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A case report on avulsed central and lateral incisors replanted after extended extra alveolar time stored in multiple storage media

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Abstract
Traumatic dental injuries (TDIs) occur frequently in children and young adults, comprising 5% of all injuries. Twenty-five percent of all school children experience dental trauma and 33% of adults have experienced trauma to the permanent dentition, with the majority of the injuries occurring before age 19. Dental avulsion is one of the most common among these dental injuries. When the tooth is knocked out, the blood supply to the pulp is interrupted and the periodontal ligament cells are exposed to injuries caused by the external environment. In recent years, research findings have shown the possibility of complete healing under favorable conditions: replanting the tooth according to the criteria required by the guideline such as the extra oral time which should be very short, the time of pulp removal after replantation, and the appropriate storage medium. This set of criteria may lead to a slower progression of the phenomenon of resorption with a better prognosis over time; however, there is a high risk of complications such as external root resorption in case of delayed replantation.
This case report presents a case of replantation of avulsed maxillary central incisor and lateral incisor after an extended extra-alveolar period of 1.5 hours.

Keywords: avulsed central, lateral incisors, multiple storage media

Introduction
Dental trauma is common during childhood and adolescence, and the most frequent causes for its insurgence are accidental falls and collisions during sport activities. Maxillary central incisors are the teeth most often involved, followed by upper laterals [1, 2].
The avulsion of permanent teeth represents 0.5–3% of all dental traumas [3, 4] The prevalence of avulsion cases in children is reported to be higher 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 [5, 6]. In avulsion, tooth is completely displaced out of its socket. It is caused by frontal impact with subsequent damage to the pulp as well as periodontal ligament.
The long-term retention of an avulsed tooth is related to the condition of the periodontal ligament (PDL) at the time of replantation, with key factors being the length of time the dental element remains outside the mouth, the storage process after trauma and the root development state. These factors will also determine different therapeutic options [7, 8]. All treatment aims at revascularization of the tooth and maintenance of viability of periodontal ligament cells [6]. The clinical dental literature regarding the fate of avulsed/replanted teeth is still dominated by isolated case reports and cross-sectional retrospective studies that lack standardization of evaluated outcomes as well as of statistical treatment of the data. Hence clinical case reports with long term follow up of replanted avulsed teeth is important. The following is a case report describing the avulsion and replantation of left maxillary central incisor and lateral incisor with closed apex and its 1-year follow-up

Case Report
A 12 year-old boy was referred to the Department of Conservative Dentistry and Endodontics at Govt. dental college, Calicut after a contact sport injury causing avulsion of maxillary left central incisor and lateral incisor. The teeth had been out of the mouth for approximately 1.5 hour at the time of the patient's arrival. Fortunately the teeth were kept in isotonic saline solution within 25 minutes of the incident from a clinic nearby. The avulsed teeth had a visibly mature apex and the crown was intact [Fig.1]. The tooth was transferred to sterile isotonic saline solution while a health history and personal information were obtained. The child's health history was non-contributory; he was not taking any medications and had no known drug allergies or systemic illness. The status of his tetanus immunization was uncertain, referral to physician for a tetanus booster was made. The patient was thoroughly examined for extra oral signs of injury, including swelling and asymmetry of the face. Extra-oral examination showed abrasions on the nose, chin, as well as a swollen upper lip. No other oral injury

was clinically detected. The intraoral examination revealed that the maxillary left permanent central incisor and lateral incisors were clinically missing with a lacerated wound of size 1 cm extending vertically from interdental papilla of avulsed incisor to the frenum [Fig. 2]. There was a grade I mobility for right central incisor and lateral incisor. Radiographs of the injured area was carried out to rule out presence of remaining tooth particles in the sockets of the avulsed teeth, and root development on the remaining incisors were found to be complete. Periapical and panoramic radiographs revealed no alveolar bone wall fracture or other hard tissue injuries. After informing the parents of the patient about possible risks, replantation was planned and carried out under local anesthesia without vasoconstrictor. The coagulum was gently rinsed from the socket of the avulsed tooth and was replanted slowly with digital pressure, so as not to force the tooth into place. The position of the replanted tooth was verified both clinically and radio graphically [Fig. 3, 5]. A semi-rigid splint was constructed from 0.028 round orthodontic wire and extended between maxillary canine on either sides to hold the tooth in place and still allow stimulation of the PDL [Fig. 4]. Lacerations over the gingiva were sutured. The patient was placed on 500 mg of amoxicillin to be taken every 8 h for 1 week [10, 11]. Root canal treatment of the tooth was initiated within 2 weeks under standard protocol [Fig. 6, 7]. The patient was advised to avoid participation in contact sports and follow a soft diet for 2 weeks. He was also told to avoid biting directly with his two front teeth. Oral hygiene instructions were given including brushing teeth with a soft toothbrush after each meal and usage of a 0.12% chlorhexidine mouth rinse twice a day [9].

