

Replantation of avulsed teeth: series of case reports

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Abstract

Avulsion of permanent teeth is one of the most serious dental injuries. Prompt and correct emergency management is essential for attaining the best outcome after this injury. Replantation of avulsed teeth is the most accepted treatment approach considering esthetic and functionality. Successful healing following tooth avulsion depends on the amount of damage to teeth and supporting structures, emergency treatment, and follow-up treatment. All of these plays a role in the long-term

prognosis of avulsed teeth. The aim of this case report is to present the multidisciplinary treatment approach and long-term follow-up of patients with avulsed maxillary central teeth.

Keywords: Avulsion, Trauma, Replantation, Maxillary Incisor, Endodontic Treatment

Introduction

Tooth avulsion is complete displacement of a tooth from its socket in alveolar bone owing to trauma and is seen in 0.5–16% of all dental injuries. Direct force on the

teeth and periodontal ligaments in the alveolar socket causes avulsion. The prevalence of avulsion cases in children increases between the ages of 7 and 9 years due to incomplete root development and minimal resistance of the alveolar bone/periodontal ligament (PDL) against extrusive forces during the eruption period of the teeth.^[1]

^{3]}The etiology of tooth avulsion varies according to the type of dentition. Avulsion in primary dentition is typically a result of hard objects hitting the teeth, whereas avulsion in permanent dentition is generally a result of falls, fights, sport injuries, automobile accidents, and child abuse.^[4-6] In permanent and primary dentition, avulsion generally occurs in the maxilla, and the most commonly affected teeth are the maxillary central incisors. Increased overjet and incompetent lips were identified as potential etiological factors in such avulsion cases.^[7] Individuals who present with overjet in excess of 3 mm are about twice as likely to suffer damage to the anterior teeth, compared to children with fewer than 3 mm overjet.^[8] Although avulsion usually involves a single tooth, tooth-supporting tissue injuries, lip injuries, and multiple avulsions have also been documented.^[9,10]

Replantation is the technique in which a tooth, usually one in the anterior region, is reinserted into the alveolus after its loss or displacement by accidental means.^[11] If re-implantation is not possible, the tooth is stored in a physiological solution to allow longer Extraoral time with fewer resorption complications after replantation. Pulp and periodontal ligament injuries can take place in avulsed or traumatized teeth. Pulp necrosis always occurs in avulsed teeth in permanent teeth and closed apex. Necrotic tissue in the dental pulp is susceptible to bacterial contamination that requires endodontic therapy or an extra-oral approach and retrograde placement of a titanium post. If root canal treatment is not performed,

the pulp chamber is infected. The presence of bacteria in the root canal and cementum damage on the external surface may result in external resorption and cause rapid tooth loss.^[12] However, in certain circumstances (high caries index, periodontitis, severe cardiac or immunosuppressive conditions, apprehensive patients), replantation option is contraindicated.

The success of replantation depends on the patient's general health, the maturity of the root, the time the tooth is out of its socket, and storage medium. The period of extra-oral time and the storage medium have the most critical effect on the status of the PDL cells.^[11,13-15] The longer the avulsed tooth is out of its socket, the less likely it will remain in a healthy functional state after replantation.

Albeit a few replanted cases have shown less long-term survival rate, not replanting a tooth is an irreversible decision. Thus, every attempt must be made to save it. The average survival of replanted teeth at pediatric patients was reported as 95.6% at 1 year follow-up.^[16]

Patient instructions given after replantation are:

- Avoid participation in contact sports.
- Eat only soft food for upto 2 weeks.
- Brush teeth with a soft toothbrush after each meal.
- Use a chlorhexidine (0.12%) mouthrinse twice a day for 1 week.

