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CASE REPORT

Management of Severe Dento-Alveolar Traumatic Injuries in a 9-Year old Boy: A Case Report

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ABSTRACT

Dentoalveolar traumas can lead to various injuries that may result in tooth loss. A suitable treatment plan and appropriate interventions should be performed to maintain the dental function and aesthetics, especially for the anterior teeth. **Objective:** To report the interventions performed on dentoalveolar trauma on a 9-years old male patient who presented with gingival immersion of the right maxillary central incisor and missing a tooth due to a falling accident. **Case Report:** The patient had multiple traumatic injuries. The medical and dental history was taken, and the clinical and radiologic examinations were performed. The patient underwent surgical intervention and splinting to take the intruded tooth back into its normal place. Moreover, the teeth with lateral luxation underwent apexification and composite filling. Also, endodontic treatment was performed on the coronal segment of the tooth with root fractures. The patient underwent clinical and radiographic follow-up for 24 months to assure the treatment efficiency and prevent further complications. **Conclusion:** It was shown that the interventions performed could preserve the function and aesthetics of the patient's teeth, which can directly impact his quality of life and emotional state in adolescence.

Key words: tooth avulsion, tooth luxation, intrusive luxation, pulp necrosis

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INTRODUCTION

Traumatic dental injuries (TDI) are common throughout the world. A recent report revealed that more than one billion living people have at least one experience of traumatic dental injuries.[1] Dentoalveolar traumatic accidents comprise most of the encountered cases of dental emergencies. These injuries are classified into four types: gingival or oral mucosal injuries (soft tissue injuries), injuries to the supporting bone, periodontal injuries, and injuries to hard dental tissues and dental pulp. Complete cure is not possible for some of these injuries. Due to the complicated management, the prognosis of these injuries can be unpredictable. The treatment course can be difficult and costly for the patient because these problems should be followed and managed for a long time to achieve the best outcome. The outcome of these injuries can affect the dental function and aesthetics, as well as the patient's quality of life.[2, 3]

Among all types of dental injuries, avulsion and intrusion are the most severe cases. These injuries may have unfavorable outcomes, leading to multiple sequelae, such as pulpal necrosis, external root resorption, and replacement resorption. Other severe forms of traumatic dentoalveolar injuries are lateral luxation and root fractures. These types of injuries have various outcomes. The condition of dentin-pulp complex, cementum, alveolar bone, and periodontal ligament determine the method and design of the treatment plan, therapeutic effectiveness, and outcome.[4, 5]

Traumatic injuries should be treated as soon as possible to reduce unfavorable complications, preferably at the moment in avulsion cases and within the first hour in other injuries.[6] Most of these traumas are in pediatric patients and usually happen in schools. Treatment for

younger patients differs from those of adolescents. A suitable treatment plan can help in preserving the tooth for a quite favorable time.[7]

The main goal of the present report was to describe a case of delayed multiple dentoalveolar traumas who was a 9-years old boy with dental avulsion, intrusion, lateral luxation, and root fracture due to a falling accident.

CASE REPORT

A 9-year-old boy was presented to the clinic of the School of Dentistry of the Guilan University of Medical Sciences with the chief complaint of gingival immersions of the maxillary incisors and missing a tooth due to a falling accident in school three days ago (Figure 1A). No notable past medical and dental history was reported. The patient's general appearance was normal, with no external lacerations. Moreover, the patient was vaccinated against tetanus according to the national guidelines.

The patient underwent full extra-oral to intraoral examinations to rule out other major injuries. There was no extra-oral injury. Intraoral examinations revealed no problem in the tongue, palate, and mouth floor. Complete dental examinations, vitality tests (electric pulp test, heat, cold, percussion, mobility, and palpation tests), and radiographs (peri-apical and orthopantomograph) were performed, and the related results are presented in Table 1. Based on the examination results and radiographs (Figure 1B), a differential diagnosis was made (Table 1).

In the first treatment session, the treatment course was explained to the patient's parents. Moreover, the parents gave informed consent for treatment initiation. Oral amoxicillin (250 mg TDS) and chlorhexidine mouthwash were prescribed for the patient to prevent infection.

Preliminary treatment plan for maxillary incisors was considered as follows:

- Maxillary right central incisor: surgical extrusion, splinting for 4 weeks, calcium hydroxide therapy for 7-10 days, apexification, composite filling, and follow-up.
- Maxillary left central incisor: splinting, calcium hydroxide therapy for 7-10 days, apexification, composite filling, and follow-up.
- Maxillary left lateral incisor: splinting and follow-up.
- Maxillary right lateral incisor: space maintenance until prosthetic rehabilitation.