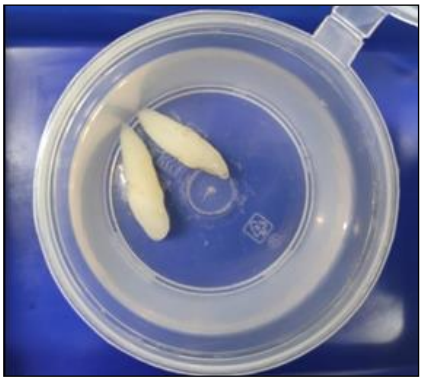


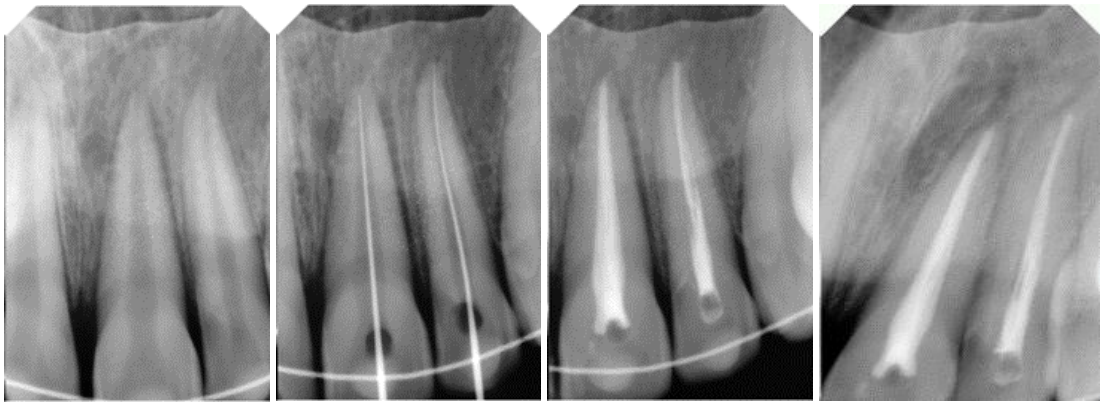
Fig 1

Fig 2

Fig 3

Fig 4

The parents were informed about the importance of regularly returning for clinical and radiographic follow-up. Two days later the patient was recalled for follow-up. He was having soreness and tenderness in the areas of trauma. Intra-orally swelling over the buccal vestibule was reduced; the upper lip was still swollen but less than before. Two weeks after replantation, The patient was again reviewed, the splint was removed and no clinical or radiological evidence of pathological changes were detected. Regular follow up at 6 months and one year [4,12,14] [Fig. 8, 9] revealed that the replanted teeth were asymptomatic, functional, having normal mobility, no sensitivity to percussion, normal percussion sound. On radiographic examination no radiolucencies and no radiographic evidence of root resorptions were present. The lamina dura appeared normal.



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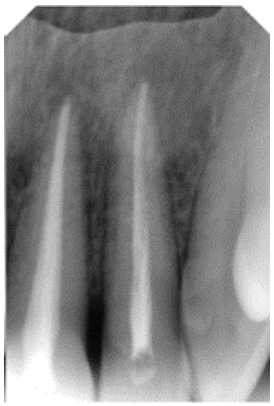

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Fig 5-9

Discussion

The factors on which outcome and success rate of the replanted tooth depend are status of avulsed tooth, dryness in extra-alveoler period, root development stage, storage environment, the treatment time and modality [12, 15, 16, 17, 18]. The best healing potential of the avulsed tooth is possible if the replantation is performed immediately (within 5 min) after trauma, as avulsion create crucial damage on the gingiva, periodontal ligament and pulp tissues. Storing the tooth in a physiological medium (eg: saline) until replantation for a short period is accepted as a well application [19, 20].

