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# Replantation in adolescents: a case report

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**Abstract**

**Background:** Tooth loss as a result of trauma most often affects young people, especially in the summer time. Implantation is considered the correct method of proceeding in the case of missing teeth. However, it is not indicated in this age group due to the constantly developing skeletal system and the change in spatial relations in the stomatognathic system. A more favorable, but less likely to be successful, method is replantation, which is more dependent on patient compliance.

**Objectives:** presentation of the clinical procedure in the case of avulsed tooth 21, with particular emphasis on the time and method of providing first aid.

**Methods:** a case report based on an anamnesis and physical examination with the use of medical records, including radiological records, of a 14-year-old boy after an injury.

**Conclusions:** The most important factors determining the success of the replantation procedure are: the time from the injury to contact with the dentist, and storage medium of an avulsed tooth. Both are only dependent on the person who has been injured or the guardian of minors. For this reason, it is important to raise public awareness of first aid in dentistry. Successful replantation of a tooth that has been outside the socket for more than 60 minutes may be associated with complications such as ankylosis or root resorption. However, even in case of the above- mentioned sequelae, the profit and loss balance is favorable, because the replanted tooth prevents bone loss, which is crucial due to future implantation, and the possible development of ankylosis in the developmental age can be treated with the decoronation procedure.

**Keywords:** avulsed tooth; tooth replantation; dental trauma; pediatric dentistry

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## Introduction

Dental practice is dealing more and more often with injuries to soft tissues in the craniofacial area and dentoalveolar trauma. In children and adolescents, they most often occur during physical activity, road collisions, acts of violence and play [1, 2]. In recent years, an additional factor contributing to the occurrence of injuries within the alveolar process of the maxilla and the alveolar part of the mandible, the middle and lower part of the facial skeleton, as well as the temporomandibular joints is the development and popularization of a new means of transport among young people, which is an electric-scooter. The conducted research has shown that injuries of soft tissues and bones in the craniofacial area occur in 26- 58% of patients with injuries resulting from the use of an electric scooter. Moreover, these types of injuries often make treatment difficult due to their separate specificity [3, 4]. Avulsed tooth characterized by complete displacement of the tooth from its socket, occurs most often in patients in the 7- 10 age group [5] and mainly affects the upper central incisors due to their prominence in the jaw. [6]. In this case, the force of the trauma is exerted from above, at an angle to the long axis of the tooth, close to its neck. It is classified as class V according to the Ellis. The presence of a malocclusion such as protrusion of the anterior upper teeth additionally increases the risk of trauma in this area. The radiological assessment of the affected area is necessary for diagnostics [5].

Implantation procedure is considered the correct method of proceeding in the case of missing teeth, which is not recommended in this age group i.a. due to the constantly developing skeletal system. The method of choice is replantation with immobilization [2, 5, 6], which is characterized by a higher risk of failure, resulting from a greater emphasis on cooperation with patients and certain developmental constraints. The most frequent complications, these include ankylosis and root resorption [5, 7]. Therapeutic success depends on proper first aid and rewarding doctor- patient relationship. The lack of these factors reduces the chance of achieving therapeutic success, which may adversely affect the patient's self-esteem and his interpersonal relations [8].

**Case report**

On 8 January 2019, a mother and her 14-year-old son presented at the Department of Dental Surgery in Lublin of Medical University. The child suffered an injury while he was using the swing, as a result of that tooth 21 was knocked out. The boy did not lose consciousness, slight bleeding was observed in the upper lip. The boy's mother sealed the tooth in a container with milk and within five hours she showed up with her son at the dentist's.

The mother denied that her son suffered from systemic diseases and allergies. After the interview with the caregiver, no decision was made to implement tetanus prophylaxis. Extraoral examination revealed skin abrasions in the middle part of the face (Fig. 1a), inflammatory infiltration of the upper lip and a cut wound on inner side of its in the projection of the lost tooth (Fig. 1b). The patient was examined for possible alveolar fractures and the entire craniofacial fractures- none were found. In the meantime, the avulsed tooth was rinsed with 0.9% saline solution and cleared of necrotic tissue. Then, it was left for several minutes in a 2% sodium fluoride solution. The physical examination did not reveal any signs of damage to the crown and the root of tooth 21, the apex of which was completely developed (Fig. 3). The patient was referred for an X-ray examination, which showed an empty socket and no fractures, thus confirming the initial clinical examination (Fig. 2). After excluding contraindications, it was decided to perform endodontic treatment outside the patient's oral cavity.

