

CASE REPORT

Delayed replantation of avulsed permanent maxillary central incisor: Case report with 6-year follow-up

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Key Clinical Message

Replantation should be attempted in any case of avulsion, be it immediate or delayed. Retention of the replanted tooth helps in preservation of adjacent alveolar bone. Despite the occurrence of replacement resorption, the tooth can stay healthy and functional in the arch for a longer duration.

KEYWORDS

avulsion, delayed replantation, external cervical resorption, replacement resorption

1 | INTRODUCTION

Avulsion, or exarticulation, is the complete displacement of a tooth from its alveolar socket as a result of trauma.^{1,2} Immediate replantation is the treatment of choice in case of avulsion.^{3,4} However, immediate replantation generally is not possible due to the presence of other comorbidities like extensive life-threatening injuries, complex damage to the recipient site like complex dentoalveolar fractures, patient's emotional condition at the moment of trauma, lack of accessible health care facility, and lack of knowledge and confidence about the immediate replantation in the general population or even the dental professionals.² The long-term prognosis of a replanted tooth is questionable as the replanted tooth might require extraction at a later stage due to the possible complications like surface resorption, replacement resorption, and inflammatory resorption. However, not replanting the avulsed tooth is an irreversible decision, so every attempt should be made to replant it.³⁻⁵ Where immediate replantation is not feasible,

the extra-alveolar conditions can be modified by storing the avulsed tooth in a physiological storage medium.¹ Numerous literatures have been published about replantation of an avulsed tooth, but literature reporting replantation after more than 72 h of avulsion with follow-up of more than 5 years are scarce.⁶⁻⁸

The present case report showcases the delayed replantation of a permanent maxillary central incisor after 72 h of avulsion where the avulsed tooth was stored in a dry field before replantation. Clinically, the replanted tooth was asymptomatic till 5-year follow-up visit, but there was presence of pinkish discoloration and slight infraposition on the 6-year follow-up visit. Radiographically, there was replacement root resorption on the 4-week follow-up visit which was progressing gradually. Apart from that, there was evidence of external cervical resorption (ECR) on the 5-year follow-up visit which progressed extensively on the 6-year follow-up visit, due to which plan for extraction of replanted tooth was made. Nevertheless, the replanted tooth served as an interim prosthesis till 6 years.

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2 | CASE-REPORT

A 14-year-old female patient reported to the Department of Pedodontics and Preventive Dentistry on March 14, 2017 with a chief complaint of dislodged upper front tooth due to trauma 72 h back. The injury had occurred as she slipped while pumping water from a hand water pump. There was no history of loss of consciousness and bleeding or discharge from the ear and nose. The day after the injury, she had visited the nearby primary health care center (PHC), but no treatment was provided there. There was no history of tetanus prophylaxis in the PHC. The patient had brought the dislodged tooth stored in dry field (Figure 1A). On examination of the avulsed tooth, there was fracture in the incisal surface involving enamel and dentin, and the periodontal ligament tissues of the avulsed tooth were desiccated.

On extraoral examination, there was an abrasion in the chin and the patient had convex a facial profile. There was no evidence of swelling of the face, deviation or deflection of the jaw, decreased mouth opening, and step deformity. Intraorally, there was an empty socket of 11 and the socket was filled with blood clots (Figure 2A). The patient had end on molar relationship and overjet of 4 mm. On radiographic examination, the socket was intact without any sign of alveolar fracture (Figure 3A). The adjacent teeth were intact with normal mobility.

Replantation of the avulsed tooth was planned. Informed assent and consent were obtained for the procedures from the patient and her father. The avulsed tooth was then cleaned and the remaining periodontal ligament (PDL) fibers were removed with Gracy curette no. 1/2 (Hu-Friedy Mfg. Co. LLC, USA) (Figure 1B), followed by soft pumice prophylaxis. As the extraoral dry time was more than 60 minutes, extraoral root canal treatment (RCT) of the avulsed tooth was planned. Access opening of the avulsed tooth was done followed by working length determination and biomechanical preparation (BMP) using sizes 10–55 Kerr files (Mani Inc. Japan). After cleaning, shaping, and drying of the avulsed tooth root canal, obturation with gutta-percha points (Meta Biomed Co. Ltd., Korea) using lateral condensation technique was done (Figure 1C–E). The fractured incisal surface was restored with composite resin (Tetric N-Ceram, Shade A2, Ivoclar Vivadent, Liechtenstein). The avulsed tooth was then kept in a solution of 2% sodium fluoride (NaF) (Fluocal Gel, Septodont Healthcare Pvt. Ltd, India) for 20 min (Figure 1F). Under local anesthesia (Lignocaine 2%, LOX*2% Neon Laboratories Limited, India), the socket was curetted and cleaned with 5% normal saline. Replantation of the avulsed tooth was done (Figure 2B) and its proper position was verified using an intraoral periapical radiograph (IOPAR). The replanted tooth was