The more severe injuries were treated sooner to prevent more unfavorable outcomes. Maxillary right lateral incisor had been avulsed and missed. The consequences of tooth loss were explained to the parents; however, they did not intend to accept any suggested treatments for space maintenance.

The first tooth to be treated in the treatment plan was the permanent maxillary right central incisor (no. 8), immersed in the gingiva. The treatment for this tooth was initiated in the first treatment session because it needed immediate intervention. It was already intruded more than 7 mm; thus, surgical extrusion was considered. Local anesthesia was performed using infiltration injection with 0.6 ml of 2% lidocaine + 1/80000 epinephrine. Then, the tooth was extruded using 150A Cryer forceps (Hu-Friedy, Chicago, IL, USA) until reaching the incisal edge of the adjacent tooth (Figure 2). Peri-apical radiography was taken to ensure the intactness of the root (Figure 3A). Then, semi-rigid bilateral splinting was performed using the Filtek™ resin composite (Filtek™ P90 Silorane shade A2; 3M ESPE, St Paul, MN, USA), G-Premium bond (GC, Tokyo, Japan) as the bonding agent, and a 0.019 x 0.025 stainless steel orthodontic wire (3M Unitek). The splinting was performed from the permanent maxillary right first molar to the permanent maxillary left first molar (Figure 3B). Since the tooth was mobile and the isolation was not possible, endodontic treatment was postponed to the next session, and the patient was asked to have a diet containing soft food.

The second treatment session was 4 weeks later, in which the mobility and vitality of tooth no. 8 was evaluated. The tooth had gained the desirable stability. The splint was removed. Moreover, the permanent maxillary left central incisor had been diagnosed necrosis in the first treatment session. Thus, both permanent maxillary central incisors (no. 8 and 9) underwent endodontic treatment. After the local anesthesia, the rubbers dam and clamp (Hu-Friedy, Chicago, IL, USA) were placed. An access cavity was prepared for both teeth (no. 8 and 9). Due to the presence of open apices, the working length was determined using radiography. The initial file was a #55 k-file (Maillefer SA, Ballaigues, Switzerland). Irrigation was performed using 0.5% sodium hypochlorite and 5.25% chlorhexidine solutions, and filing was performed gently to prevent dentinal damage. Canals were filled with calcium hydroxide paste (Masterdent, NY, USA), and a temporary coronal filling was placed using the packable Fuji IX (GC, Europe).

The third treatment session was 2 weeks later, in which radiography was performed to evaluate the condition of the root canals, of teeth no. 8 and 9. Local anesthesia and isolation were performed. Then, calcium hydroxide was removed using irrigation, canals were dried using paper points, and a 4-mm apical barrier with Mineral Tri-oxide Aggregate (MTA) was placed (Figure 3C). A temporary restoration was placed, and the patient was asked not to leave the clinic until the MTA (Angelus, Londrina, PR, Brazil) setting was completed, which

Table 1. Radiograph and vitality test results by type of tooth

Tooth (universal number)	Vitality tests						Diagnosis
	Electric pulp test	Cold test	Heat test	Palpation test	Mobility test	Percussion test	
Permanent maxillary right lateral incisor (7)	-	-	-	-	-	-	Avulsed and missed
Permanent maxillary right central incisor (8)	-	-	-	-	-	Tender	Necrosis, crown fracture, intrusion
Permanent maxillary left central incisor (9)	-	-	-	-	Grade two	-	Necrosis and crown fracture
Permanent maxillary left lateral incisor (10)	+	+	+	-	-	-	Subluxated and vital

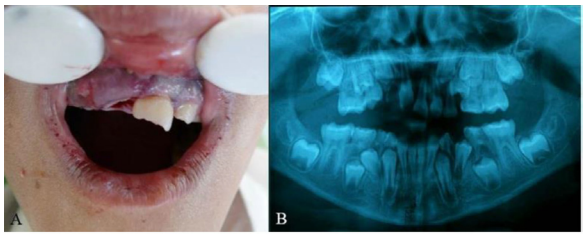

Figure 1. A) Photograph taken in the first appointment; B) Orthopantomograph taken in the first session

