Pulp and Periodontal Regeneration of an Avulsed Permanent Mature Incisor Using Platelet-rich Plasma after Delayed Replantation: A 12-month Clinical Case Study

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Abstract

Numerous publications have reported revascularization of necrotic immature permanent teeth, but the regenerative potential of pulp in mature teeth has rarely been considered. Platelet-rich plasma (PRP) meets many requirements of a scaffold for regenerative endodontics. To the best of our knowledge, no clinical study has evaluated PRP for endodontic regeneration in a mature avulsed tooth. The present case evaluated PRP for pulpal regeneration in an avulsed mature incisor (>8 hours extraoral dry time) of an 11-year-old boy after delayed replantation. The canal was disinfected after extraoral access cavity preparation and pulp extirpation. The root apex was enlarged, and the tooth was placed in doxycycline solution for 20 minutes. After tooth replantation and splinting, PRP was injected up to the level of the cementoenamel junction and sealed with glass ionomer cement. The 6-month follow-up revealed evidence of internal and external root resorption with periapical radiolucency and an apparent periodontal ligament space. Access was reopened; slurry of 2 antibiotics (minocycline and metronidazole) was inserted into the canal and sealed. Nine- and 12-month radiographs revealed resolution of periapical radiolucency with no further progression of internal resorption. The tooth showed a positive response to thermal and electric pulp tests. The findings observed in this case warrant further research under controlled conditions to evaluate endodontic and periodontal regeneration in a tooth that would otherwise be expected to have an unfavorable prognosis. *(J Endod 2016;42:66–71)*

Key Words

Avulsion, children, delayed replantation, endodontic regeneration, periodontal regeneration, platelet-rich plasma

Avulsion of permanent teeth is the most serious dentoalveolar injury. In a growing child, loss of a permanent tooth leads to severe atrophy and arrests alveolar bone formation. The alveolar ridge would be narrow and difficult to restore in the future with either a bridge or implant (1). Therefore, the treatment objective in children should concentrate on preserving the alveolar bone volume.

The International Association for Dental Traumatology guidelines advocate that replantation should be performed within 60 minutes after injury to have a better prognosis. Delayed replantation (>60 minutes) has a poor long-term prognosis with an expected eventual outcome of ankylosis and resorption (2, 3). In children, delayed replantation has an upper hand over not replanting because it promotes alveolar bone growth to encapsulate the replanted tooth, preserving the alveolar bone. Esthetics, function, and psychological reasons are other benefits of replantation (4).

Current research in regenerative endodontics applies many principles from the fields of traumatology and tissue engineering; several recent case reports have been published based on this information. These case reports describe regenerative endodontic procedures applied to cases of necrotic immature permanent teeth, which offer a biologically based alternative to conventional endodontic treatment (5–9).

In an avulsed immature tooth, revascularization is the most desirable healing response because the tooth continues to grow to form strong root dentin (6). However, the regenerative potential of dental pulp, particularly in mature teeth, has been considered extremely limited, and the potential to regenerate a necrotic pulp would be the best root filling possible (10). Also, current evidence says that all attempts to revascularize an avulsed tooth should be restricted to teeth replanted within 60 minutes after injury (2, 3).

A recent innovation in dentistry is the use of platelet-rich plasma (PRP) for regenerative techniques. Growth factors derived from platelets initiate connective tissue healing, bone regeneration, and repair; promote the development of new blood vessels; and stimulate the wound healing process (11). PRP is autologous, can be made available in a dental setting, is rich in growth factors, forms a 3-dimensional fibrin matrix, and degrades over time; thus, it satisfies many requirements of a scaffold for regenerative endodontic therapy (12–16).

For the present case, we investigated the role of PRP for endodontic regeneration of an avulsed mature permanent incisor (>8 hours extra oral dry time) after delayed replantation. The special circumstances and challenges faced are discussed.

Case Report

An 11-year-old boy reported 8 hours after he lost his upper front tooth when he was hit by a car. A medical emergency unit performed soft tissue debridement and sutured a laceration on his lower lip. He was given a tetanus toxoid vaccine and referred for further dental treatment. The avulsed tooth was dry wrapped in paper.

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Extraoral examination revealed swelling and deep laceration on the left half of the lower lip with a contusion injury of the chin. A thorough intraoral examination revealed avulsion with uncomplicated fracture of tooth #9 (maxillary left central incisor) (Fig. 1*A*), intrusion of tooth #8, subluxation of teeth #7 and #10, and gingival laceration of teeth #8 and #9. The presence of trauma from dental occlusion was also noted. Clinical and radiographic examination ruled out the presence of any other dentoalveolar fractures.

Based on these findings and the patient's condition, the best possible treatment with the following objectives was planned:

1. Perform delayed replantation, which involved providing intermediate treatment to preserve alveolar bone volume.
2. Attempt pulpal regeneration using PRP, in which the regenerated tissue would act as the best root filling possible.

The pros and cons of the procedure were explained to the parents, and informed consent was obtained.

Treatment Rendered

Preparation of PRP. Three milliliters of the patient's venous blood was mixed with anticoagulant and centrifuged at 2500 rpm for 20 minutes to separate supernatant plasma (17).