Follow-up

- Splint removal and clinical and radiographical control after 2 weeks
- Further clinical and radiographic controls after 4 weeks , 3 months , 6 months , 1 year and then yearly thereafter for atleast 5 years.^[17]

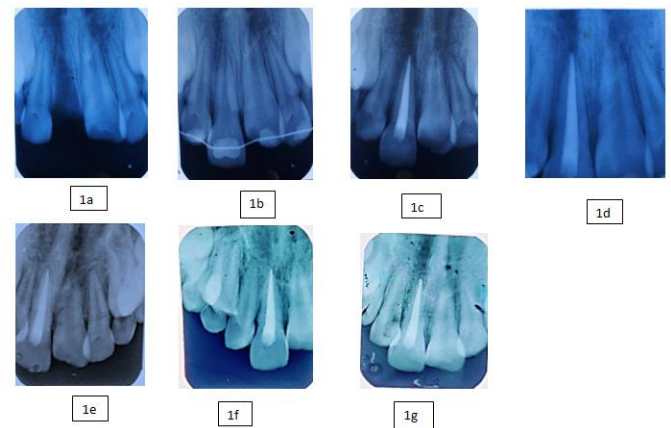
The aim of this case report was to present five different cases of replantation of avulsed maxillary central incisors with different extra-alveolar period.

Case Report 1

A 9 year-old female patient presented with an alleged history of fall and injuries sustained to the anterior maxillary region 20 min ago. The patient had no relevant past medical history and was alert as well as responsive during the process of examination. Extra-oral examination revealed mild abrasion and swollen lower lip. On intraoral examination, the right maxillary central incisor (11) was missing, left maxillary central incisor had Ellis class I fracture in 21 and 22. The marginal gingiva in the associated area was not lacerated and appeared fine. On inspection and palpation of the anterior maxillary segment, the dento-alveolar fracture was ruled out. IOPAR of anterior maxillary region revealed an empty alveolar socket with an intact lamina dura in the 11 region, there was no other injury or fracture of the associated alveolar structures (Figure 1a). The case was diagnosed as an Ellis class V fracture with 11 and Ellis class I fracture in 21, 22.

The patient preserved the avulsed tooth in milk and reported to the Department of Pedodontics and Preventive Dentistry of Haldia Institute of Dental Sciences and Research, West Bengal approximately 20 minutes after the incidence of trauma. The patient was informed about the possible complications (inflammatory resorption, replacement resorption /ankylosis, tooth discolouration) involved with replanting an avulsed tooth that had endured an extra-oral time of approximately 20 minutes. After obtaining informed consent, it was decided to reposition and replant the avulsed tooth. The avulsed tooth had an intact crown and a well-formed root with a closed apex. After taking it out from the milk, the avulsed tooth was held by the crown, taking care that the root surface was not touched. The root surface was then gently rinsed with normal saline in order to remove any debris that had

adhered to it. The alveolar socket was gently rinsed with normal saline. The avulsed tooth was then repositioned in the socket with slight digital pressure and the correct positioning was verified with RVG. After radiographic verification, the replanted tooth was stabilised in its socket with splinting that comprised of an orthodontic wire (0.4 mm stainless steel wire) secured with light-cure flow able composite resin. The patient was also recommended to seek an anti-tetanus booster dose. After 2 weeks periapical lesion was noted in 11 thus, conventional root canal therapy was initiated in the replanted tooth according to IADT guidelines. The splint was removed after 2.5 weeks of replantation and a vitality test was performed on the adjacent teeth that elicited a positive response to electric pulp testing (EPT). Follow up radiographs up to 2 years are as follows (Figures-1a-g)



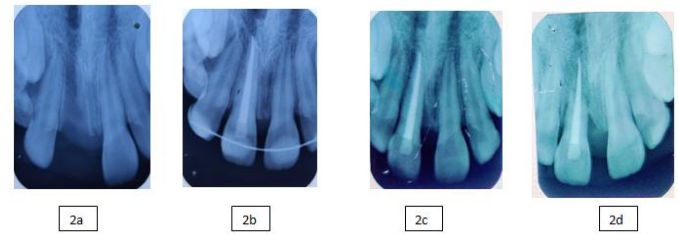
Figures 1: a) Radiograph at the time of avulsion , b) Splinting of teeth on day of avulsion , c) After 1.5 month , after completion of endodontic treatment , d) 3 month follow up , e) 6 months follow up , f) 1 year follow up , g) 2 years follow up

