide aggregate (MTA) following application of calcium hydroxide was attempted. At 3-year and 6-month follow-up, the tooth was asymptomatic with adequate clinical function. The radiograph showed resolution of the periapical lesion and apparent radiopaque tissue under MTA plug resembling root end morphology.

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Tooth avulsion implies total displacement of a tooth from its socket and represents 0.5–16% of traumatic injuries in the permanent dentition (1). The maxillary central incisors in children between 7 and 10 years of age are most frequently involved in avulsion (2). Tooth avulsion results in attachment and pulpal damage.

When a dental pulp becomes necrotic before completion of root development, the canal remains large with thin and fragile walls, and with the divergent apex. These features make instrumentation of the canal difficult and compromise the formation of an adequate apical stop for optimal seal of the root canal (3). In such cases, bacteria must be eliminated from the canal and apexification treatment must be initiated to create an environment conductive to production of mineralized tissue barrier or root-end formation (4). Calcium hydroxide had been commonly used for this purpose. In recent days, however, mineral trioxide aggregate (MTA) has taken the place because of its good physical and biologic properties. The aim of this study is to report an interesting apexification outcome of a replanted tooth that closely resembled normal root morphology.

Case report

A healthy 7-year-old girl was referred to the clinic for following treatment after injuring her anterior teeth. Her upper left central incisor had been avulsed after hitting the tree and 3 h later she had visited the emergency clinic of Asan medical center. Fortunately, the avulsed tooth remained in the child's mouth, so her parents had her spit it out into a disposable paper cup. On arrival at the hospital, the tooth was inspected and found to be intact and clean. It was covered with saliva that was barely enough to prevent complete dryness of the tooth. The tooth was immediately placed in saline, while a systemic history and personal information were obtained. Replantation was then carried out under local anesthesia, after tooth and the socket were gently washed with saline. A splint was then applied using 0.028″ round orthodontic wire and composite resin (Fig. 1). Amoxicillin was prescribed for a week. All the procedures were carried out by a dental intern at the emergency clinic.

Two weeks after replantation, the patient presented with swelling above the tooth. The replanted tooth showed marked tenderness to percussion. A diagnosis of an acute periapical abscess was made. The splint was removed. After the application of the rubber dam and access cavity preparation, the necrotic pulp was removed and a working length was obtained. The canal was instrumented and cleaned using K files under irrigation with 1% sodium hypochlorite (NaOCl), dried with sterile paper points, and then packed with calcium hydroxide dressing material (Calcipex; Nishika, Shimonoseki, Japan).

After a month, the tooth was comfortable and showed no untoward signs and symptoms. A decision was therefore, made to perform apxification with MTA. The calcium hydroxide was removed by rinsing with 1% NaOCl. The canal was dried with sterile paper points and a MTA plug was placed at the apex. The MTA mixture (ProoRoot MTA; Dentsply, Tulsa, OK, USA)

Fig. 1. Initial periapical radiograph revealing a replanted upper left central incisor with incomplete root formation.

Fig. 2. Mineral trioxide aggregate apical plug placed under rubber dam.

was used exactly according to the manufacturer's instructions. It was inserted with a small amalgam carrier to the canal and adapted to the canal walls using a manual plugger. Radiographic control was performed to check the correct position of the apical plug (Fig. 2). The MTA plug was placed in the apical 4–5 mm. A wet cotton pellet with sterile water was placed in the pulp chamber, and the access cavity was closed with Cavit. The cotton pellet and Cavit were removed a week later. After establishing that the MTA had set satisfactorily,

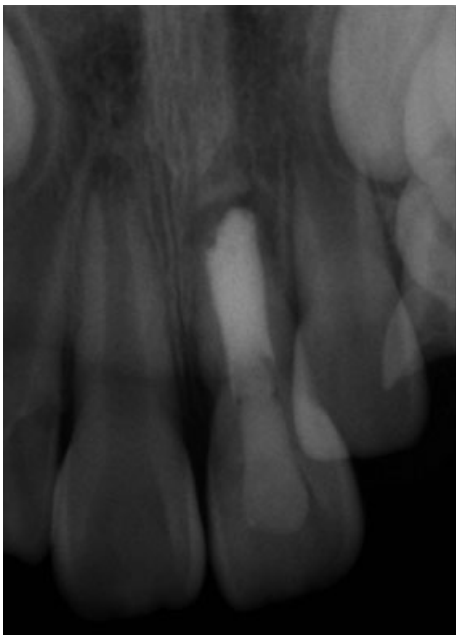

Fig. 3. One-month follow-up periapical radiograph showing apical rarefaction and some radiopaque tissue formed under mineral trioxide aggregate plug of maxillary left central incisor.

the rest of the canal was obturated with warm gutta-percha using Obtura applied with a canal sealer AH26. The crown was subsequently restored with a hybrid composite resin (Z350;3M ESPE, St. Paul, MN, USA).