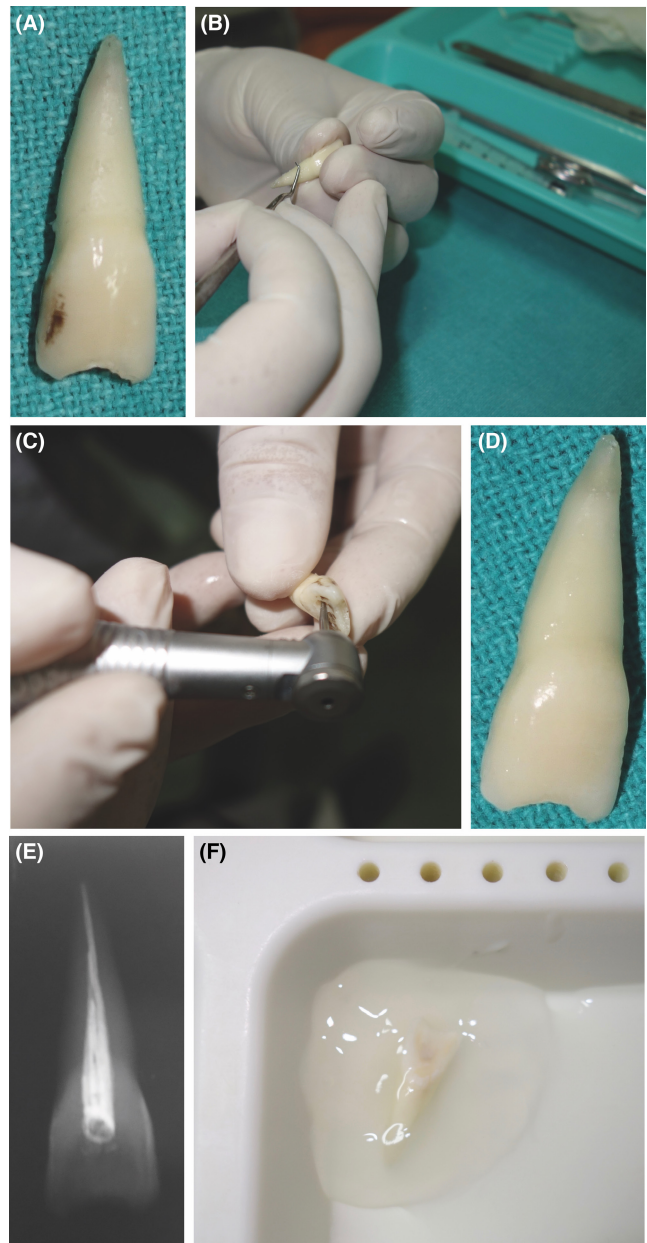


FIGURE 1 Treatment of the avulsed tooth before replantation: (A) Avulsed tooth. (B) Removing the PDL cells. (C) Performing extraoral RCT. (D, E) After completion of extraoral RCT. (F) Placing the tooth in a solution of 2% sodium fluoride.

then splinted from canine-canine using a 0.4-mm diameter stainless wire and composite resin (Tetric N-Ceram, Shade A2, Ivoclar Vivadent, Liechtenstein) (Figures 2C and 3B). Antibiotics (Amoxicillin 500 mg eight hourly for 7 days) and analgesics (Paracetamol 500 mg as per need) were prescribed. The patient was advised to consume soft diet for 2 weeks and maintain good oral hygiene. The patient was then referred to the medical practitioner for the evaluation of the need for an anti-tetanus booster. The splint was kept for 4 weeks.

On the regular follow-up visits till 5 years, the replanted tooth was asymptomatic without any mobility, swelling, or sinus tract formation clinically (Figure 2D,E). Radiographically, there was evidence of replacement root resorption on the 4-week follow-up visit which was gradually progressing (Figure 3C–F). But on the 5-year follow-up visit, along with replacement resorption, there was initiation of external cervical resorption also (Figure 3G). On the 6-year follow-up

visit, the tooth was intact in the arch with no pain and mobility, but there was evidence of pinkish discoloration and infra-position of <1 mm clinically (Figure 2F), and the radiograph showed an increase in the amount of both the external cervical and replacement root resorption (Figure 3H). The adjacent teeth were normal both clinically and radiographically during the follow-up visits. The patient was then referred for the extraction of the tooth followed by provision of definitive prosthesis.