Fig. 1a

Fig. 1b

Fig. 2

Fig. 3

The pulp was extirpated, the tooth was endodontically treated, and the canal was filled with gutta-percha using a lateral condensation technique with the use of AH + sealant (Fig. 3). During treatment, 2.5% sodium hypochlorite was used for irrigation in two cycles with ultrasound activation. Then citric acid 40% was used to remove inorganic part of the smear layer. Furthermore, distilled water was used to rinse acid out to prevent the demineralisation of the dentin. Finally, the canal was irrigated with 2% chlorhexidine.

Under local anesthesia with 2% lidocaine with norepinephrine into the socket, flushed with physiological saline to remove blood clots, the lost tooth was gently and lightly inserted (Fig. 4). Then it was stabilized with an orthodontic archwire splint, bonding by a flow- type dental composite for 2 weeks (Fig. 5). A periapical X-Ray was taken, confirming the correct position of the reponated tooth (Fig. 6). Wounds in the area of soft tissues were cleaned with moist gauze pads, then a vitamin A ointment was applied.

Fig. 4

Fig. 5

The patient was instructed to take doxycycline in a dose of 100 mg every 12 hours for 14 days, follow a soft diet for 2 weeks and maintain impeccable oral hygiene by brushing the teeth daily - twice a day by using a soft toothbrush and rinsing the mouth with 0.1% chlorhexidine solution 2 times a day for a week.

He was also informed about the necessity to avoid contact sports. A follow- up visit was scheduled after 2 and 4 weeks, or earlier, if disturbing symptoms were noticed. Furthermore, he was instructed on the need for radiological control 3, 6 and 12 months after the injury.

