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Replantation of an immature permanent central incisor following pre-eruptive traumatic avulsion

CASE REPORT

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Abstract – Tooth avulsion represents 0.5–16% of traumatic injuries. Avulsion of a pre-eruptive left permanent maxillary incisor in a 6-year-old boy is presented. The immature tooth was replanted after rinsing with saline following 10 min dry extra-oral time. This case report describes treatment and a 2-year follow-up of the tooth. During the follow-up period, continuation of root development, pulp revascularization, and irregular dentin formation were demonstrated. The tooth is vital, functional, and esthetic. To the best of our knowledge, no such case of replantation of a pre-eruptive tooth has been reported previously.

Traumatic injury to the anterior maxillary incisors is a frequent finding in children aged 8–10 years, during early mixed dentition. This is also a period of incomplete root development and dynamic jaw growth. Etiological factors include falls, automobile accidents, sports, and child abuse (1–3). Most injuries involve the maxillary incisors, especially when there are predisposing factors such as increased overjet, incompetent lips, or a history of trauma to the anterior teeth (1–4). Tooth avulsion implies total displacement of the tooth from its socket and represents 0.5–16% of traumatic injuries in the permanent dentition and 7–13% in the primary dentition. The main etiologic factors in the permanent dentition are fights and sports injuries, while hitting against hard objects are a common cause in the primary dentition. In both dentitions, the maxillary central incisors are the most frequently avulsed teeth (1–4).

Avulsion of teeth most frequently occurs in children aged 7–9 years while the permanent incisors are erupting. At this age, the loosely structured periodontal ligament (PDL) surrounding erupting teeth provides only minimal resistance to an extrusive force. Usually avulsion involves a single tooth, although multiple avulsions and involvement of other tissues such as the alveolar bone or the lips have also been documented (5).

Replantation of avulsed teeth is recommended in accordance with certain guidelines, but can lead to several complications in 57–80% of cases. The extent of long-term damage to the tooth and the supporting tissues depends upon the treatment of that tooth before replantation, the extra-alveolar time, the storage medium and the patient's general health (5, 6). The negative outcome of replantation can be divided into that related to the dental pulp and that related to the PDL response and may lead to inflammatory or replacement root resorption. The rate of replacement root resorption differs with child age and the rate of skeletal growth and can lead to resorption of the entire root. In cases with the tooth submerging in combination with replacement resorption, decornation is suggested to preserve bone height, function, and esthetics (7, 8).

In 1995, the International Association of Dental Trauma (IADT) published new recommendation for treatment of avulsed teeth. Preconditioning of the root prior to replantation and the stage of root development were taken into consideration (9).

According to the guidelines for the treatment of avulsed immature teeth, treatment depends upon the extra-alveolar dry time (6, 9–11). In cases of open apices or partially developed roots with extra-oral dry time <60 min, it is recommended to soak the tooth in doxycycline 0.05% (1 mg/20 ml) for 5 min before replantation. In cases of teeth with more than 60 min extra-oral dry time, replantation of immature teeth is not recommended (6, 9–11).

After replantation, it is recommended to immobilize the tooth with a semi-rigid splint for 7–10 days, suture gingival lacerations, and administer systemic antibiotics to evaluate the need for a tetanus booster. A soft diet and

meticulous oral hygiene (with chlorohexidine mouth rinses) are also necessary (6, 9–11).

The present report describes the follow-up of a complete root development and pulp revascularization after replantation of avulsed immature permanent maxillary incisor that has not erupted at the time of injury.

Case report

A healthy 6.5-year-old boy was referred to the Department of Pediatric Dentistry at the Hebrew University-Hadassah School of Dental Medicine in Jerusalem by his dentist. Thirteen days earlier, while playing, he hit his mouth with a chair and both his left primary maxillary incisor and the left permanent maxillary incisor, which had not erupted, were avulsed. The immature tooth was found on the ground and transferred with the boy to the emergency dental clinic. Under local anesthesia the permanent tooth bud was replanted after washing with saline after 10 min dry extra-oral time. A composite resin splint was prepared and applied. Amoxicilin (250 mg × 3 a day) was prescribed for 1 week.

