Avulsion, which is defined as the total displacement of the tooth form its socket and change of its place, is responsible for 0.5-3% of all traumatic dental injuries [1]. Avulsion is frequently seen in maxillary incisors, especially between the ages of 7 and 9 when permanent incisors are erupting; this is also the period when root development is uncompleted and the resistance of periodontal ligament against extrusive forces is minimum [2, 3]. Avulsion is one of the dental injuries which require early and urgent intervention in permanent teeth.

After tooth avulsion, blood supply to the pulp is interrupted and its periodontal ligament cells are exposed to trauma [3]. For this reason, in order to obtain ideal recovery in avulsion injuries, the avulsed tooth needs urgent reimplantation . The success of reimplantation is directly connected with the general health of the patient, root development stage of the tooth, its time spent outside socket and the storage medium [4]. The time that the tooth spent outside socket and the storage medium is most important factor which affect the vitality of periodontal ligament cells [5]. Especially the time spent in dry time is critical importance for the cells can remain alive [1]. For this reason, treatment protocol must be determined with reference to the time passed after trauma. If an avulsed tooth is delayed reimplantation, root resorption can be formed at high rate, and the possibility of revascularisation is very low [6].

As avulsion is a trauma including several dental tissues such as dental pulp, periodontal fibril, alveolar bone and cement; thus, the management and follow-up of treatment is highly important for the success of the treatment.

The purpose of this case report is presented in which an 8 years old patient, who exposed dental trauma and applied to our clinic 3 hours after dental trauma, with avulsion and lateral luxation injuries, was treated and 48 months clinical follow-up of.

Case report
A male patient of 8 years age referred to our clinic due to dental trauma. The patient had no systemic disease and had a history of dental trauma after a fall at home. The patient was first taken to the emergency department and after being taken to short stay unit for two hours he was referred to our clinic. The clinical examination of the patient revealed lateral luxation in tooth 11, avulsion in tooth 21, crown fracture in tooth 22 (Figure 1). The avulsed tooth was kept in dry environment for some 2 hours and later, upon direction from the emergency doctor, was kept in milk and brought to our clinic (Figure 2). In radiographic examination, alveolar socket was normal, and no root fractures were observed in alveolar bone and adjacent teeth.

Before treatment of the patient, parents were informed on the possible complications of the treatment and their consent.

Keywords
Avulsion; MTA; Dental Trauma

Abstract
Teeth injuries after dental trauma can be observed in teeth from enamel crack to avulsion. This case report purpose is to make the required treatment of the child patient who was suffered serious dental trauma and regain his dental health. We were determined that a 8 year old, male patient was suffered from lateral luxation in tooth 11, avulsion in tooth 21, crown fracture in tooth 22. The avulsed tooth 21 was reimplanted and splint was made with the help of wire and composite. After one week, Ca(OH)2 was placed in root canal for prophylactic purpose. Root-canal treatment of the avulsed tooth was finished with MTA. 48 months follow-up of the patient did not observe any symptoms. The use of MTA in delayed reimplantation cases was found successful.
form was received. Dead tissues on the root were removed with a sterile sponge. Under local anaesthesia, the socket was cleaned with sterile saline solution and the tooth 21 was held from crown part and the alveolar was placed into the socket with the help of finger pressure. After the tooth 11 was brought back to its original position, the positions of teeth 11 and 21 were checked with radiography. Teeth 11 and 21 were splinted to adjacent teeth using non-rigid stainless steel wire and composite resin (Figure 3). Tetanus vaccine was not seen necessary as the patient had no contact with soil and he had been vaccinated recently. Two weeks of soft diet was recommended to the patient and he was told that he had to brush with soft brush after meals. Penicillin V and a 0.12% chlorhexidine gluconate mouth rinse were prescribed.

As resorption is inevitable in delayed replantation cases, medical dressing with calcium hydroxide was decided 1 week later (Figure 4). Access cavity was opened, debris inside the canal was removed and irrigation was made with 2.5% NaOCl. Calcium hydroxide was blended with distilled water and sent with the help of lentulo. Access cavity was covered with cotton pellet and temporary filling material. At the end of 4 weeks, the splint was removed. In clinical examination, the tooth and surrounding tissues was normal and asymptomatic. In the same session, irrigation was made with 2.5% NaOCl and canals were dried with paper point. Mineral trioxide aggregate was mixed according to the manufacturer’s instructions. Then, MTA was transferred to access cavity with amalgam carrier, it was materials are placed inside root canals with lentulo files and the canal was completely filled with MTA. A dry cotton pellet was placed in the coronal pulp chamber, after the access cavity was sealed with a temporary restorative material (Cavit; ESPE, Cergy Pontoise, France). After 24 hours, the temporary restoration was removed and the cavity was restored with composite resin (3M Filtek Supreme). The immature tooth 11 which suffered lateral luxation was maintained its vitality and its apex closed during the follow-up period.

Figure 1: Intra-oral view before treatment

Figure 2: The avulsed tooth which was stored in milk at 2 hours after dental trauma

Figure 3: Splinted view of the case

Figure 4: View of radiography after pulp extirpation
Discussion

Dental trauma might cause pulpal and periodontal pathologies in teeth. For this reason, the purpose for treatment of dental trauma must be preventing or minimizing such pathologies. Although there are different treatment protocols for the treatment of avulsion, it is agreed that avulsed tooth must be reimplanted immediately [1]. In those avulsion injuries when the tooth cannot be reimplanted immediately, the tooth must be kept under appropriate storage conditions so that periodontal ligament cells can be kept alive. It must be kept in HBSS (Hank’s balanced salt solution), milk, saliva or saline solution. Kinirons et al. reported that after being kept in dry environment for 5 minutes, any 10 additional minute in dry environment increased resorption risk by 29 percent [7].

