

## Avulsion – Reimplantation Case Reports

Dr. Amina H Nazneen, Dr. Anupam Kumar TV, Dr. A B Bindu, Dr. Jubna A.J

Department Of Pediatric And Preventive Dentistry, Dental College, Kozhikode, India

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### Abstract

Avulsion is a rare but serious dental injury which requires quick and careful treatment. This case report shows how avulsed maxillary incisors were successfully replanted, even after being outside the mouth for 120 minutes and stored in tap water. Two 12-year-old boys suffered dental injuries to their front teeth due to falls. After examining them, the avulsed teeth were replanted following the guidelines from the International Association of Dental Traumatology (IADT) and were stabilized with a splint. Both patients underwent planned root canal treatment. Follow-up checks at one, three, six, and twelve months showed no issues, and X-rays confirmed no signs of tooth resorption.

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Date of Submission: 06-11-2024

Date of Acceptance: 16-11-2024

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### I. Introduction

Dento-alveolar trauma occurs as a result of a sudden impact to the teeth and their supporting structures, potentially leading to a range of injuries, including the complete dislodgment of a tooth from its socket. Such traumatic dental injuries are particularly prevalent among children aged 7 to 11 years. (1) The predominant

causes of these injuries include accidental falls, followed by participation in sports, road traffic incidents, and instances of physical violence. One of the most severe forms of dental trauma is avulsion, Tooth avulsion refers to the complete removal of a tooth from its alveolar socket (2). Despite the fact that permanent tooth avulsion is not common, its occurrence ranges from 0.5% to 16% among all types of traumatic dental injuries. The maxillary central incisors are the teeth most frequently affected due to their anterior positioning in the dental arch. (3)

Replantation is the primary method of treating an avulsion injury. However, there are some circumstances in which this treatment would not be appropriate, including a high caries index, periodontitis, serious cardiac or immunological disorders, or patients who are anxious. The choice not to replant a tooth is irrevocable, even if some replantation cases have shown a decreased long-term survival rate. Therefore, every effort should be made to preserve the tooth. (4) The patient's general health, the root apex's maturity, the storage medium used, and the amount of extra-oral time all affect how well the replantation procedure goes.(5,6)

Preventing dehydration is essential for maintaining the health and activity of the periodontal ligament (PDL) cells that are still present on the root surface of an avulsed tooth. The selection of storage media and the duration of extra-oral time have the most effects on the PDL cells' state. Milk, Propolis, Viaspan, Hank's balanced salt solution (HBSS), saliva, or saline are all good ways to keep an avulsed tooth.(7) Milk is the most often suggested storage medium among these since it is widely available, has an ideal pH, and contains nutrients, growth factors, and osmolarity.(8) This case report illustrates the detailed procedures undertaken for the successful replantation of avulsed maxillary incisors, despite an extended period outside the oral cavity.