Figure 2. Surgical extrusion of the intruded maxillary right central incisor

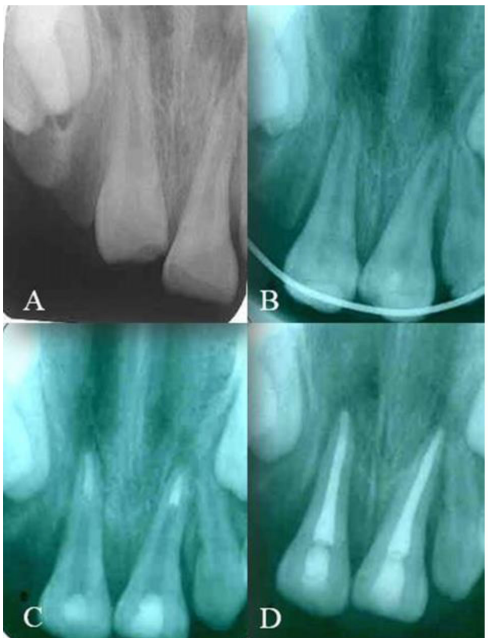

Figure 3. A) Initial condition of the intruded maxillary right central incisor; B) Wire-composite splinting after surgical extrusion; C) MTA plug placement; D) The periapical radiography after obturation and composite resin restoration.

took 4 hours. According to the treatment plan, further canal space was filled by a warm vertical technique using the Obtura II system (Obtura Spartan, Fenton, MO) and AH26 sealer (Dentsply, Tulsa Dental, Tulsa, OK, USA). Teeth were restored using the resin composite Filtek Z250 (3M ESPE, St. Paul, MN, USA) (Figure 3D).

4th treatment session was 4 weeks later. Three-angled radiographs were taken from the anterior region, and there was radiolucency around the permanent maxillary left lateral incisor (no. 10). The vitality tests showed necrosis because the patient did not react to any of the tests but percussion. A diagnosis of horizontal root fracture resulting in pulp necrosis was made. The tooth underwent local anesthesia and isolation. The coronal segment was filed with a working length of 12 mm. Then, it was irrigated with a 0.5% sodium hypochlorite solution and filled with calcium hydroxide paste. The tooth was temporarily restored using the resin-modified glass ionomer (Figure 4A).

5th treatment session was considered 4 weeks later. In this session, the left maxillary lateral incisor (no. 10) was obturated by a warm vertical technique using the Obtura II system and AH26 sealer. The tooth was restored using the resin composite Filtek Z250 (Figure 4B).

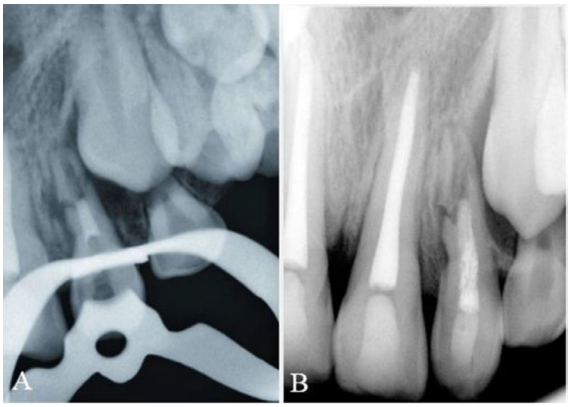

Figure 4. A) Placement of calcium hydroxide paste in the maxillary left lateral incisor. B) Maxillary left lateral incisor after obturation and composite restoration

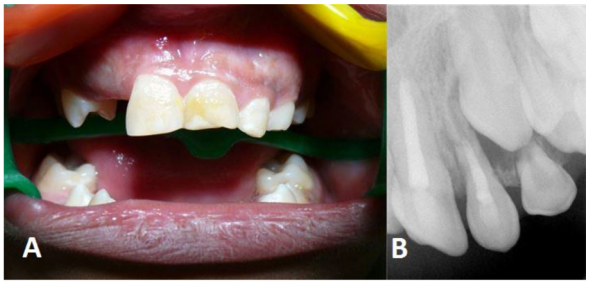

Figure 5. A) Follow-up photograph after 24 months. B) Follow-up radiography of maxillary left lateral incisor after 24 months