Tooth Preparation. The avulsed tooth was gently debrided with wet gauze and thoroughly washed with saline to remove sand particles, debris, and blood stains. Extraoral access cavity preparation and complete pulp extirpation were performed, and the canal was disinfected using normal saline and 5.25% sodium hypochlorite (Fig. 1*B*). The root apex was enlarged to approximately 1.5–2 mm to ensure a wide apical foramen, and the tooth was placed in doxycycline solution for about 15 to 20 minutes.

Socket Preparation and Tooth Replantation. Clinical and radiographic examination confirmed an intact socket wall. Normal saline and Betadine (Win Medicare Ltd, New Delhi, India) were used for socket irrigation. The tooth (#9) was replanted, and then both teeth #8 and #9 were repositioned with slight digital pressure and stabilized with a wire and glass ionomer cement (GIC) splint (because of a shortage of time) extending up to the first molars. Under thorough isolation (a rubber dam could not be placed because of lip injury and patient's lack of cooperation), the canal was irrigated with saline and dried with paper points. PRP was injected up to the level of the cementoenamel junction, and the access cavity was sealed with GIC. These procedures were performed under local anesthesia. According to the baseline vitality (heat) test, tooth #9 was nonresponsive, #8 showed a delayed response, and #7 and #10 were responsive. Analgesics, antibiotics (doxycycline 100 mg 2× per day for 7 days) and chlorhexidine mouth rinse were prescribed, and the patient was discharged with advice to consume a soft diet and use a soft bristle tooth brush for 2 weeks.

Examination on day 13 revealed excellent soft tissue healing of the lip and gingiva with no abnormal mobility of tooth #9; the splint was removed and the crown restored with GIC (Fig. 2*A*). Clinically, the tooth remained asymptomatic during the 2- and 3-month follow-ups. The patient failed to keep up the appointments and returned with a dislodged coronal restoration at 6 months. Radiographically, evidence of internal resorption with periapical radiolucency, external root resorption, and apparent periodontal ligament (PDL) space were observed in tooth #9 (Fig. 2*B*). Clinically, the tooth was responsive to cold and electric pulp tests.

Under thorough isolation, the access was reopened in tooth #9 and local anesthesia intentionally avoided. A bloodlike field was viewed through an endomicroscope (Seiler, St Louis, MO), and the patient experienced pain on insertion of a sterile paper point to about half its length through the access cavity. On removal, the paper point was noticed to be blood stained. There were no signs of pulpal necrosis (eg, no foul odor or purulent exudates). The canal was not debrided in order to avoid disturbing any vital/vascular tissue regenerated inside the canal, and a conservative approach with an antibiotic mix to manage internal resorption was attempted. Canal debridement was planned in the event that the resorptive process was found to be progressing in subsequent visits.

Approximately ¼ of a tablet of metronidazole 400 mg (Flagyl; Nicholas Piramal India Ltd, Thane, India) and the contents of a 100-mg capsule of minocycline (Divaine; Cipla Ltd, Mumbai, India) were mixed with saline to a watery slurry consistency and inserted into the root canal with a syringe. The needle was kept just at the

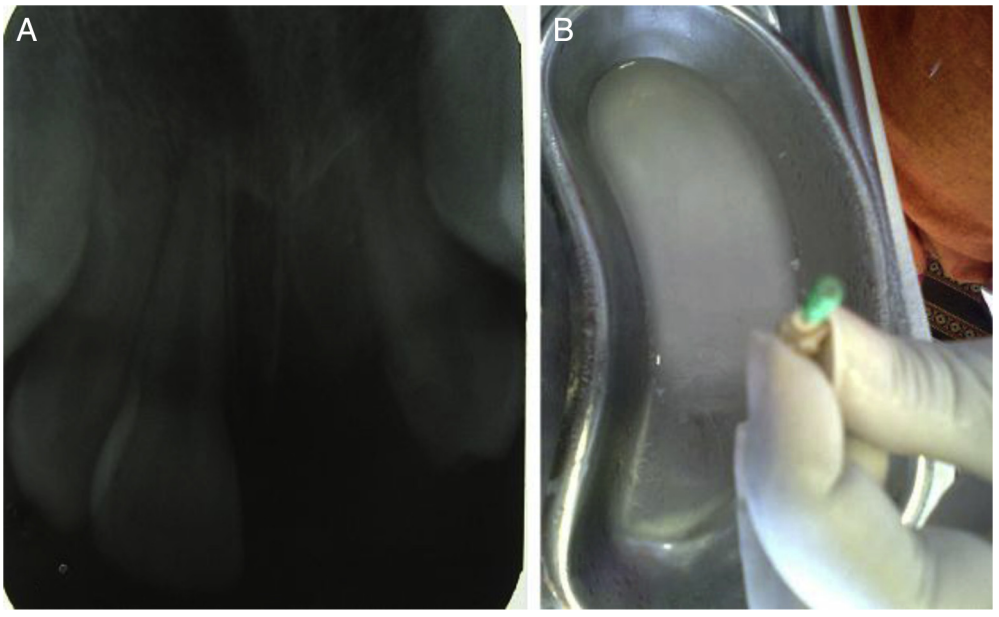

Figure 1. (*A*) A preoperative radiograph showing missing (avulsed) tooth #9. (*B*) Extraoral access cavity and complete pulp extirpation.