Case Report 2

A 9 year old boy reported to the Department of Pedodontics and Preventive Dentistry of Haldia Institute of Dental Sciences and Research, West Bengal with chief complain of broken front tooth due to fall back

injury while playing on ground 14 hrs ago. Tooth was kept dried without any storage media. The past medical history was unremarkable and he was not taking any medication and had no allergies. Initial examination of the facial bones and TMJ were within normal limits. There were no occurrences of unconsciousness, nausea and vomiting. On intraoral examination, it was found that patient had avulsed 11 tooth (Ellis class v fracture). The tooth was avulsed as whole without any fracture no fractured segment was present inside the socket. Root formation of 11 was found to be complete. No active bleeding was there, only clot formation within the socket of 11. Proclined 21 present. On extraoral examination, no gingival cut / laceration was present. Patient showed habit of lower lip trap. Radiographs examination showed a normal socket for tooth 11 and inexistence of fracture. No root fragment was present within the socket. The procedures performed included endodontic treatment; replantation followed by splinting of several teeth.

After obtaining an informed consent from the patient, replantation of tooth 11 was decided. As the tooth was received after 14 hrs without any storage media the tooth was cleaned with N-saline followed by immersion in 1.23 % APF gel for 20 min. Extraoral root canal treatment was performed on tooth 11 and the tooth was obturated with gutta-percha. The empty socket was curetted then irrigated with normal saline. Replantation of tooth 11 was carried out, followed by splinting using composite & wire (0.4 mm) splint with respect to 12, 11, 21, 22. Patient was given post-operative instructions and recalled for periodic follow ups. Figure 2(a-d) shows periodic follow up radiographs up to 1 year.



Figures 2: a) Radiograph at the time of avulsion, b) Splinting of teeth on day of avulsion, c) 6 months follow up, d) 1 year follow up.

Case Report 3

A 7.5 year old female patient reported to the department with complaint of iatrogenically avulsed lower anterior tooth. History of presenting illness showed iatrogenic extraction of 31 by parents while trying to extract 71 with preshedding mobility at home 18 hours ago. The patient's medical and family history was non-contributory for the pertinent findings. On examination, the patient did not show any signs or symptoms of neurological or Extraoral injury. His parents had let the avulsed tooth 31 dry in a piece of paper and brought it to the hospital & 31 had only 2/3rd root completion.

The root surface of the avulsed tooth was treated with 1.23% acidulated phosphate fluoride (APF) gel for a duration of 20 minutes. Extraoral root canal therapy with retrograde monoblock obturation was performed in 31 with MTA. Local anaesthesia (2% lignocaine without vasoconstrictor) was administered. The alveolar socket was gently rinsed with normal saline. The avulsed tooth was then repositioned in the socket with slight digital pressure and the correct positioning was verified with RVG. After radiographic verification, the replanted tooth was stabilised in its socket, stabilized with 3-0 silk suture along with splinting that comprised of an orthodontic wire (0.4 mm stainless steel wire) secured with light-cure flow able composite resins. Post-operative instructions were given & patient is kept on

periodic follow-up as per IADT guidelines. Figures 3(a-f) shows 1 year follow up.

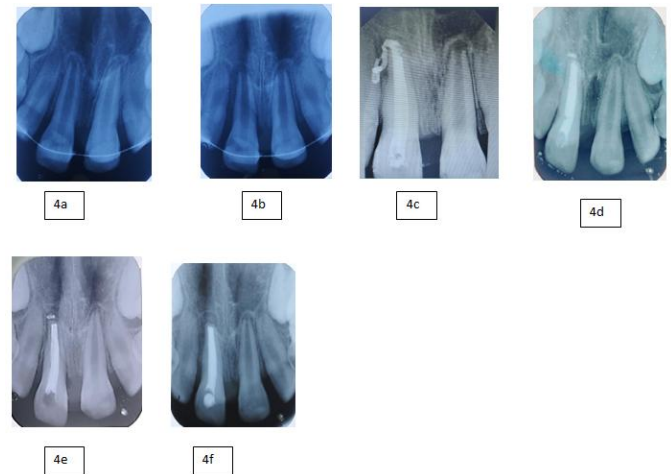


Figures 3: a) intraoral picture at the time of avulsion, b) intraoral picture after 1 year, c) radiograph at the time of avulsion, d) after splinting, e) 6 months follow up, f) 1 year follow up.

