

Indirect replantation post trauma of immature teeth in children

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Abstract

Introduction: Traumatic injuries to the dentition are frequently seen in children and young adults. One of the most complex forms of dental trauma is avulsion, which usually affects the maxillary central incisors between the ages of 7 and 10, during the early stages of permanent dentition. An avulsion can result in gingival injury, total rupture of the periodontal ligament, or complete loss of connection between the tooth and the socket.

Case History: An 8-year-old girl was referred to the IGD RSKGM-P Airlangga Surabaya, complained that her upper tooth was loose from its socket after falling from a bike around 5 hours prior. The tooth had been soaked in milk for an hour before the patient went to the hospital.

Discussion: Replacing missing teeth as soon as feasible is the best course of action after an avulsion injury. The dental prognosis is influenced by the extraoral time, root maturity, and storage of the avulsed tooth. To prevent infection, trigger an inflammatory response, and promote root resorption, endodontic therapy may be carried out prior to replantation if the extraoral dry period beyond sixty minutes (Golden Period). For patients with avulsion injuries, prompt intervention, suitable treatment plans, and skilled emergency management are crucial to the outcome. The tooth is routinely examined after replantation to look for indications of ankylosis, resorption, mobility, and vitality.

Conclusion: Replantation preserves the patient's appearance and functionality; it is regarded as the best course of action for treating an avulsed tooth.

Keywords: Avulsion; Replantation; Immature Teeth; Endodontic Treatment; Human and Health

1. Introduction

Traumatic injuries of the dentition are frequently seen in children and young adults, with luxative injuries are seen in primary dentition and crown fractures are commonly seen in permanent dentition. Among the traumatic dental injuries (TDI), avulsion comprises from 0.5 to 16% in permanent teeth [1]. Tooth avulsion is a complete loss of attachment between the tooth and the socket with complete rupture of the periodontal ligament and cemental damage [2]. It is considered one of the most complicated types of trauma to the teeth, where a total displacement of the tooth from its socket occurs [3]. Anterior teeth are the most commonly traumatized part of the dentition during childhood [4]. The prevalence of avulsion in permanent teeth is reported to be 0.5 to 3.0%. Avulsion is most common in young permanent dentition [5], with maxillary central and lateral incisors being the most affected. The peak incidence of avulsion for the maxillary central incisors usually occurs between the ages of 7 years and 10 years [4].

In most cases, replantation is the treatment of choice for avulsed teeth but cannot always be carried out immediately. Prognosis of replanted teeth depends on; the amount of physical damage to the root surface like cementum and

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periodontal ligament cells, the extraoral (dry) time, the type of storage medium, and the amount of root development of the avulsed tooth [3]. Replantation is considered to be the treatment of choice for an avulsed tooth since it maintains both the patient's aesthetic and functional needs [1].

Avulsion causes the severing of the periodontal ligament and disruption of the vascular-nerve bundle, with a consequent loss of blood supply to the tooth, which can lead to pulp necrosis [3]. In an avulsed tooth, dental pulp cells, periodontal ligament cells, cementum, gingiva and alveolar bone are all damaged but the ultimate challenge in the management of avulsion is to maintain the vitality of periodontal cells [6]. The vitality of periodontal ligament cells is the most important factor to allow the reattachment of tooth replantation [2]. Most periodontal ligament cells left on the root surface are due to the tearing of the alveolar-dental ligament; these cells must be hydrated to maintain the durability of the tooth while reducing the phenomenon of resorption and allowing healing. However, when the extraoral time increases, leaving the periodontal ligament dry, inflammatory resorption occurs. The incidence of an external root resorption (inflammatory/replacement) remains high even in a correct management of replantation of the tooth [7]. The damage to developing teeth can result in an open apical, which makes the tooth non-vital and can cause discoloration and an infection of the pulp tissue. Therefore, endodontic treatment of the tooth is required [8].