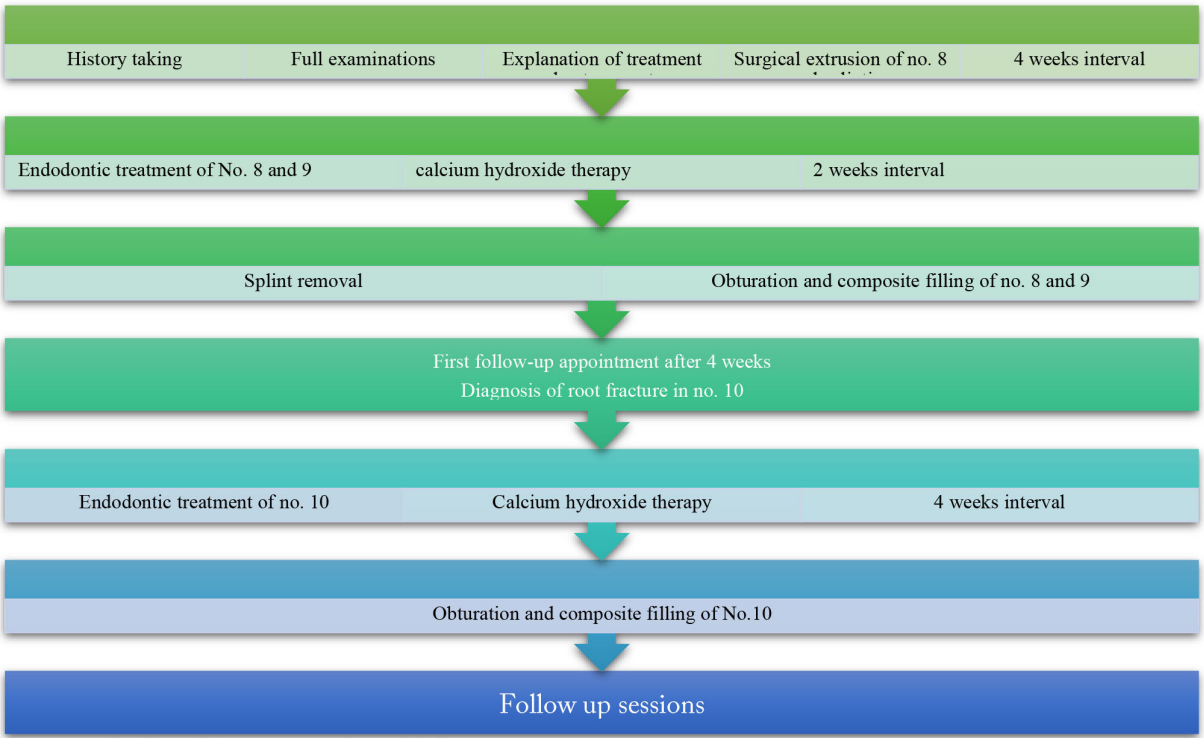

Figure 6. Timeline of the treatment plan and follow-up

With 2-, 4-, 8-, and 12-week intervals (Figure 5), no significant external root resorption was observed. There were follow-up visits 2, 4, 8, 12, and 24 months after the first session (Figure 5), and no sign of pathologic resorption, PDL widening, and apical or peri-radicular radiolucency was observed in the follow-up radiographs. Also, no unusual mobility was observed. The patient was at the end of the mixed dentition era, and the maxillary canines were about to erupt. Thus, the parents were asked to consider a temporary treatment for avulsed tooth, such as a fiber-reinforced composite bridge. However, they showed no interest.

DISCUSSION

Simultaneous intrusive luxation and avulsion of adjacent teeth is a rare phenomenon because the forces causing these injuries have different mechanisms. However, combined injuries are common in severe traumatic events. According to studies, teeth with crown fractures and luxation, regardless of the presence or absence of pulp exposure, are more likely to develop pulp necrosis and infection.[8] Thus, any possible effort should be made to preserve the pulp in the immature permanent tooth to ensure full root development. A vast majority of TDIs occur in children and teenagers,

who will face lifetime problems due to permanent tooth loss. However, an immature permanent tooth has a considerable ability for healing after traumatic pulp exposure, luxation injury, or root fracture.[9]

Optimistically, pulp and periapical tissues will heal after the traumatic dentoalveolar injuries. However, various complications often develop, such as pulpal necrosis, apical periodontitis, tooth discoloration, external root resorption, and complete tooth loss in some cases. The severity of damages highly depends on the trauma and related treatment.[3] Intrusive luxation is the most severe traumatic dental injury and needs a highly precise treatment. Moreover, this problem has a poorer prognosis compared to other dentoalveolar traumatic injuries. Teeth with intrusion may experience further complications, such as ankyloses, external root resorption, and periodontal issues.[5] Considering the depth of the intrusion, surgical extrusion may be preferred to orthodontic extrusion and re-eruption. Due to high eruption potential, re-eruption is considered in teeth with open or closed apices in 12-17-year-old patients.[9] According to a systematic review by Al-Khalifa, [10] there is no significant difference in the extrusion outcomes using the surgical and orthodontic approaches.