### II. Case Reports

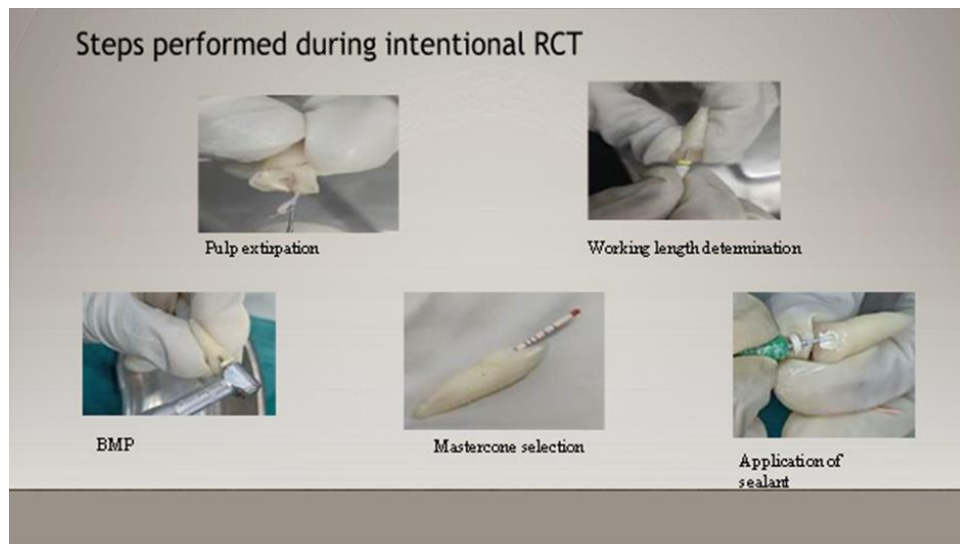
#### Case 1

A 12-year-old male patient reported to the department with a history of a fall, resulting in injuries to the anterior maxillary area. The patient was awake and receptive throughout the examination, and they had no noteworthy medical history. An extra-oral assessment showed no swelling of the upper lip, and there were no reported medical comorbidities. An intraoral examination revealed a laceration in the affected area's peripheral gingiva and the absence of the left maxillary central incisor (21). A dento-alveolar fracture was ruled out after examination and palpation of the anterior maxillary section. In the area of tooth 21, radiovisiography (RVG) revealed an empty alveolar socket with an intact lamina dura; no additional fractures or injuries were observed in the nearby teeth or alveolar structures. It was determined that tooth 21, which had been avulsed, had an Ellis class V fracture.

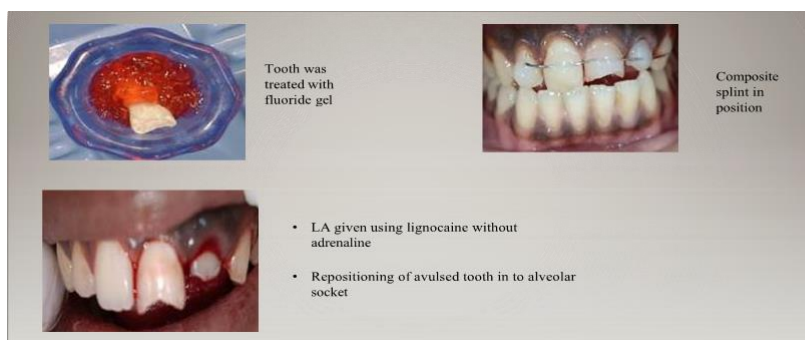
Within two hours of the incident, the patient arrived at the Kozhikode dental college's Department of Pediatric and Preventive Dentistry with the avulsed tooth preserved in tap water (see figure 1). The patient was made aware of the possibility of inflammatory resorption, replacement resorption/ankylosis, and tooth discoloration while transplanting an avulsed tooth that had been out of the mouth for roughly two hours. Repositioning and replanting the avulsed tooth was decided upon after informed consent was obtained. The avulsed tooth had a well-formed root with a closed apex and an unbroken crown. The crown handled the teeth to prevent contact with the root surface after it was removed from the tap water. To get rid of any dirt, the root surface was then gently cleaned with regular saline.



**Figure 1** Tooth Brought To Dept In Tap Water In A Steel Glass



**Figure 2** steps performed during intentional RCT



**Figure 3** Showing Tooth Treated With Fluoride Followed By Reimplantation With Splinting

A purposeful RCT was carried out (figure 2). The pulp was taken out and an access cavity made. A #15 K file (Dentsply Maillefer, Ballaigues, Switzerland) was used to measure the working length. The ProTaper Gold rotary file system (Dentsply Maillefer, Ballaigues, Switzerland) was used to shape and prepare the root canal until it reached size F2. Following each instrument change, 2.5 ml of a 3% sodium hypochlorite (NaOCl) solution was used to irrigate the canal. A final rinse with a 17% ethylenediamine tetra-acetic acid (EDTA) solution was then performed for one minute. The canal was rinsed with saline and then dried with absorbent paper tips. After using a spreader to apply a ZOE sealant in the root canal, a GP cone was positioned, and a temporary filling was used to seal the access cavity.