Extra-oral examination revealed abrasion and laceration of the upper lip. An intra-oral examination showed gingival healing around the maxillary incisors with accumulation of plaque. A resin splint was placed between the replanted tooth and the primary canine. The left maxillary incisor was positioned labially and higher (gingival contour) relative to the right maxillary incisor (Fig. 1). The tooth was tender to percussion, and sensitive to a cold test with Endo-Ice. The results of the electric pulp tests (EPT) were not reliable because of the child's inconsistent response. Radiographic examination revealed a right permanent maxillary central incisor in the normal course of eruption, while its left counterpart, showed a radiolucent area surrounding the apex (Fig. 2). This appointment included adjustment of the splint, meticulous oral hygiene instructions with chlorohexidine (0.2%). A follow-up appointment was scheduled after 3 weeks.

Fig. 1. Frontal view, 13 days after trauma, the upper left maxillary incisor in labial position, splinted to the left deciduous canine.

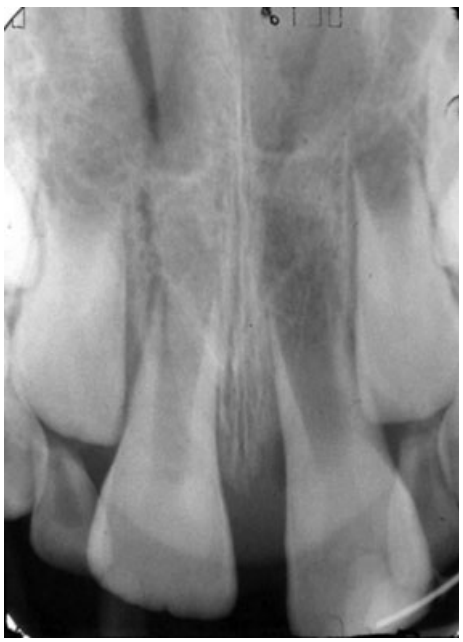

Fig. 2. A radiolucent area surrounding the apex of the left-splinted permanent maxillary central incisor.

During the following 2 years, the child visited the clinic frequently. Table 1 summarizes 2 years of follow-up visits, including clinical examinations, vitality tests (percussion, mobility, cold test, and EPT) and radiographic findings.

Four weeks later tenderness to percussion was no longer present; after 6 weeks of physiological tooth mobility, the splint was removed. The response to cold test appeared 2.5 months after the trauma, lasted for 15 months and then disappeared.

Radiographs taken during the follow-up period revealed that the root was gradually developing, followed by irregular formation of dentin. The PDL appeared normal (Fig. 3). At 6 months after the trauma, calcifications and partial obliteration appeared in the root canal of the tooth (Figs 4 and 5). Advanced obliteration was also noted after 12-month follow-up (Fig. 6).

After stabilization of the traumatized teeth, the child was provided with a mouth guard to reduce the risk of additional trauma to the anterior teeth (Fig. 7). The child and his family had refused early orthodontic treatment in spite of the fact that the tooth was in a labial position with proclination of both anterior teeth and an enlarged overjet with tongue thrust. At 24-month follow-up, the root was fully developed, with normal PDL and advanced obliteration (Figs 8 and 9).

Discussion

This case report describes a relatively severe, rare traumatic injury to an immature central incisor that had not erupted. The report emphasizes the importance of immediate treatment after avulsion, especially in immature teeth.