Extraoral time, storage of the avulsed tooth, and maturity of the root are also important to dental prognosis [2]. When replantation treatment was carried out after 15 minutes of avulsion, the prognosis would be good. However, when the extraoral dry time was more than 60 minutes, the endodontic treatment may be done prior to replantation or after the replantation [2,4,6]. In case of the dry storage time exceeds 15 minutes, the precursor, progenitor, or stem cells are no longer capable to differentiate into fibroblasts and if the dry storage time exceeds 30 minutes, virtually all of the periodontal ligament cells that are remaining on the root surface are likely to have become necrotic which results in a poor long-term prognosis [9].

Storage medium enhances the healing outcome of the replanted teeth. Different materials/solutions like Hank's Balanced Salt Solution (HBSS), Eagle's Medium, milk, ViaSpan, Eurocollins, tap water, saliva, normal saline, saliva extract, green tea, red mulberry, and coconut water are used as storage media [1,9]. Among the various storage media available for preserving an avulsed tooth, milk is the most extensively used and recommended due its ease availability, suitable pH, appropriate growth factors, nutrients, and osmolarity. Also, milk being a gland secretion contains epithelial growth factor (EGF) that stimulates the proliferation and regeneration of epithelial cell rests of Malassez, especially low fat and cold milk serve as better storage media [1,10].

2. Case History

An 8-year-old girl was referred to the IGD RSKGM-P Airlangga Surabaya and complained that her upper tooth was loose from its socket after falling from a bike around 5 hours prior. The tooth was soaked in milk for an hour before the patient went the hospital. The patient did not have a medical history of systemic disease, nor did she have any food or medication allergies. It's also confirmed that the tetanus vaccine of the patients was up-to-date. The parents want a treatment to prevent their child from losing the tooth. In order to prevent their child from losing their teeth, the parents desire a treatment.

On extraoral examination, there are small lacerations on her chin. During the intraoral examination, we found lacerations measuring 5x2 mm on the gingiva of regions 21 and 22. The sockets of teeth 21 and 22 are bleeding, and there is a blood clot present (Figure 1). There is no mobility in the other teeth. After examination and asepsis of the gingiva in regions 21 and 22, teeth 21 and 22 were cleaned and soaked in NaCl for 15 minutes. Prior to replantation, each tooth was treated extraorally while holding the crown. The obturation was done with gutta-percha and sealer, followed by final restoration with composite. The root canal was cleaned with sodium hypochlorite (NaOCl), followed by aquadest, then dried and filled with gutta-percha covered with resin sealer. We applied a base (ZnPO₄) and restored the tooth with composite.

Before replantation, the tooth was maintained in a NaCl solution for 15 minutes to potentially slow down osseous replacement. Simultaneously, after intraoral asepsis with 1% povidone iodine, we administered local anesthesia using Pehacain (Lidocaine 20 mg and Epinephrine 0.0125 mg/mL) around the socket and irrigated it with saline solution. Once anesthesia was achieved, we performed curettage on socket walls. Curettage was carried out vertically along the socket walls to remove residual blood and debris. After confirming the absence of bone fractures inside the alveolus, teeth 21 and 22 were gently replanted while holding the crowns. We ensured that teeth 21 and 22 were correctly positioned and aligned. Then, we splinted teeth 11, 12, 21, 22, 63, and 64 with brackets and wire (ligature wire and ss 0.014), and applied flowable composite at the ends of the wire. Amoxicillin and paracetamol were prescribed every 8 hours for 5 days. A soft diet was advised for 4 weeks, along with careful brushing using a soft toothbrush. Follow-up

appointments were scheduled for the next day, two weeks later, and a month later to monitor tooth vitality. We informed the parents that decoronation or other procedures might be necessary if the replanted tooth becomes ankylosed and infra-positioned, depending on the patient's growth and the probability of tooth loss.