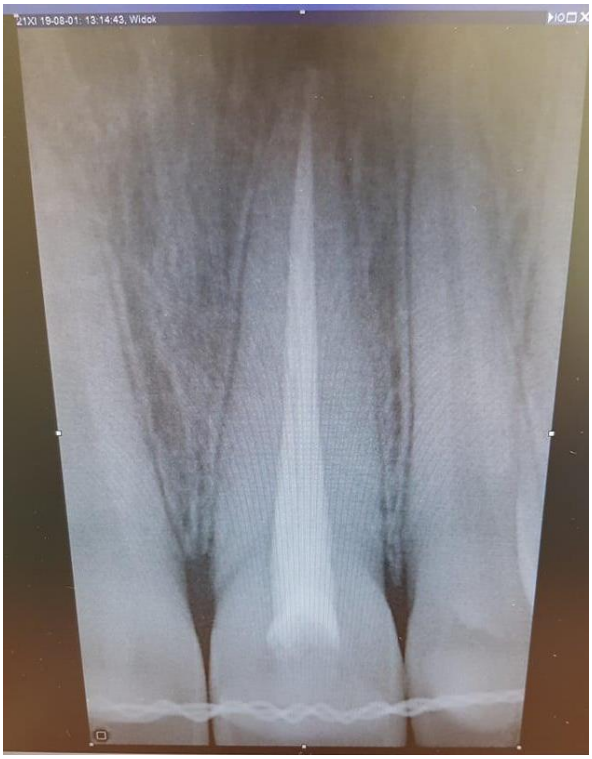


Fig. 6

**Discussion**

Luxatio totalis dentis permanentis causes immediate ischemia in the pulp as well as in the periodontium- due to the rupture of the neurovascular bundle and rupture of the periodontal fibers. This problem is exacerbated by failure to provide first aid when an injury occurs, because the longer the tooth is outside the oral cavity, the lower the chance of preserving the vitality of the periodontal ligament cells is [2, 7]. During this time, an unprotected tooth is harmful exposure to biological, chemical and physical factors like drying and non specific bacterial contamination. The conclusion is that the therapeutic success is closely related to the two factors: the time the tooth remains outside the socket and the way it is stored. If this time does not exceed an hour, the chance of partial or even complete regeneration of the periodontium is quite high [1, 7, 9]. There is no unequivocal position regarding teeth that have exceeded this time period due to the high probability of complications such as ankylosis and root resorption. However, it is worth noting, that after the performed decoronation- delayed replantation in children is a favorable phenomenon, because it allows for the preservation of further growth and development of the skeletal system and the continuation of changes in spatial relations in the stomatognathic system. In the case of a tooth whose root has already completed its development, delayed replantation will enable its preservation for several years [9]. There is also no doubt that the replanted tooth prevents the progressive atrophy of bone tissue, which is crucial from the point of view of possible implantation in the future.

Proper, post-traumatic treatment includes gentle rinsing of the tooth with the patient's saliva, saline solution or, ultimately, cold water, and its replacement in the alveolus [2, 10]. If this is not possible and the patient or other participant in the event is not able to replant, they should store the tooth in a moist environment, preferably in its own saliva- for example in the bottom of the vestibule on the cheek side, milk- which has the right pH and osmolarity for viable cells or 0.9% NaCl solution [2, 7, 10]. It is also worth mentioning the dedicated products that increase the chance of survival of periodontal cells, such as Save-A-Tooth or SOS Dentobox, whose manufacturers inform about the possibility of storing the tooth after an injury in a ready-made solution for a period of 24-48 hours. It should also be noted that when performing these activities, the tooth should not be touched and held within its root. The best way is to pinpoint the crown with a clean piece of gauze. After the appropriate protection, the patient should immediately go to the dentist, who will decide on further treatment.

Despite the fact that immediate replantation is the method of choice, it is also necessary to remember about its contraindications, which include, among others, advanced caries of a traumatic tooth, periodontal disease, reluctance to cooperate with the dentist, coexisting immunosuppression or general diseases, such as heart defects [7, 10]. Each case should be considered individually on the basis of a carefully collected history and the conducted clinical examination.

In the described case of a 14-year-old boy, the decision was finally made to perform replantation despite the time that has passed since the tooth was completely knocked out. The patient's age, willingness to cooperate, proper tooth protection by the mother and well-forecasting information collected in the interview were taken into account. The physical and psychological benefits of this procedure significantly outweighed the high probability of failure. The procedure followed the current recommendations of the International Association of Dental Traumatology (IADT), including the verification of the need for tetanus prophylaxis, cleaning the tooth from remaining, necrotic soft tissues, performing root canal treatment outside the patient's oral cavity, administering local anesthesia, checking the continuity of the alveolar bone walls, rinsing it with physiological saline, resetting the knocked out tooth, verifying its position clinically and on the basis of X-rays, and stabilizing it with a splint for a period of 2 weeks. On the basis of recommendations, the patient was also ordered to receive antibiotic therapy with doxycycline due to its antibacterial, anti-inflammatory and anti-resorptive properties, and was informed about post-treatment recommendations [10].

Over the years, studies have been conducted on the effectiveness of the local and systemic effects of tetracycline antibiotics on the healing of the pulp and periodontium after replantation. One significant human study showed that completely decayed permanent teeth treated with doxycycline did not achieve better clinical outcomes compared with teeth treated with saline only. However, in the case of the other two studies conducted on animals, a significantly better healing of the pulp of immature teeth treated topically with doxycycline was demonstrated, while another similar study did not reveal a difference in healing with the use of both substances [11]. Yet another study in mice found that minocycline (one of the components of 3Mix - together with ciprofloxacin and metronidazole) may inhibit osteoblast differentiation by migrating dendritic cells to the site of injury and activating progenitor cells, which accelerates the differentiation of odontoblast-like cells in deliberately delayed tooth replantation [12].

It should be remembered that after replantation, the most common pathways for bacterial penetration are the gingival tissues, periodontium, the root canal with adjacent side canals, and dentinal tubules [11]. In a study conducted by Sea-Lim, it was concluded that systemic antibiotic therapy with orally administered tetracycline provides better healing of periodontal tissues and reduces root resorption of traumatic tooth [11]. Due to the discrepancy in the presented results and the insufficient number of studies similar to the above-mentioned- the impact and application of these antibiotics are inconclusive.