Table 1. Twenty-four months follow-up of left central maxillary incisor

Time after avulsion of left maxillary incisor	Clinical examination	x-ray	Treatment Procedure
13 days	Splint existence, ulceration on the lip	Periapical radiolucency	Correction of splint, observation in 3 weeks
4 weeks	Good OHI, no ulceration, gingival edema	Radiolucent area around the apex	Observation in 3 weeks, OHI instructions
6 weeks	No pathologic findings, high gingival contour, and buccal position #21	No change in the radiolucent area around the apex	Removal of splint, orthodontic consultation
8 weeks	No pathologic findings	A beginning of root development	Observation
3 months	No pathologic findings, high gingival contour, and buccal position #21	Formation of PDL, continuation of root development	Observation
4.5 months	No pathologic findings	Continuation of root development, dentin apposition, formation of PDL calcifications inside root canal	Observation
6 months	No pathologic findings	Apex closure, calcification, and obliteration of root canal	observation
9 months	No pathologic findings, high gingival contour, and buccal position	Irregular apex shape, calcification, and obliteration of root canal	Observation
12 months	No pathologic findings, high gingival contour, a little improvement in #21 alignment	Irregular apex shape, calcification, and obliteration of root canal	Orthodontic consultation, periodontic consultation, mouth guard
15 months	No pathologic findings improvement in #21 alignment	Closed apex, with calcifications inside root canal, no pathology evident	
24 months	No pathologic findings yellowish color of #21	Continuous PDL, partial obliteration, no pathology evident	Referral to orthodontic treatment

OHI, Oral hygiene instructions; PDL, periodontal ligament.

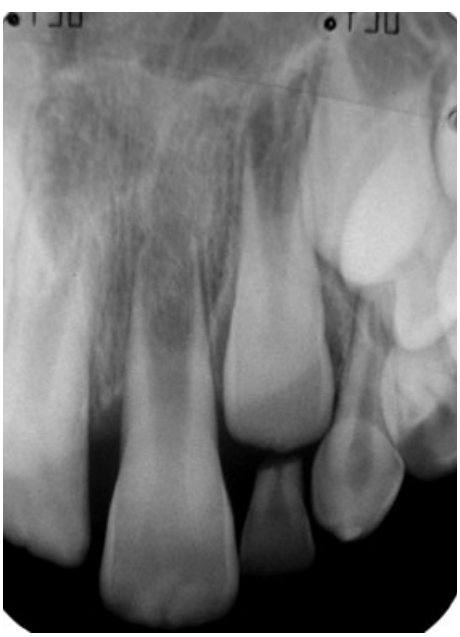

Fig. 3. Three months after trauma, continuation of root development, periodontal ligament appears normal.

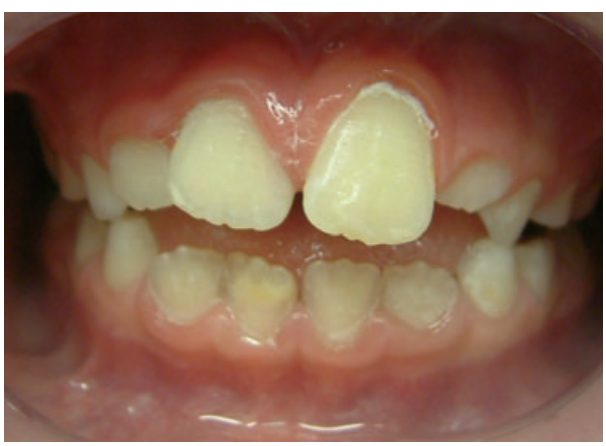

Fig. 4. Frontal view, 6 months after trauma, improvement in the labial position of the upper left maxillary incisor.

Complete pulp revascularization after tooth replantation is relatively low (18%) in replanted immature teeth, and does not occur in fully root-developed teeth (12). This is due mainly to contamination of the infracted pulp tissue by microorganisms (13–15). Cvek et al. (12) showed that topical treatment with doxycycline before replantation of avulsed teeth in monkeys significantly decreased the frequency of microorganisms in the pulpal lumen, while increasing the frequency of complete pulp revascularization in immature teeth by about 23%.