The recovery of periodontal tissues is crucial for the long term prognosis of an avulsed tooth, inorder to improve it splinting of the replanted tooth to the adjacent teeth flexibly for 2 weeks is necessary. In cases with closed apex root canal treatment is initiated within this 2 weeks to prevent the inflammatory root resorption.[9] In the presented case, the avulsed teeth were having a closed apex and was kept in milk followed by saline solution from the moment of trauma until its replantation 1.5 hr later. The two important factors that cause deficiency in pulpal and periodontal healing are prolonged extra-alveolar time and closed apex, so it was assumed that the prognosis of the tooth would be questionable or poor. The decision of replanting in the present case was took to retain the tooth until the patient reaches an age where a permanent replacement (an implant or fixed partial denture) can be made. The consequences due to early loss of the permanent dentition such as space loss and deviation of the midline can be mitigated with replantation of avulsed teeth. when performing the treatment the major aims were focused to prevent the early tooth loss, maintain aesthetic and functional properties and minimize inflammatory root resorption. In order to achieve the goal of the treatment, the avulsed teeth were replanted back into its original socket, and then splinted to the adjacent teeth with 0.028 round semi rigid orthodontic wire splint and composite resin for 2 weeks [2]. This type of splint allows for stimulation of the PDL during healing and reduces the incidence of ankylosis. During this period, the patient was recommended to avoid biting on the splinted teeth and continue to brush his other teeth, and keep the mouth and teeth as healthy as possible. Additionally, systemic penicillin was prescribed.

The value of systemic administration of antibiotics in human after replantation is still questionable as clinical studies have not demonstrated its value. Experimental studies have, however, usually shown positive effects upon both periodontal and pulpal healing especially when administered topically [1]. For this reason, antibiotics are in most situations recommended after replantation of teeth. In addition, the patient's medical status or concomitant injuries may warrant antibiotic coverage. For systemic administration, tetracycline is the first choice in appropriate dose for patient age and weight the first week after replantation. The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients. A penicillin phenoxymethyl penicillin (Pen V) or amoxycillin, in an appropriate dose for age and weight the first week, can be given as alternative to tetracycline [2, 10, 11]. The replanted tooth was endodontically treated and calcium hydroxide intracanal dressing was applied to prevent inflammatory resorption.

Storage media with an osmolality more like the tissue fluid do not destroy the cells [6]. Teeth can be stored in saline or balanced salt solution. Storing the tooth in a person's saliva is another alternative for shorter periods. Blomlof *et al*. found cold milk to be a suitable storage medium for a period of up to 3 hours [14]. Hank's Balanced Salt Solution (HBSS) is a standard saline solution used as a storage medium which support the growth of many cell types [22]. It contains metabolites necessary to maintain normal metabolism of cells. HBSS is pH balanced (7.2), has an osmolality of 320 mOsm/kg which provides an ideal osmotic pressure for PDL cells, biocompatible and is non-toxic in nature. Ideally culture medium like Hank's balanced salt solution or ViaSpan, an organ transport medium, allows the best opportunity for PDL cell preservation [23]. Limited availability of these media may prevent them from being used at some injury sites. In the present case the avulsed tooth were able to be immersed in milk followed by isotonic saline solution within 25 minutes of the injury. Normal saline is a solution of 0.90% w/v of NaCl and osmolality of 280 mOsm/kg and despite being compatible to the cells of the PDL, it lacks essential nutrients, such as magnesium, calcium, and glucose, which are fundamental to the normal metabolic needs of the cells of the PDL. The favorable results of milk probably occur due to the presence of nutritional substances, such as amino acids, carbohydrates, and vitamins.2 Being a gland secretion, milk contains epithelial growth factor, which stimulates the proliferation and regeneration of epithelial cell rests of Malassez and activates the alveolar bone resorption [25]. Although primary teeth may also be avulsed, they should not be replanted because the manipulation may result in injury to the underlying permanent tooth germ.

In comparison with adults more extensive inflammatory root resorption after replantation are exhibited in children and adolescents [21]. The mentioned increase in resorption rate is related to the bone remodeling which is more extensive in children during the grow-up period [19]. The complications following replantation including root resorption and ankylosis may give rise to infra-occlusion during the growing process [21]. Concerning the ankylosis after replantation in young patients, clinician must be diligent about the growth phase, because the avulsed tooth may be placed in an infra-position and disturb the alveolar and facial growth. In these cases, other treatment modalities such as decoronation, autotransplantation, resin-retained bridge, space maintainer, or orthodontic procedure should be considered, and when growth is accomplished, implant is a possibility [1, 24].

Conclusions

The present case demonstrates that avulsed central incisors showed satisfactory clinical outcomes after delayed replantation at 1 year follow-up. The present case adds to the literature a rare occurrence of success in a case which used multiple storage media and with a reserved prognosis. For this reason, replantation should always be considered following IADT guidelines and, even in extreme situations, even if it is a temporary treatment in order to allow the most appropriate plan for each case.

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