Three factors contributed to damaged teeth play role in success of treatment, which are root evolution stage, patient's age and severity of intrusion. [11] The critical time for treating intrusive luxation injuries is within 2-3 weeks. If the surgical approach is selected for the intruded teeth, some factors, including the damage to the adjacent teeth and bone remodeling, should be considered. Pulp extirpation time, splinting duration, and root canal filling are all important in the success of the intrusive luxation treatment.[12] The present case had a high risk of necrosis due to poor oral hygiene, complete tooth intrusion (more than 7 mm), and multiple lateral luxations. Therefore, surgical extrusion and semi-rigid splinting were performed, which accelerated the fixation and allowed endodontic treatment with calcium hydroxide paste that prevented further inflammation of pulp and resorption. The patient was 9 years old, so the roots of the central incisors were fully developed but had open apices. Therefore, the MTA plug was considered to seal the apical foramen of both central incisors. According to the guidelines, pulp sensibility was tested at each appointment to evaluate the condition of each tooth and perform an immediate endodontic treatment if needed in order to prevent further unfavorable outcomes.[7]

Having a prevalence of 44.2%, pulp necrosis is the most common complication of lateral luxation. However, it is less common in immature teeth (17.5%). Several studies have emphasized the importance of follow-up sessions in evaluating the vitality of damaged teeth.[13, 14] Teeth with fractures in the middle or apical third have a higher survival rate compared to those with fractures in the cervical third. This is due to the interposition of soft tissue between the fragments.[5] If the follow-up sessions are neglected, there may be potential consequences, including undetected necrosis and abscess, leading to tooth loss. Permanent maxillary left lateral incisor had an undetected root fracture that was diagnosed in the follow-up sessions using the clinical and radiographic examinations. As the fracture was located in the middle third of the root canal, there was a possibility of maintaining the pulp vitality. The vitality tests were repeated in each follow-up session to perform an in-time endodontic intervention if needed in order to prevent further complications, including canal obliteration, necrosis of the coronal segment, and inflammatory resorption. However, the tooth showed no responses to vitality tests and was diagnosed with necrosis. Thus, the coronal segment underwent endodontic treatment. No periapical radiolucency was observed in the follow-up radiographic evaluations.

Teeth with simultaneous crown fracture and luxation are more likely to develop necrosis, which is the main complication of periodontal ligament injury. Inflammatory resorption is the third most severe post-traumatic complication after intrusion and root fractures.[3, 11] Maxillary left central incisor had a complicated crown fracture and did not respond to vitality tests in the first and second visits. Thus, endodontic treatment was performed to prevent unfavorable outcomes. Moreover, the MTA plug was used for this tooth because the root was fully developed while the apex was open.

Maxillary right lateral incisor was avulsed and missed. According to the latest guidelines by the International Association of Dental Traumatology, the management of choice for this case was immediate replantation at the site of injury or referral to a dentist with the avulsed tooth kept in a medium storage. In tooth loss, patients or their parents should be completely informed of the prognosis of the avulsed tooth as soon as possible, and different treatment options should be discussed with them. The treatment options may include a resin-retained bridge, a removable partial denture, or orthodontic space closure with or without resin composite modification until a permanent prosthetic treatment could be available.[15]

In such cases, follow-up using three-angled radiographs and pulp vitality tests is essential for immediate diagnosis of complications, such as necrosis and resorption. In most cases, proper and in-time endodontic intervention prevents tooth loss. In case of inflammatory resorption, especially external root resorption, Cone Beam Computed Tomography (CBCT) is necessary to ensure the condition and obtain further information for intervention.5 Dental traumatic complications are unpredictable, and

accurate diagnosis and treatment may be postponed to follow-up sessions. Post-treatment monitoring of the patient is the key factor in the prevention of further complications and costs. Regardless of the approaches recommended in the guidelines for traumatic event management, it is necessary to consider the socio-economic status and oral health of the patient for proper treatment selection. Also, it is important to inform the parents of the pediatric patients about the consequences of traumatic dental injuries and the importance of follow-up sessions. In present case parents understood the importance of any effort to retain the injured teeth and to completely cooperate in follow-up sessions but due to economic reasons they wanted to postpone any treatment for the avulsed tooth.

CONCLUSION

The present case underwent surgical, endodontic, and restorative treatment to preserve the function, stability, and aesthetics of the injured teeth. Follow-up using clinical and radiographic examinations is essential to ensure the treatment's efficacy and prevent further complications. A combination of effective treatment and close follow-up can preserve the function and aesthetics of the treated teeth, which can directly impact the quality of life and emotional state of the patient in adolescence.

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