FIGURE 2 Intraoral frontal photographs before replantation and post-replantation follow-up visits: (A) Preoperative. (B) After replantation of avulsed tooth. (C) After splinting. (D) Four-week follow-up. (E) 19-month follow-up. (F) 6-year follow-up.

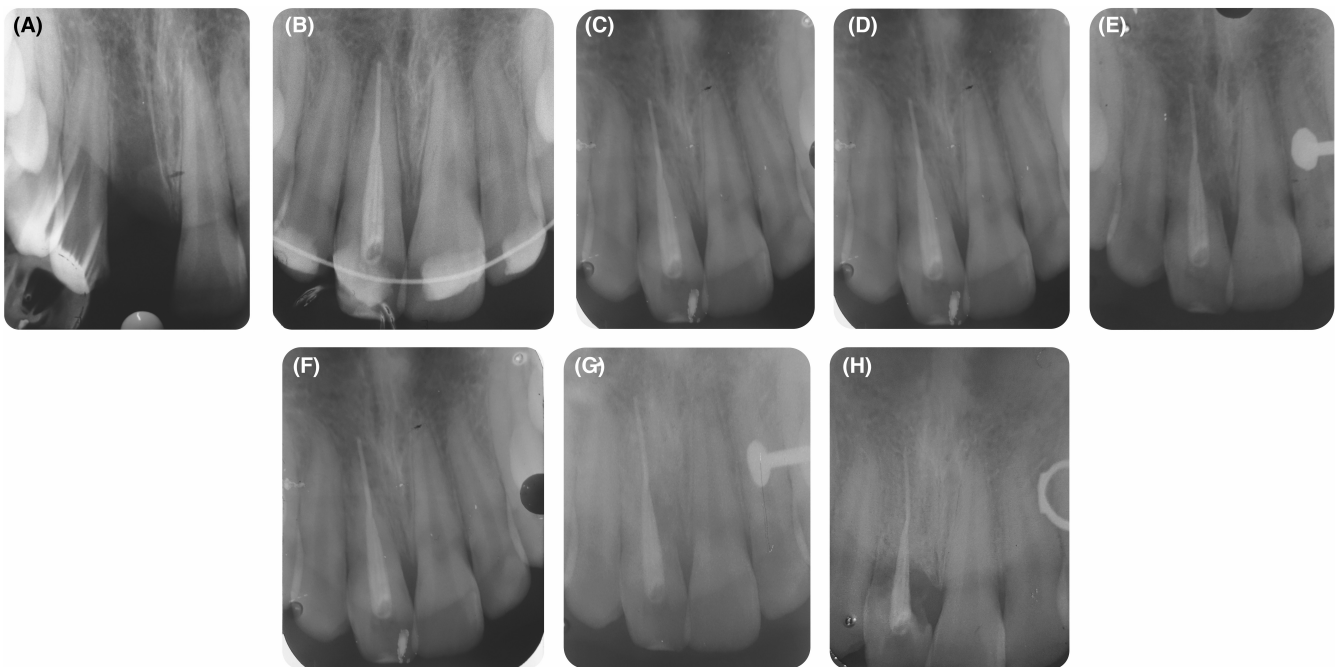


FIGURE 3 Intraoral periapical radiographs before replantation and post-replantation follow-up visits. (A) Preoperative. (B) After replantation of avulsed tooth and splinting. (C) Four-week follow-up. (D) Six-month follow-up. (E) Twelve-month follow-up. (F) Nineteen-month follow-up. (G) Five-year follow-up. (H) Six-year follow-up.

Extraction of the replanted tooth along with intraosseous gutta percha was done which was then followed by placement of implant prosthesis by the team of periodontist and prosthodontist.