A 1.23% acidulated phosphate fluoride (APF) gel was applied to the tooth's root surface (Figure 3). Labial and palatal infiltration of 2% lignocaine without vasoconstrictor was used to administer local anesthetic to the afflicted area. Normal saline was used to gently cleanse the alveolar socket. To make sure it was positioned appropriately, the avulsed tooth was then delicately reinserted into the socket with a little pressure. There was no need for an occlusal modification because the repositioned tooth fit the bite perfectly. A splint composed of 0.4 mm stainless steel orthodontic wire and light-cure flowable composite resin (Brilliant Flow, Coltene, Altstätten, Switzerland) was used to hold the replanted tooth in its socket. After using 37% phosphoric acid for 20 seconds to etch the labial surfaces of the maxillary front teeth at the middle third of the crown, the teeth were cleaned and allowed to air dry. The application of a bonding agent (ScotchBond Universal adhesive, 3M ESPE, Bayern, Germany) was followed by a 20-second light cure. After light curing each tooth for 20 seconds, the orthodontic wire was fastened and flowable composite was applied to the etched areas (Figure 3). For five days, the patient was provided oral analgesics and antibiotics (400 mg of metronidazole three times a day, 500 mg of amoxicillin plus 125 mg of clavulanic acid twice a day). Additionally, he was recommended to receive an anti-tetanus booster. He was also told to use a soft-bristled toothbrush and a mouthwash with 0.12% chlorhexidine for oral hygiene, as well as to adhere to a soft diet for two weeks.

TF was switched to GIC two weeks following replantation. Electric pulp testing (EPT) revealed a favorable result when the splint was removed and a vitality test was performed on the neighboring teeth. Additionally, it was seen that the transplanted tooth's movement had diminished.

The clinical examination during the one-month follow-up revealed that the transplanted tooth was moving normally and had a healthy probing depth. X-rays revealed a continuous periodontal ligament (PDL) space surrounding tooth 21 with no indications of resorption, an intact lamina dura, and a normal periapex free of periapical radiolucency. At the three-, six-, and ten-month follow-up visits, these findings were unchanged.



Figure 4|showing 6 months and 10 month follow u

**Case 2**

12 years old boy with history of trauma due to an accident brought to our department with avulsed (11), (21) and (22) as shown in (Figures 5)



**Figure 5** showing avulsed teeth

The patient kept the avulsed tooth dry (figure 6) and arrived at the Department of Pediatric and Preventive Dentistry at the dental college in Kozhikode about two hours after the injury. The patient was made aware of possible issues (like inflammatory resorption, replacement resorption/ankylosis, and tooth discoloration) that could arise from replanting a tooth that had been out of the mouth for up to two hours. The team chose to relocate and replant the tooth after obtaining informed consent. The avulsed tooth had a well-formed root with a closed apex and an unbroken crown. The tooth was held by the crown to prevent contact with the root surface after being taken out of the tap water. To get rid of any dirt, the root surface was then gently cleaned with regular saline.



**Figure 6** showing avulsed 11,21 and 22

Intentional RCT was performed. An access cavity was created, and the pulp was removed. The working length was measured using a #15 K file (Dentsply Maillefer, Ballaigues, Switzerland). The ProTaper Gold rotary file system (Dentsply Maillefer, Ballaigues, Switzerland) was used to shape and prepare the root canal until it reached size F2. Following each instrument change, 2.5 ml of a 3% sodium hypochlorite (NaOCl) solution was used to irrigate the canal. A final rinse with a 17% ethylenediamine tetra-acetic acid (EDTA) solution was then performed for one minute. The canal was rinsed with saline and then dried with absorbent paper tips. After using a spreader to apply a ZOE sealant to the root canal, a GP cone was inserted, temporarily covering the access cavity.

1.23% acidulated phosphate fluoride (APF) gel was applied to the tooth root surfaces. Labial and palatal infiltration of 2% lignocaine without vasoconstrictor was used to administer local anesthetic to the afflicted area. Normal saline was used to gently cleanse the alveolar socket.