Case Report 4

A 9 year old child presented with mobile upper front teeth due to trauma 7 days ago. Gave a history of presenting illness as trauma to 11 due to fall back injury 7 days ago resulting in avulsion of 11. Patient immediately replanted avulsed tooth into the socket due to fear of getting scolded. Family members got to know about this after 5 days of incident and reported to the hospital on 7th day. The past medical history was unremarkable and he was not taking any medication and had no allergies. Initial examination of the facial bones and TMJ were within normal limits. No extraoral laceration or abrasion of soft tissues noted. Intraoral examination revealed grade 3 mobility in previously avulsed self-replanted 11 and grade 2 mobility in 12, 21, 22 and proclined anteriors. Radiographic examination revealed open apex of 11. Replantation of 11 was done properly followed by splinting with composite and ligature wire (0.4 mm) was done with respect to 53, 12, 11, 21, 22, 63. Post-operative instructions were given to the patient.

After 1 week of splinting periapical lesion was noted in 11 radiographically. Endodontic treatment was initiated in accordance to IADT guidelines. Calcium hydroxide (Metapex) was placed as an intracanal medicament for 8 weeks. MTA was placed as apical barrier in apical 3rd of the root and obturation done with gutta-percha in 11. Figures 4(a-f) shows 1.5 year follow up.



Figures 4: a) Radiograph after Splinting of teeth on day of reporting, b) After 1 week, c) 2.5 months follow up, d) 6 months follow up, e) 1 year follow up, f) 1.5 year follow up.

Discussion

Current efforts in the trauma literature of avulsion injury focuses on the following areas: Dry extra oral time, storage of the avulsed tooth, treatment of the periodontal ligaments, touching the cementum surface, splint treatment for prolonged time and treatment of the pulp canal to reduce the risk of inflammatory resorption. Treatment of the avulsed tooth's root surface may also increase the probability of successful replantation. Other factors such as the age of the individual, type of splinting, mastication, socket treatment, endodontic treatment, antibiotics, the time of replantation and macroscopic contamination, can also affect the clinical success of replantation.

The most important thing is survival, which is followed

by the healing of periodontal ligament cells. The long-term achievement of replanted avulsed permanent incisors is directly affected by the health of the periodontal. Periodontal reactions to replantation occur in four different conditions, namely, healing with normal periodontal ligament, healing with surface resorption, healing with replacement of resorption (ankylosis), and healing with inflammatory resorption (infection).^[18]

Andersson and Bodin discovered that teeth replanted within 15 minutes have a favorable long-term prognosis, and most teeth replanted within 10 minutes experienced no resorption. It has been found that dry storage of greater than 15 minutes causes precursor cells on the root side of the PDL to fail to reproduce and differentiate into fibroblasts.^[19]

According to Resende et al.^[20], natural products are reported to be more effective than synthetic media. Natural media that can be used from plant derivatives are propolis which has potential effects on cell viability, anti-inflammatory effects, and osteogenic differentiation. Other natural media are coconut water, aloe Vera and green tea. Other types of storage media are non-physiologic media (e.g. tap water) and physiologic media (e.g. milk, HBSS, Eagle's medium, soymilk, egg white, and etc.). Amongst these, milk being easily available and having a suitable pH with appropriate growth factors, nutrients, and osmolarity, is the most extensively used and recommended storage media. In this present case, it was mentioned that the avulsed tooth was in a dry storage media, milk being a gland secretion contains epithelial growth factor (EGF) that stimulates the proliferation and regeneration of epithelial cell rests of Malassez.^[21] The condition of the media is non-physiologic media prior to replantation that can result in total necrosis of the periodontal ligament and healing by replacing root resorption. Periodontal ligament and tooth

surfaces are resorbed and replaced with the surrounding alveolar bone resulting in ankylosis. If the treatment can be carried out properly, avulsion tooth with non-vital periodontal ligaments can be replanted and continue to function for several years.

Immediate surgical repositioning of the luxated tooth has been associated^[22] with a high incidence of ankylosis, pulp necrosis and especially marginal bone loss. These complications can be avoided by root surface treatment of the avulsed tooth with fluoride. The exact mechanism is not known but it is hypothesized that fluoride converts hydroxyapatite into fluoroapatite by direct action on dentin, cementum, and bone. It is also believed that fluoride specifically inhibits the activity of clastic cells.^[23] However, current IADT guidelines do not recommend any surface treatment but it was mentioned in previous guidelines.