3 | DISCUSSION

Traumatic dental injuries (TDI) are very frequent in every part of the world. According to a comprehensive review done by Petti et al. in 2018,⁹ the worldwide prevalence of TDI was 15.2% in permanent dentition, 22.7% in primary dentition, and 18.1% among 12-year-old children. Avulsion of permanent teeth is seen in 0.5%–16% of all TDI.^{3,10} Among the TDI that occurred in Nepalese children, avulsion of the tooth was found to be 19.64%, and the prevalence of avulsion was higher in permanent teeth as compared to primary teeth.¹¹ Age-wise, children in the age group 6–10 years have shown the highest prevalence of avulsion. The reason for this high prevalence in this age group could be attributed to their playful nature and their active involvement in contact sports.^{2,11–13} Injuries of teeth like fractures are more common among adults whereas luxation injuries are more common in children. The smaller crown root ratio and elasticity of alveolar bone which favors absorption of energy are the reasons for more frequent luxation injuries in children.¹⁴ Gender-wise, males have been shown to have a higher prevalence of avulsion injuries.¹² The reason might be that boys prefer outdoor activities and contact sports more when compared to girls.¹¹ Maxillary central incisors are the most commonly avulsed teeth,¹² and the patients often report a history of increased proclination of the avulsed teeth¹⁵ as seen in the present case. Avulsion injuries are sometimes associated with fractures of the avulsed tooth and intraoral and extraoral soft and hard tissue injuries.¹² In the present case also there was associated soft tissue injury in the chin.

As avulsion is a dental emergency situation, prompt management of the avulsed tooth ensures better prognosis. A study conducted by Mazur et al. in 2021¹⁶ among Italian dentists showed that the proper management protocol of avulsed tooth was not well understood by the participants and the same findings were revealed by a study done among the Nepalese dentists.¹⁷ A study conducted by Pradhan et al. among the Nepalese school teachers also revealed that the participants lacked adequate knowledge about emergency management of dental trauma.¹⁸ In the present case also, the patient reported to the hospital after 72 h of avulsion as she lived in remote area where health care facility and manpower for management of avulsion cases were not available. The patient did not have knowledge about the emergency

management of the avulsed tooth, so the avulsed tooth was kept in dry field for 72 h, which ultimately led to compromise in the post-replantation outcome. Provision of adequate infrastructure in the local health care centers, and knowledge about the emergency management among the dentists, other health care professionals, and even general population should be prioritized during policy making.

Replantation of the avulsed tooth helps to maintain alveolar bone volume and morphology which at a later date provides more rehabilitation options like implants.^{19,20} Apart from that, retention of the patient's tooth by replantation or interim prosthesis offers psychological benefit to the patients that his/her tooth was put back rather than an artificial tooth.²¹ This was evident in the present case as well, the replanted tooth provided immense psychological benefit to the patient who was a 14-year-old adolescent concerned very much about her esthetics.

Replantation of an avulsed tooth within 5 min of avulsion usually ensures prompt return of the PDL cells to their normalcy.^{20,22} In case of more than 15 min of dry storage time, the precursor, progenitor, or stem cells are no longer able to differentiate into fibroblasts,^{1,2} and after 30 min of dry storage, virtually all of the PDL cells that are remaining on the root surface are likely to have become necrotic hence the poor long-term prognosis.^{1–3,23}

Studies have been done focusing on either cell-based therapy or activation of endogenous repairing systems induced by additional biological cues. In a study done on animal models, there was a reestablishment of the PDL cells where the cultured PDL cells were applied in delayed replantation cases. Apart from cultured PDL cells, PDL stem cells, bone marrow mesenchymal stem cells, adipose-derived stem cells, and other induced pluripotent stem cells have shown favorable results in reestablishing the formation of PDL cells.²⁴ Different literatures have presented cases in which delayed replantation had been attempted,^{6–8,25–31} but most of them being <72 h of extraoral dry time, and the replanted teeth serving its function for years.^{6,7,25–34}

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, Minimum Essential Medium, Gatorade, Custodiol, Dubelco's storage medium, propolis, tooth rescue box (Dentosafe), conditioned medium, contact lens solution, tap water, egg white, saliva, normal saline, saliva extract, green tea, red mulberry, ricetral, and coconut water are used as storage media.^{1,2} A study conducted by Hegde et al.³⁵ has shown that GC tooth mousse plus which contains casein phosphopeptides-amorphous calcium phosphate (CPP-ACP) can also be used as storage media to prevent

desiccation of PDL cells for up to 60 min. In the present case, although the extraoral dry time was 72 h which indicates a poor long-term prognosis, replantation was attempted. Once the patient and the avulsed tooth were received in the hospital, every attempt was made to follow the standard guidelines.⁴

Placement of replanted tooth in 2% NaF for 20 min was recommended by the IADT 2012 guidelines. NaF was suggested to inhibit root resorption in delayed replantation cases as NaF was believed to convert the hydroxyapatite present in dentin into fluorapatite which is more resistant to resorption. However due to lack of scientific evidence, the IADT 2020 guidelines no more advocated for the pretreatment of avulsed tooth with NaF.^{3,4} A study done by Roskamp et al., in which post-replantation outcome was compared among the replanted teeth managed following IADT 2012 and IADT 2020 guidelines, showed no statistically significant difference.³⁶

