Pulp and periodontal healing after replantation of a maxillary immature incisor: a 13-year follow-up

**Abstract**

**Background** Traumatic tooth avulsions occur most often in 7 to 9 year-old children. Replantation is considered the treatment of choice and follow-up is required in order to prevent possible complications.

**Case report** A case of replantation of a maxillary immature incisor in a 9.2-year-old male is reported. Tooth 21 was stored in saliva, in the child’s mouth, and it was replanted within 45 min following a bicycle accident. A flexible splint was applied from tooth 11 to tooth 63, and it was removed after 4 weeks. Pulp canal obliteration was diagnosed at the 6 months check-up visit. Pulp sensibility was positive after 3 months and absent after 5 years. During the follow-up the tooth completed its development and always presented a physiological mobility and a probing depth < 3 mm. Only a minimal discoloration of the crown was observed.

**Conclusion** The knowledge of emergency care at the scene of dental trauma is resolutory for treatment outcome.

**Keywords** Avulsion; Dental injury; Immature tooth; Periodontal healing; Permanent tooth; Pulp canal obliteration; Replantation; Trauma.

**Introduction**

Avulsion is the total displacement of the tooth out of its socket; it represents up to 3% of traumatic injuries to permanent teeth and occurs most often in 7 to 9 year-old children [Andreasen and Andreasen, 2007]. Recreational and sport activities are one of the main causes of traumatic dental injuries in young people and increased overjet with protrusion and inadequate lip coverage is the most important anatomical risk factor [Glendor, 2009].

Replantation of the avulsed tooth is considered the treatment of choice, but prognosis depends on the type and time of extra-alveolar storage, root development and on the knowledge of the emergency management at the scene of the accident [Andreasen and Andreasen, 2007].

Follow-up is particularly recommended after replantation of immature teeth in order to set up an early treatment planning of the possible complications such as pulp necrosis and replacement root resorption. At the first sign of pulp necrosis the apexification procedure must be initiated [Trope, 2002], and if replacement root resorption occurs, the appropriate timing of removal of the ankylosed tooth must be established [Malmgren and Malmgren, 2002]. Severe infraocclusion due to local arrest of the alveolar bone development is usually observed when ankylosis is diagnosed before the growth spurt: it determines a disharmony of the smile and compromises future prosthetic treatment [Sapir and Shapira, 2006].

A case of a 9.2-year-old male who suffered the avulsion of tooth 21 following a bicycle accident is reported with a 13-year follow-up after replantation.

**Case report**

A healthy 9.2-year-old male came for emergency treatment to the Unit of Orthodontics and Paediatric Dentistry of the University of Milan, where he was already waiting for an orthodontic treatment, within 45 minutes after dental trauma. Tooth 21 was forced out of its socket due to a bicycle accident. The father called the Unit and received instructions about the first aid at the site of accident. Because the tooth was in the child’s mouth, immediate replant represented the best solution. If this hadn’t been possible, the tooth would have had to be stored in saliva into the buccal vestibule or in a saliva-and-blood mixture spat or drooled into a receptacle, and as soon as possible in preferably cold milk in order to preserve the viability of the periodontal ligament cells.

When the patient arrived at the Unit, the tooth was still in his mouth. After the parents’ informed consent, the clinician rinsed and stored it in saline to prepare the socket for replantation. A local anaesthetic was administered, the socket was rinsed with saline to remove the coagulum and then the tooth was gently pushed back. A flexible splint, constructed using an orthodontic braided wire and composite resin,
from tooth 11 to tooth 63 was applied (Fig. 1). The maxillary incisal area was decontaminated with 0.2% chlorhexidine gel. A radiograph was obtained to confirm the proper positioning of the replanted incisor (Fig. 2). Tetanus prophylaxis was not necessary.

The patient received instructions about soft diet for 2 weeks and oral hygiene: brushing his teeth with a soft toothbrush after each meal and rinsing his mouth twice a day for 1 week with 0.12% chlorhexidine. Amoxicillin was administered systemically for 1 week.

Recall visits were planned according to the International Association of Dental Traumatology (IADT) guidelines. Because of the open apex, the incomplete root length development and the short extra-alveolar storage period in saliva, pulp revascularisation and periodontal healing were expected. The splint was removed after 4 weeks and no signs and symptoms of pulp necrosis were observed. Positive pulp sensibility was diagnosed after 2 months (3 months recall visit). At this period the patient was encouraged again to strive for a better oral hygiene. Partial pulp canal obliteration was diagnosed after 6 months from replantation (Fig. 3) and total pulp canal obliteration was observed later. The patient was monitored yearly during the first 5 years and then after 8, 10 and 13 years after replantation. Pulp sensitivity was uncertain at 3 years and absent at 5 years checkup visit, when the coronal pulp chamber and root canal appeared completely obliterated (Fig. 4). After 13 years from replantation the tooth appeared in good condition and only a minimal yellow discoloration of the crown was observed (Fig. 5). During the follow-up the tooth completed its development and always presented a physiological mobility and a probing depth < 3 mm.
Discussion