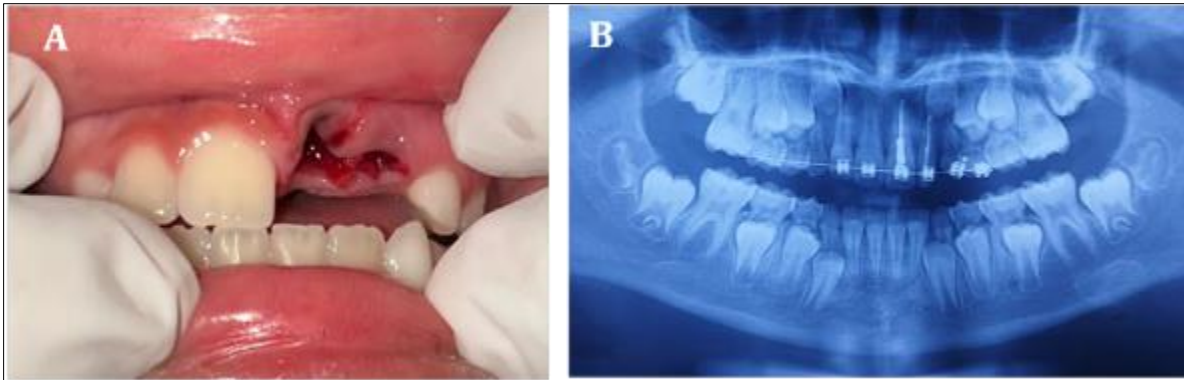


Figure 1 (A) Intraoral examination before replantation; (B) Radiographic after replantation

At the one-month follow-up, we performed clinical, radiographic, and sensibility tests. The patient reported no complaints (Figure 2). At the two-month follow-up, the splint was removed, and the pulp status remained unchanged in both teeth. Clinical, radiographic, and sensibility tests were conducted again, and no resorption or infection was observed in teeth 21 and 22

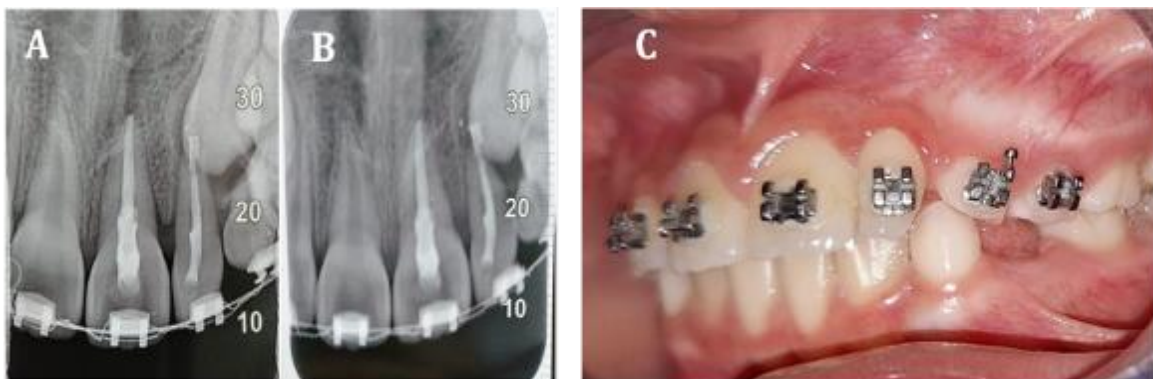


Figure 2 Follow up; Radiographic (A) After 1 month. (B) After 2 month. (C) Intraoral examination after 2 month

3. Discussion

In dental terminology, avulsion is defined as the complete separation of a tooth from its alveolus. A different term for this phenomenon is "exarticulation", which often involves the maxillary teeth [11]. In the majority of cases, replantation emerges as the preferred treatment for avulsed teeth; however, immediate action may not always be feasible. The prognosis of replanted teeth is dependent on various factors, including the extent of root surface damage, the duration of time the tooth remains outside the mouth (extraoral time), the quality of storage medium utilized, the level of root development of the avulsed tooth [3] and ensuring the socket's sterility prior to treatment. Dental avulsion treatment is carried out based on consideration of root maturity (open or closed). In cases of tooth with open apex, revascularization of the pulp is an effective treatment option that facilitates complete root growth. In cases of an avulsed immature permanent tooth with extraoral dry time longer than 60 minutes, the long-term prognosis after replantation is very poor. Any attached necrotic soft tissues should be removed using gauze. Root canal treatment should be done prior to replantation through the open apex [6].