The current literature does not recommend replanting immature teeth that had been left dry for over 60 min (6–10), because of thin dentinal walls, wide dentinal tubules, and a high basal metabolic rate in children. In our case, the left maxillary central incisor was replanted after a relatively short extra-oral period of time (10 min). Since the patient arrived at our clinic 13 days after trauma and replantation, it was decided to monitor the tooth, for possible revascularization. The immediate treatment in this case, did not include the application of doxycycline, for obvious reasons. Revascularization and continuation of root formation probably occurred because of the short extra-oral period. Evidence of the tooth's vitality was

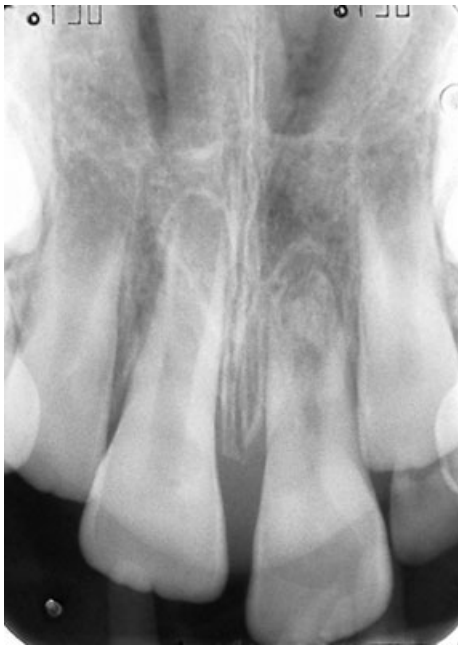

Fig. 5. At 6 months after the trauma, calcifications and partial obliteration is noted along the root canal space, the root was gradually developing. The periodontal ligament appears normal.

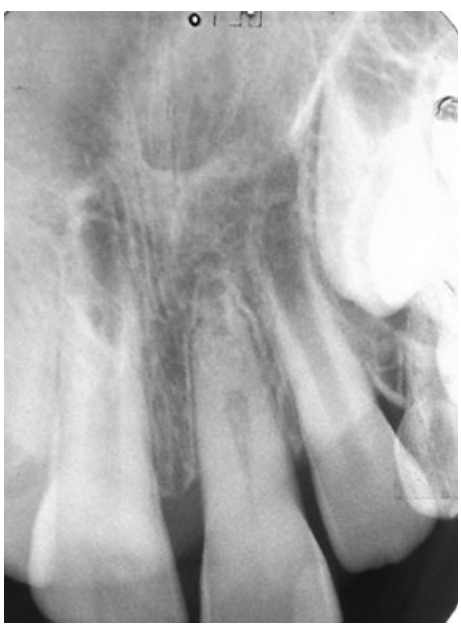

Fig. 6. Twelve months post-trauma, advanced obliteration, and apical closure is noted.

first observed 3 months after the trauma, as the root continued to develop with normal and continuous PDL. As follow-up proceeded, calcifications inside the root canal space and partial obliteration were detected. Calcification within the pulpal space, indicating tooth vitality, has been previously described in immature teeth that had been replanted shortly after trauma (16, 17).

Fig. 7. To reduce the risk of additional trauma to the anterior teeth, a mouth guard is provided to the child.

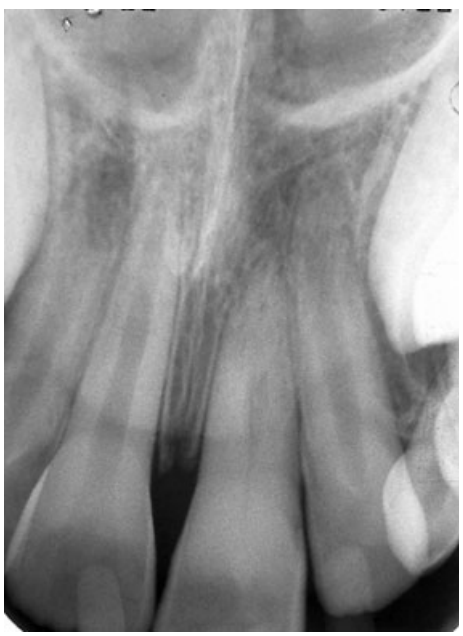

Fig. 8. Twenty-four months after trauma, the upper left maxillary incisor with fully developed root. Normal periodontal ligament and advanced obliteration are observed.