Since then the patient has been recalled periodically for three and a half years. Clinically, the tooth revealed adequate clinical function with absence of adverse symptoms such as spontaneous or stimulated pain, swelling, and sinus tract. The radiographic follow-up at a month (Fig. 3) revealed decrease of the periapical rarefaction and some hard-tissue formation under MTA. At 6 months, the periapical radiolucency still remained but distinguishable radiopaque tissue appeared under MTA plug resembling a root tip (Fig. 4). The follow-up radiographs taken at 2 years (Fig. 5) and three and a half years (Fig. 6) consistently disclosed more resolved radiolucency and apparent hard tissue that resembled normal root end morphologically.

Discussion

Successful apexification depends on the formation of hard tissue at the apex by cells that differentiate under the specific signals to become cells capable of secreting cementum or osteodentin organic matrix (5). While the goal of apexification is such a stimulation of apical barrier formation, in the belief that continued root formation cannot occur, there are a number of reports of continued apical development in spite of the necrotic pulp (6–8). Greer (9) even reported a case in which the root was developed when the tooth was not replanted after avulsion. In those cases, Hertwig's epithelial root sheath has been suggested to play an important role. Hertwig's epithelial root sheath is known to be responsible for the development of the root and very resistant

Fig. 4. Six-month follow-up periapical radiograph showing distinguishable hard tissue under mineral trioxide aggregate plug resembling a root tip.

Fig. 5. Two-year follow-up.

that the sheath may remain vital even after treatment of complete pulpal necrosis (10). Cooke and Rowbotham (11) suggested that the remnants of Hertwig's epithelial root sheath of a non-vital tooth may organize the apical mesodermal tissue into root components under favorable conditions and advised avoidance of trauma to the tissue around the apex. In this case, it may be speculated that the Hertwig's epithelial root sheath was left behind when the tooth was avulsed and continued developing separate from the tooth after replantation.

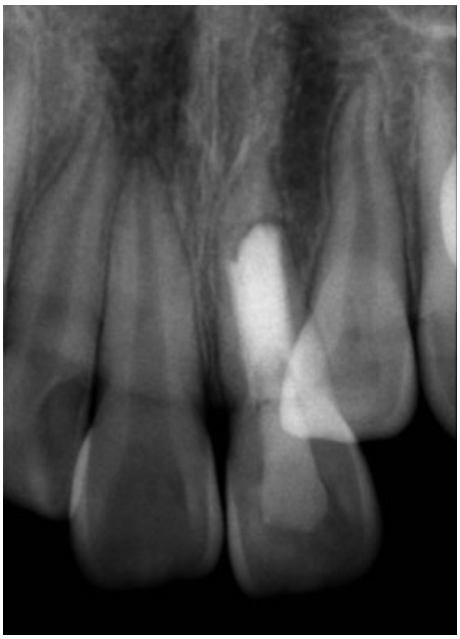

Fig. 6. Three-year and six-month follow-up periapical radiograph showing more resolution of radiolucency and apparent hard tissue under mineral trioxide aggregate plug.

Because the root developed in this case had not been evaluated histologically, and radiographic finding suggested its discontinuance with the original root, its role and significance in maintenance of the tooth itself may be questionable. Yang (8) extracted a tooth that showed continued root formation after apexification and examined the root histologically. The author reported that the newly developed root consisted of hard tissues appearing like osteodentin, immature cementum, or immature bone. Gibson (12), on the other hand, reported that such extracted root fragment revealed a confusing picture of disturbed dentinogenesis, resorption, and repair, and suggested it to be something akin to pulp stone. Although it was not possible to evaluate the root histologically in the present case, further research in the future regarding the histology of such developed root would provide greater clarity on mechanism and significance of continued root formation.

Length of extra-alveolar duration and type of storage are both critical factors that can affect long-term prognosis of replanted teeth (13). In this case, the extraoral time of the tooth was 3 h, but complete dryness of the tooth surface was prevented as the patient expectorated saliva onto it. It has been shown that death of periodontal ligament (PDL) cells could be delayed by storage in saliva (14). *In vitro* and *in vivo* studies have, however, reported that the vitality of PDL cells is maintained upon 30-min immersion in saliva but decreases remarkably after 60 min (13–15). Nevertheless, despite the long extraoral time in the case presented in this study, maintenance of root integrity, an intact lamina dura, and an absence of abnormal mobility and resorption was observed even after 3 years and 6 months of replantation. Thus, it has to be assumed that the patients' actions in trying to keep the tooth moist with

saliva contributed to the favorable prognosis. Moreover, immersing the tooth in saline prior to replantation for elimination of cell lysis products on root surface as well as debris and bacteria from saliva and administration of systemic antibiotics might also have contributed to such favorable healing outcomes (15, 16).

The present case illustrates an unusual healing outcome of the avulsed tooth with an immature root which is most likely due to the maintenance of the viability of the cells of the root sheath attached to the avulsed tooth, or because of activation and organization of remnants of the root sheath left in the socket after the tooth was avulsed. The observed outcome is a favorable one. It should be remembered, however, that despite initial favorable soft- and hard-tissue responses, root resorption and ankylosis of replanted tooth may occur after 4 or 5 years (15). Thus, regular follow-ups and continued monitoring for a longer period are planned for this patient.

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