The goal of replanting an immature tooth is to allow its pulp and periodontal healing. Consensus-based treatment methods emphasise the importance of minimising damage to the root cementum and periodontal ligament in order to prevent infection of the root canal and to promote functional healing [Ram and Cohenca, 2004]. So an adequate first aid at the site of accident becomes resolutory. In this case, when the father called the Unit, he received instructions to replant immediately the tooth, or if it had not been possible due to the child's emotional state, to store it in a biological medium like saliva and as soon as possible in cold milk. When the patient arrived to the Unit the tooth was in his mouth. Usually parents prefer not to replant teeth due to their fear of replacing them incorrectly and of causing pain to the child, while school teachers, coaches and caregivers refer inadequate training, fear of bloodborn infections and possible legal consequences [Hamilton et al., 1997; Blaktynty et al., 2001].

Due to a broad apical foramen and short root canal, and to about 45 minutes storage in saliva, pulp revascularization was expected within 4-5 weeks. This condition represents the biological response to a severe injury and is characterised by accelerated dentin apposition along the root canal with its rapid partial or total obliteration. Bacterial contamination of the root surface prevents pulp revascularisation and arrests root length development, so Cvek et al. [1990] proposed topical treatment with doxycycline for 5 minutes to avoid these complications. Doxycycline was not applied in this patient because it was not available. Bacterial contamination can also be contrasted using tetracycline which, with its inhibitory effect on collagenase activity and osteoclasts, proves to be effective in the prevention or attenuation of external root resorption [Chappuis and von Arx, 2005]. In this clinical case amoxicillin was prescribed instead of tetracycline, to avoid possible damage to the developing patient's teeth.

Partial pulp canal obliteration was diagnosed at the 6-month recall visit, and later it evolved in total pulp canal obliteration. This physiological condition must be monitored because pulp necrosis with gray discoloration has been reported to be a possible complication with a percentage of 7.3% to 27.2% [Oginni et al., 2009]. During the observation period the tooth was not subjected to new trauma or therapeutic procedures, including fixed orthodontic treatment and cavity and functional based treatment methods emphasise the importance of minimising damage to the root cementum and periodontal ligament in order to prevent infection of the root canal and to promote functional healing [Rozenfarb et al., 1997]. The ideal biological medium is Hank’s Balanced Salt Solution, but its availability near the site of an accident is doubtful. So the father was encouraged to replant the tooth immediately or to store it in saliva and after in preferably cold milk and to reach the Unit as soon as possible. The tooth was stored in saliva, in the child’s mouth. Due to the emotional state of the young patient, the usually recommended storage in buccal vestibule should be reconsidered because of the risks of swallowing the tooth and because it is not necessary for the treatment outcome. Therefore the storage in a saliva-and-blood mixture spat or drooled into a receptacle may be preferred. Saliva is a hypotonic solution, its osmolality (60-70 mOsm/kg) is much lower than the physiologic one, causing cell swelling, which stretches the cell membrane, and potentiates the effect of bacterial products and toxins present in saliva [Rozenfarb et al., 1997]. Blomlöf et al. [1983] reported that teeth which had been stored in saliva for 2 h or in milk for 6 h showed periodontal healing almost as good as that of immediately replanted teeth. But Rozenfarb et al. [1997] referred that cells stored in human saliva showed a significant decrease in cell viability after 45 min. Currently a storage time no longer than 30 min in saliva is preferred [Lin et al., 2000; Udoye et al., 2012]. Because saliva is always available, it should be considered as a temporary medium to avoid dry storage when an immediate replantation is not possible. A combination of brief storage in saliva is recommended with subsequent storage in milk, rather than storage in saliva only [Blomlöf, 1981], keeping in mind that milk does not revitalise dead cells [Blomlöf et al., 1983; Biagi et al., 2013].

Finally a flexible splint made by an orthodontic braided wire and composite resin was placed from tooth 11 to tooth 63. This functional splint is a simple and fast technique without laboratory procedures; it allows a good oral hygiene and preserves physiologic teeth mobility avoiding further damage to the periodontal ligament. The splint was removed 4 weeks later. A shorter splinting time is preferred: up to 2 weeks according to the current guidelines of the IADT [Andersson et al., 2012], even if its duration does not affect the likelihood of successful periodontal healing after replantation [Kahler and Heithersay, 2008; Hinckfuss and Messer, 2009].

Conclusion

Replanted teeth can maintain under some conditions their integrity and function. Root development, time
and type of extra-alveolar storage and emergency care at the scene of trauma influence pulpal and periodontal healing. Dental assistants, hygienists and coaches should be trained about first aid in dental traumatology, and parents should be informed through direct education or via press.

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References