In order to improve the healing processes and reduce the chance of complications, it is possible to use substances such as platelet-rich plasma and platelet-rich fibrin. It is also possible to use the cell homing method [17].

Platelet-rich plasma (PRP) is a blood product that contains concentrated platelets that are suspended in a small amount of plasma. It is obtained from the patient's peripheral blood, which is centrifuged after adding the anticoagulant. Thrombin is then added, which converts fibrinogen to fibrin, creating an insoluble fibrin network which promotes coagulation. Increased concentration of platelets is associated with a greater number of GFs (growth factors). This feature determines the functionality of platelet-rich plasma in relation to all its applications.

After the replantation procedure is performed, periodontal regeneration takes place, which consists of the regeneration of the alveolar bone, PDL and cement. Various growth factors are necessary for the proper course of these processes [17]. The application of PRP to the surface of replanted roots increases periodontal regeneration [18]. It was also investigated that thrombin activates the growth and accumulation of fibroblasts, which prevents ankylosis and improves periodontal regeneration[13]. Another study compared the effect on periodontal regeneration using: PRP activated with thrombin and calcium chloride, PRP activated with calcium chloride, platelet poor plasma and bone marrow mononuclear cells with PRP activated with calcium chloride. Ankylosis did not occur only in the group where thrombin was used [16].

Platelet-rich fibrin (PRF) can be easily obtained by centrifuging freshly drawn blood in which platelets and fibrin predominate at various concentrations [13]. The processing of PRF by centrifugation promotes the immediate degranulation of platelets, which means a significant release of cytokines. PRF contains a dense network of fibrin and a high concentration of many growth factors, such as platelet-derived growth factor (PDGF) and vascular endothelial growth factor (VEGF). The most important factor is transforming growth factor β1 (TGFβ1), which positively induces differentiation of the cells of the dental papilla into odontoblasts, providing an appropriate environment for PDL cell proliferation and extracellular matrix synthesis [19]. The local action of these factors results in cell survival, migration, proliferation and differentiation [14]. Due to these properties, PRF can be used to improve the regeneration of the replanted tooth by applying it directly to the socket or to protect the tooth outside the socket, thanks to the properties that reduce the death of PDL [15].

Cell homing enables the complete reconstruction of the lost structures, and even the entire tooth, by creating a special scaffold in the shape of a missing tooth thanks to 3D bioprinting. The scaffold consists of a hybrid of poly-ε-caprolactone and hydroxyapatite with 200 μm diameter microchannels present. Stromal factor 1 (SDF1) and bone morphogenetic protein 7 (BMP7) are introduced into the microchannels. In the case of replantation, the goal is to restore the PDL and these substances ensure angiogenesis and recruit endogenous cells that create new tissue [20].

Moreover, some researchers described the method wherein the tooth roots were immersed in a 17% EDTA solution to achieve demineralization. Then the root surface was covered with SDF1 and BMP7 and the tooth was inserted into the socket. After 6 months, PDL-like tissue composed of spindle cells, capillaries and highly organized collagen fibers was observed. The periodontal-like characteristics of the new tissue were confirmed by immunohistochemical staining for collagen I, fibronectin and osteocalcin. This method enables the avoidance of ankylosis or the occurrence of substitute resorption [21].

**Conclusion**

The situation presented above shows how important is patient awareness about adequately provided first aid in cases of injuries within the stomatognathic system. The most important factors that have a real impact on the success of further treatment are: the time- from the occurrence of the injury to the visit to the dentist- and the type of storage medium and the method of transporting an avulsed tooth. In the case of a quick response, the likelihood of successful replantation is significantly increased, especially in adolescents, due to their greater capacity for tissue regeneration. As research shows, the group which is most exposed to this type of injury are young people aged 7- 10 years. It is therefore crucial to educate adults, parents and guardians of minors in this regard in order to increase their knowledge of what to do when such an incident occurs. It is also extremely important to popularize preparations that increase the chance of survival of periodontal cells outside the oral cavity, such as “Safe a tooth” or “SOS Dentobox”. In the future, the methods using PRP, PRF or cell homing may also become widespread, which will probably have a significant impact on the results of replantations.

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