To guarantee correct alignment, the avulsed tooth was then delicately reinserted into the socket with a little pressure. There was no need for an occlusal modification because the repositioned tooth fit the bite perfectly. Light-cure flowable composite resin was used to fix the replanted teeth in their sockets using a splint constructed of 0.4 mm stainless steel orthodontic wire (Brilliant Flow, Coltene, Altstätten, Switzerland). The middle third of the crown of the maxillary anterior teeth's labial surfaces were etched for 20 seconds using 37% phosphoric acid, followed by rinsing and air drying. ScotchBond Universal Adhesive (3M ESPE, Bayern, Germany) was used as a bonding agent, and it was light-cured for 20 seconds. Following 20 seconds of light curing each tooth, flowable composite was applied to the etched areas and the orthodontic wire was fastened. For five days, the patient was provided oral analgesics and antibiotics (400 mg of metronidazole three times a day, 500 mg of amoxicillin plus 125 mg of clavulanic acid twice a day). Additionally, he was recommended to



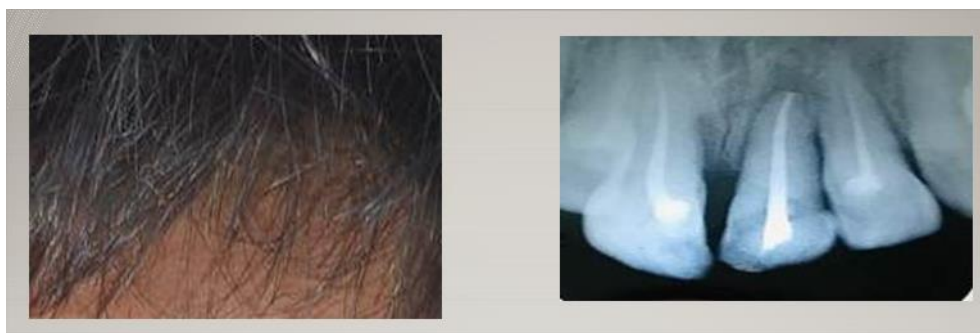
receive an anti-tetanus booster. Additionally, he was instructed to follow a soft diet for two weeks and to use a soft-bristled toothbrush along with a 0.12% chlorhexidine mouth rinse for oral hygiene.

Two weeks after the replanting, the treatment was switched to glass ionomer cement (GIC). The splint was taken off, and a vitality test on the nearby teeth showed a positive result with electric pulp testing (EPT). It was also observed that the mobility of the replanted teeth had decreased.

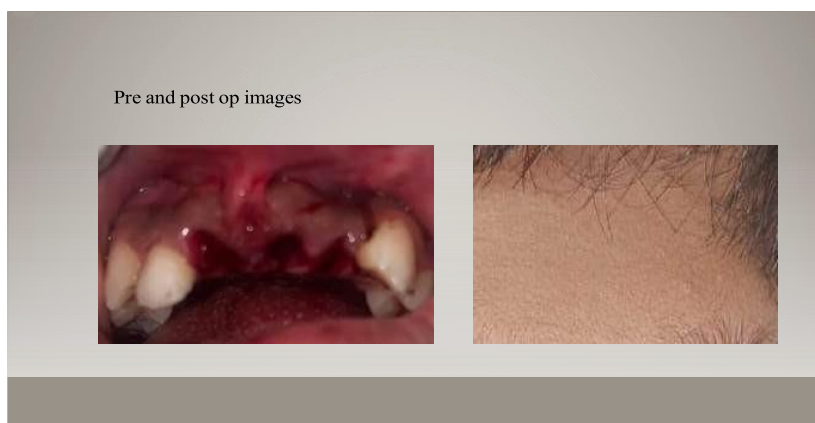
The clinical examination during the one-month follow-up revealed that the transplanted tooth was moving normally and had a healthy probing depth. X-rays showed a continuous periodontal ligament (PDL) space surrounding teeth 11, 21, and 22 with no indication of resorption, an intact lamina dura, and a normal periapex free of periapical radiolucency. These outcomes did not change at the two-month mark.