Regular clinical and radiographic evaluation of the replanted teeth is advised at 2 weeks, 4 weeks, 3 months, 6 months, 1 year, and yearly thereafter for at least 5 years. The periodontal reactions to replantation mainly occur in four different manners; healing with normal PDL, healing with surface resorption, healing with replacement resorption, and healing with inflammatory resorption.⁵ Healing with normal PDL and healing with surface resorption are considered as the favorable outcomes,³⁷ whereas the presence of swelling or sinus tract, excessive mobility, infraposition of the replanted tooth, replacement root resorption, external root resorption, internal root resorption, external cervical resorption, and peri-radicular radiolucency are the unfavorable outcomes in case of replantation.^{3,19} A meta-analysis conducted by Souza et al. have found the incidence of internal root resorption to be 1.2%, surface root resorption to be 13.3%, inflammatory root resorption to be 23.2%, and replacement root resorption to be 51%, which shows that resorption in any form is inevitable sequelae of a replanted tooth.^{6,7,25,26,29,30,34}

In delayed replantation cases, root resorption is common.^{3,38} In the present case, the occurrence of replacement root resorption within a month of replantation might have been due to the prolonged extraoral dry time that resulted in the destruction of PDL cells.^{1,3,4,23} Usually, replacement resorption is associated with infraposition. In the present case, there was no evidence of infraposition till 5-year follow-up but in the 6-year follow-up visit, slight infraposition of the replanted tooth was noticed. Apart from replacement resorption, external cervical resorption was noticed on the 5-year follow-up which progressed rapidly within a year.

External cervical resorption which is also known as invasive cervical resorption, is a specific class of external

resorption that initiates at the cervical aspect of the tooth. The exact cause and pathogenesis of ECR remain poorly understood. ECR is found to be caused due to the over-proliferation of PDL tissues and inflammation is believed to be a prerequisite for the initiation. External repair, internal repair, palliative treatment, and extraction are the treatment options for ECR. In the present case, as there was rapidly progressing ECA and progressing replacement resorption, the mutual decision was made along with the patient to keep the tooth in its usual state till it was asymptomatic and then to refer for extraction.³⁹

In the present case, the occurrence of inflammatory resorption (external cervical resorption) might be due to the residual inflamed PDL cells or residual inflamed pulp tissue in the root canals which might have initiated the resorption. Meticulous cleaning of the root surface and the root canals might have prevented the occurrence of ECR. Apart from ECR, the occurrence of replacement root resorption in the present case might be due to the prolonged extraoral dry time of the avulsed tooth. This can be considered the limitation of the present case report. Nevertheless, the authors tried to provide the best management which was possible for the patient in the presented scenario, and occurrence of resorption in different forms has been reported by many authors^{6,25,26,29–31,34,39} in replantation cases despite the best possible management.

Lastly, the goal of replanting the tooth in the present case was to serve as the interim prosthesis until the patient, who was just 14 years of age, would be ready for the definitive prosthesis. Provisional prosthesis like removal partial denture (RPD) and Ribbond fiber bonded fixed prosthesis can also be considered as the possible prosthetic options in young patients. The coronal fragment of the avulsed tooth can also be used for the rehabilitation of edentulous space along with RPD or ribbond bonded fixed prosthesis.^{21,40} Retention of the whole or decoronated replanted tooth for some years can be considered a success as the alveolar bone can be preserved, which on a later date provides a greater number of options for definite prosthesis like implants.¹⁹ Considering all the adversities like prolonged extraoral dry time of 72 h, the replanted tooth was clinically intact in the arch for 6 years despite progressing replacement and external cervical resorption, and at the same time having back own tooth replanted boosted the confidence in the patient who was a 14-year-old adolescent concerned very much of her esthetics.

4 | CONCLUSIONS

Traumatic dental injuries are inevitable but what follows after such incidents are very much under the control of dental professionals once the patient is received. The

present case report emphasizes the fact that replantation should be attempted in any case of avulsion, be it immediate or delayed. Despite the occurrence of replacement resorption, the tooth can stay healthy and functional in the arch for a longer duration. Never stop hoping, never stop trying!

AUTHOR CONTRIBUTIONS

Amita Rai: Examination of the patient; investigation; treatment planning; management of the patient; follow-up; literature review and writing – original draft. **Bandana Koirala:** Treatment planning; investigation; supervision; writing – review and editing. **Mamta Dali:** Treatment planning; supervision; investigation; writing – review and editing. **Sneha Shrestha:** Treatment planning; supervision; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors have nothing to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CONSENT

Written informed consent for sharing the photographs and publication was taken from the patient.

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