The golden period of dental avulsion or the optimal time for replantation is typically considered to be within the first 30 minutes to one hour after the avulsion occurs. Replantation during this period optimises the chances of successful reattachment and long-term tooth viability. In this case, the tooth's prolonged extra-alveolar time of over 240 minutes in a dry state, coupled with storage in milk for only 60 minutes, raises doubts about the prognosis. Despite milk being readily accessible for natural storage, the extended dry period poses challenges for the tooth's viability. A delay in the

replantation of avulsed teeth will lead to resorption of the root due to the presence of necrotic periodontal ligament, thus it is required to remove the dead periodontal ligament. Mechanical debridement is considered a simple and effective way of removing the periodontal ligament as it does not aggressively remove the tissue. Irrespective of the root treatment, the replanted teeth should undergo root canal treatment. This is to remove the necrotic pulp tissues present inside the canal. In the present study, root canal treatment was initiated extraorally [2]. The endodontic treatment was carried out extraorally and the avulsed tooth was obturated with Gutta Percha since revascularization of the pulp is no longer possible to occur. Endodontic treatment was done prior to replantation to prevent infection, stimulate inflammatory response and root resorption [12].

The periodontal reactions to replantation can be classified into four main categories; healing with normal periodontal ligament, healing with surface resorption, healing with replacement resorption, and healing with inflammatory resorption. Root resorption is frequently observed in cases of delayed replantation. In the present case, if there is an occurrence of root resorption within months of replantation, it might have been due to the prolonged extraoral dry time that resulted in the destruction of periodontal ligament cells. The occurrence of inflammatory resorption (external resorption) might be due to the residual inflamed periodontal ligament cells or residual inflamed pulp tissue in the root canals which may have initiated the resorption [4,9,10]. Once a pulpal infection have been established, external root resorption is maintained by microorganisms and their toxins, which enter the inflammatory process in the periodontal ligament via open dentinal tubules after loss of the barrier function of the root cementum [13].

Splinting was key to maintaining the correct positioning of the tooth while protecting both the pulpal and periodontal tissues when the tooth exhibited signs of soft mobility and function [2]. An arch wire splint was used to secure the tooth for 2 weeks. Splinting types and duration on periodontal healing have been widely studied on replanted teeth [14]. The splint was attached for a period of two months, utilizing brackets and 0.014 stainless steel orthodontic wire, bonded to the maxillary anterior teeth using a light-cured flowable composite resin. While the optimal duration for splinting a replanted avulsed tooth is generally two weeks, as research indicates that more than 60% of the mechanical properties of the injured periodontal ligament recover within this timeframe, we opted to prolong the splinting period to two months. This choice was informed by the lack of significant improvements in outcomes associated with shorter splinting durations.

It is recommended that regular clinical and radiographic evaluation of the replanted teeth be conducted at 2 weeks, 4 weeks, 3 months, 6 months, and 1 year [9]. However, we continue to follow up on this case to monitor the vitality, mobility, and resorption of the tooth every month. The healing process is also influenced by the level of patient cooperation, which includes maintaining proper oral hygiene, adhering to a healthy diet, and participating in regular control measures.

4. Conclusion

To achieve the most favorable results, it is crucial to replant the teeth promptly following an avulsion. While replantation is typically the preferred treatment for avulsed teeth, immediate action may not always be possible. Other factors influencing successful treatment and prognosis include the degree of damage to the root surface, the duration of time the tooth is outside the mouth (extraoral dry time), the quality of storage medium employed, and the stage of root development of the avulsed tooth.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this document.

Statement of informed consent

Informed consent was obtained from patient included in the study.

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