**Figure 7** Showing Reimplanted Teeth With Composite Splinting



**Figure 8** Showing Clinical And Radiographic Follow Up Pictures



### III. Discussion

The most effective treatment for an avulsion injury is the prompt replantation of the avulsed tooth. Nevertheless, this approach may not always be practical. This case report examines the replantation of an avulsed maxillary incisor after an extra-oral duration of nearly two hours. Effective emergency management, comprehensive treatment strategies, and timely intervention are crucial for achieving a favorable prognosis in avulsion injury cases.(9) Several factors influence the success of replantation, including the patient's overall

health, the maturity of the tooth's root, the choice of storage medium, and the duration of extra-oral exposure, with the latter two being particularly significant.(5) Among the various options for preserving an avulsed tooth, milk is frequently recommended due to its wide availability and suitable pH, which contains essential growth factors, nutrients, and osmolarity. Additionally, as a glandular secretion, milk is rich in epithelial growth factor (EGF), which promotes the proliferation and regeneration of the epithelial cell rests of Malassez.(10)

The duration of the extra-oral period is significantly correlated with the viability of periodontal ligament (PDL) cells. Research indicates that teeth replanted within five minutes exhibit the most favorable prognosis.(11) In contrast, if replantation is delayed beyond one hour, it leads to the death of PDL cells.(12) Therefore, it is essential to store the avulsed tooth in an appropriate medium and to initiate replantation as soon as possible. In the cases discussed, the patient transported the avulsed tooth in tap water and under dry conditions, arriving at the department nearly two hours post-trauma. Such delays in replantation can result in PDL cell necrosis, leading to complications like inflammatory or replacement root resorption. These adverse outcomes can be mitigated through the application of fluoride to the root surface of the avulsed tooth. (13)Although the precise mechanism remains unclear, it is suggested that fluoride facilitates the conversion of hydroxyapatite to fluorapatite by acting directly on dentin, cementum, and bone. Additionally, fluoride is thought to specifically inhibit the activity of osteoclasts. In the cases presented, the root surface of the avulsed tooth was treated with 1.23% acidulated phosphate fluoride (APF) gel to prevent root resorption following replantation. Evidence suggests that the likelihood of complications is greater in teeth with immature apices compared to those with mature apices.(14) Fortunately, in the current cases, the avulsed tooth had a closed apex, which is a favorable factor.

Stabilizing a transplanted tooth in the proper place is the primary objective of splinting it. The International Association of Dental Traumatology (IADT) recommended a two-week splinting period and the use of 0.4 mm stainless steel orthodontic wire that was bonded to the maxillary anterior teeth using light-cure flowable composite resin. Research shows that about 60% of the damaged periodontal ligament (PDL) properties are restored within two weeks, although splinting may be extended for an additional week in cases of significant trauma or improper positioning.

IADT guidelines also state that root canal therapy should begin within two weeks post-replantation to prevent necrotic pulp and toxins from affecting the PDL, which can lead to resorption. In the discussed cases, endodontic treatment was performed extra-orally before replantation. Continuous follow-up of the replanted tooth is crucial, with assessments at three, six, and twelve months, and annually for at least five years, including clinical and radiographic evaluations to identify complications. Additionally, educating patients on emergency protocols and proper storage for avulsed teeth is essential for effective management.

#### IV. Conclusions

Replantation is considered the preferred intervention after an avulsion injury. It is important to note that the success of replantation can still be achieved even when the avulsed tooth has been outside the oral cavity for an extended period. The current case series and other research has shown that, under certain conditions, teeth that have been avulsed for several hours can still be successfully replanted. This method preserves the surrounding bone structure, which is essential for possible prosthetic rehabilitation in the event of replantation failure, while simultaneously meeting the patient's functional and cosmetic needs. If all established criteria and protocols are carefully followed, the replantation of an avulsed tooth can have excellent results even with a prolonged extra-oral duration.

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