According to the International Association of Dental Traumatology (IADT) guide which was updated in 2012, root canal treatment of teeth which remained in dry environment more than 60 minutes can be made before or after reimplantation [1]. There is no total agreement on the most appropriate time to start extirpation after replantation [8]. Some authorities advocate that as inflammatory resorption in reimplanted teeth can be reduced or prevented, the pulp should be removed early [9]. On the contrary, Andreasan suggests that endodontic treatment should be postponed for 1 week so as to prevent resorption after reimplantation and ensure reattachment of periodontal fibrils [3]. Following Andreasan, we performed pulp extirpation 1 week after reimplantation of the tooth which remained in dry environment for more than 60 minutes. Timing of pulp extirpation in avulsed teeth depends on the maturation of the tooth and, if the tooth is an immature one, pulp extirpation depend on the time that it spends outside socket. Another study which assesses the timing of pulp extirpation concluded that extirpations made after 14 days increased the risk of inflammatory root resorption development [10].

Calcium hydroxide destroys necrotic tissues, it is antibacterial and it neutralises environment increasing pH; thus, it reduces the risk of inflammatory root resorption [11]. It helps formation of apical barrier in immature teeth [12]. Andreasan et al. reported that the fracture resistance of immature teeth which were performed apexification treatment with calcium hydroxide reduced by 50 percent [13]. It is reported that using MTA and calcium hydroxide in combination in apexification treatment may favourable influence the regeneration of periodontium[14]. In our case, we limited calcium hydroxide treatment to 3 weeks; the fracture resistance of the tooth would be reduced significantly due to the combined effect of resorption and longer calcium hydroxide treatments.

IADT guide which was updated in 2012 assesses that, in avulsion cases, avulsed teeth which were not kept in suitable storage medium for more than 60 minutes, with open or closed apex, have a poor prognosis; however, their replantation was recommended [1]. In delayed replantation cases, resorption becomes inevitable as periodontal ligament is necrotic. In almost all teeth, which remained outside mouth for a long
time, ankyloses or replacement resorption was observed. It is reported that patients with the avulsed teeth would suffer from ankyloses and then resorption in 3 to 7 years [15]. In our case, at the end of 4th year ankyloses was observed followed by minimal resorption (Figure 6). In our case, although the tooth which was kept in milk after being exposed to dry stored for 2 hours was treated with reimplantation has a poor prognosis, satisfactory results were obtained in terms of aesthetics and function in the long term.

The factor which most affects the survival of an avulsed tooth is the time spent outside socket [16]. The most frequent complication in reimplanted teeth is external resorption [17]. External inflammatory resorption occurs with increased osteoclastic and odontoclastic activity which increases due to the dropping of pH under 3-4, 5 following post-traumatic pulp necrosis [18]. The severity and size of external resorption is depending upon the time delay between avulsion and reimplantation, appropriate endodontic treatment and patient follow-up [19, 9]. The time that the tooth spent outside socket as dry stored is the most important factor in the development of post-reimplantation resorption [20]. For these reasons, minimizing the time spent by tooth outside socket as dry stored is a critical importance. However, this factor is mostly outside the initiative of the dentist. For this reason, in delayed reimplantation cases, the dentist must apply treatment strategies directed at preventing or stopping the inevitable resorption.

MTA was first developed as an alternative to Ca(OH)2 in order to create a barrier in apex of immature teeth; it is a material which can be used successfully in cases where clinical treatment method is difficult in such cases as internal-external resorption, repair of horizontal root fractures, and root and furcation perforations [21, 22]. It is reported that MTA, which is bio-compatible with periapical tissues, can be used as permanent root canal filling material in delayed reimplantation cases which can consist of external root resorption [23].

MTA effects on trigger formation of hard tissue in not only for apical region but also for the developed external resorption zones [24]. MTA can preserve high pH level and release calcium ion in the long term [25]. The 12 pH created by MTA can continue for months. For the foregoing reasons, we used MTA for root canal filling material in the avulsed tooth and took it under long-term follow-up. If no resorption is observed in the first 2 years, the resorption risk is considerably lowered [3, 26]. In our case, At the end of 18 months ankyloses was developed in the tooth as a result of replacement resorption (Figure 5). At the end of 48 months, slight increase in resorption was observed (Figure 6). The reason of such slow progress of resorption is believed to be related to the MTA preserving its alkali pH in the long term and considerably decelerating inflammatory resorption and odontoclastic activity.

Compared to adults, inflammatory root resorption in children and adolescents is faster and more intense [27]. These increased resorption rates are related to the bone remodelling of children in their growth and development periods [2]. For these reasons inflammatory and replacement root resorption in childhood and adolescence result in infraposition. In the following periods, when infraposition exceeds 1 mm, decoronation can be necessary [1]. In our case, it was observed at the end of 48 months that the avulsed tooth suffered from infraposition close to 1 mm clinically, and colouring was observed in the servical of the tooth (Figure 7).

It has been reported that teeth with post-trauma luxation injury with open apex can occur revascularization [28]. In our case the controls after repositioning of the tooth 11 which suffered from lateral luxation continued vitality and completed apex development (Figure 6).

**Conclusion**

Dental trauma in juvenile and children can cause serious aesthetic, functional and psychological problems. In avulsion cases, suitable treatment and follow up is critical. For these reasons, inflammatory or replacement resorption is inevitable in delayed reimplantation cases, we believe that using MTA as canal filling material is a good treatment option to stop or decelerate resorption process. The purpose of delayed replantations is to restore the tooth for aesthetic, functional and psychological reasons, in addition to protecting the width and height of alveolar bone and pave the way for future prosthetic treatments.

**References**