The rationale behind splinting the replanted tooth is to stabilise it in its appropriate position. In the case discussed above, splinting was done in accordance with the guidelines prescribed by IADT^[17] with 0.4 mm stainless steel orthodontic wire bonded to the maxillary teeth with a light cure flowable composite resin. The ideal duration of splinting a replanted avulsed tooth is believed to be two weeks because studies have shown that more than 60% of the mechanical properties of the injured PDL return within two weeks following injury. However, an additional week of splinting would be necessary in case of excessive trauma or if it is unable to maintain the avulsed tooth in its correct position.^[24]

The replanted tooth needs endodontic therapy because the necrotic pulp and its toxins may gain access to the periodontal ligament through various portals of exit, thus contributing to the process of resorption.^[25] In the past, it was advised to perform root canal therapy extra-orally before replantation.^[3] However, the current guidelines

recommend root canal therapy be performed intra-orally.

This minimizes the extra-oral time and associated risk factors.^[17] Calcium hydroxide has antimicrobial effects, inhibits bacterial enzymes, activates tissue enzymes such as alkaline phosphatase, and stimulates mineralisation; thus, helping in thorough disinfection and reducing the chances of replantation associated root resorption.^[28]

Although the current guidelines recommend placing calcium hydroxide for a longer duration of four weeks, it has been shown to have similar efficacy when placed for a shorter duration in the absence of pathology.^[26] The occurrence of replacement resorption increases with extended periods of dry storage. Replacement resorption ranges from only 9.5% in teeth with short dry storage of below 15 min to 100% in teeth with dry storage exceeding 60 min.^[27]

The emergency treatment and the clinical decisions must be made at the time of injury. Furthermore, there is need for long term follow up because of the high incidence of complications. The correct application of restorative techniques immediately after the trauma should improve short and long term outcomes. Treatment guidelines are extremely important in providing the clinician with the most current evidence-based information for the management of traumatic dental injuries and form the basis for treatment decisions. Not replanting a tooth is an irreversible decision. Thus, every attempt must be made to save it for aesthetic, functional and psychological needs.

A replanted tooth must be followed up at regular intervals till 12 months and thereafter annually for a minimum period of five years, with clinical and radiographic examinations at every follow-up visit to rule out any associated complications.^[17] Educating the patient regarding emergency management following avulsion and various storage media is essential for the

successful management of an avulsed tooth child, in the mixed dentition stage of dental development, had anterior maxillary over-jet protrusion. This type of malocclusion is considered to be a predisposing factor for traumatic dental injuries.

A systemic antibiotic course was prescribed, consistent with the recommended treatment guidelines and based on evidence that the presence of microorganisms hindered pulp revascularization and that systemic antibiotics administered at the time of replantation prevented inflammatory root resorption. Even though the value of systemic administration of antibiotics is highly questionable, the periodontal ligament of an avulsed tooth often becomes contaminated by bacteria from the oral cavity, the storage medium, or the environment in which the avulsion occurred.^[29]

Aksel et al. established a prospective new clinical protocol to manage avulsed teeth based on the current progress of cell-based PDL regeneration studies.^[30]

- Extraoral time is <1 h and the tooth is kept wet. Immediate replantation along with PRF is advised.
- Extraoral time is more than 2 h but <7 days and the tooth is kept wet. RCT should be done followed by replantation with PRF. The outcome of this situation is certainly less favorable.
- Extraoral time is <7 days but the tooth is dry. RCT followed by cell-mediated therapy is the only optimal way.
- Extraoral time is more than 7 days either tooth is kept wet or dry; RCT followed by cell-based therapy is the only option.
- Extraoral time is longer than weeks, either kept wet or dry. RCT is followed by creating socket space, which by then has been filled with granulation tissue or immature bone, for the cell-based replantation procedures.

Conclusion

Replantation is the treatment of choice following avulsion. It not only satisfies the patient's functional and aesthetic concerns but also helps to maintain the surrounding bone for prosthetic rehabilitation, in case of replantation failure. Despite an extended extra-oral time, replantation of an avulsed tooth can have a favourable outcome if all the recommended guidelines and protocols are followed.

Treatment decisions should be patient-centered and made in consideration of accepted evidence-based treatment guidelines, the clinical circumstances presented at the time of the injury, the clinical judgement of the attending dentist and the dental and oral health needs of the patient.

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