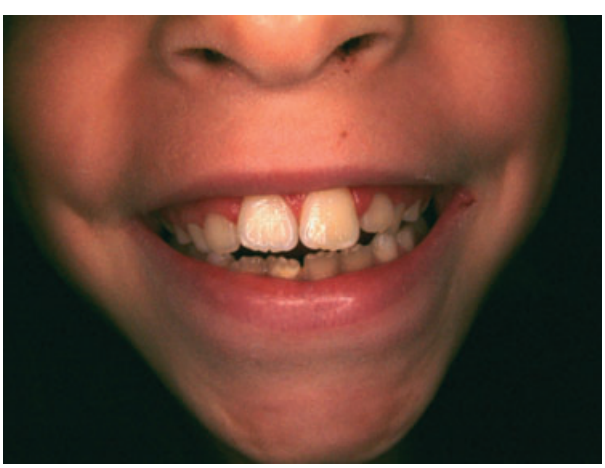

Fig. 9. Clinical view of the left maxillary incisor 24 months after trauma.

According to the IADT, the suggested period of time for splinting an avulsed tooth after replantation is 7–14 days, to allow physiologic movements, prevent ankylosis, and permit good oral hygiene (9). In the present case, the splint remained in place for 6 weeks, not as recommended in the literature. The avulsed tooth had a short root and thin dentinal walls, and there was concern that if the splint would be removed after 14 days, the tooth would exfoliate spontaneously. A longer, period (1–2 months) of splinting is recommended when there is root or alveolar bone fracture (5).

Vitality tests were performed in each follow-up visits although they cannot predict reliably the pulp status shortly after trauma and in immature teeth with open apices (2). However, the test values served as a baseline, with which values obtained in the following visits could be compared.

The response to cold, which appeared 6 months after the trauma and later disappeared, indicates that the tooth was vital. The response probably disappeared because of calcifications inside the root canal space which were observed in the follow-up radiographs.

The use of mouth guards is recommended during contact sport such as soccer, football, and wrestling. Studies have shown that the use of mouth guards reduces the frequency and the severity of most oral injuries by absorbing and dispersing the force of the injury (18, 19). According to one study (20), the forces needed to cause an injury are significantly higher in the presence of mouth guards. Indeed, it was found that mouth guards decrease intracranial pressure and skull bone deformity (21), reduce the frequency of intracranial hemorrhage, loss of consciousness, and neck injuries (22, 23). Despite the advantages of mouth guards, children and athletes do not use them on a routine and regular basis. The common complaints are inconvenience, disturbances in breathing and speaking, and poor retention (24). These complaints may be resolved by proper adjustment of the appliance by the dentist.

In our case, the boy was provided with a mouth guard 1 year after the trauma because of several risk factors: the child refused orthodontic treatment, the buccal alignment of the tooth, and the concern to additional trauma during sport activities. The boy cooperated fully in using the mouth guard frequently. Interestingly, improvement of the position of the tooth was observed 1 year later and was probably attributable to dentition replacement and the mouth guard.

Great importance is attached to frequent follow-up visits in case of severe trauma to teeth, such an avulsion of immature teeth. Many complications, including pulp necrosis, replacement, or inflammatory resorption, may occur and may be anticipated.

In the present case 2 years after, revascularization of an immature avulsed tooth, the tooth is vital, functional, and esthetic. To the best of our knowledge, no such case of replantation of a pre-eruptive tooth has been reported previously.

In this case report, the significance of a short extra-oral time is confirmed by revascularization and continuation of root development, despite the dry storage.

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