Management Guidelines for Traumatically Injured Teeth during Orthodontic Treatment

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This article presents a summary of incident management guidelines for traumatically injured teeth during orthodontic treatment. In addition, treatment of a 17-year-old patient with traumatic extrusion and palatal displacement of the permanent maxillary incisors while undergoing active orthodontic treatment is reported.

Key words: *orthodontic management, dental injury, management guidelines, orthodontic treatment, dental trauma*

INTRODUCTION

Conventional treatment guidelines for managing dental trauma incidents do not always apply to every case because each case presents with a unique set of challenges. Most trauma cases need individualized treatment planning which takes a multidisciplinary approach (i.e., pediatric dentistry, endodontics, oral surgery, orthodontics, restorative dentistry, and prosthodontics) with consideration for the biological, functional, esthetic and economic factors as well as the patient's wishes and compliance.[1-3]

Limited information is available in current literature about the management of dental trauma during orthodontic treatment.[4, 5] Most available information in the management of traumatized teeth during orthodontic treatment is based on case reports, expert opinion, and individual clinical experiences.[4-7] This paper seeks to present a short review of the guidelines for orthodontic management of traumatically injured teeth during orthodontic treatment. In addition, a case is reported on the orthodontic mechanics used on a patient with traumatic extrusion and palatal displacement of his permanent maxillary incisors which occur during the patient's active orthodontic treatment.

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DENTAL TRAUMA DURING ORTHODONTIC TREATMENT

In the management of dental trauma cases, multiple factors must be carefully considered such as the patient's general health, the type and severity of the trauma, their dental age (primary, mixed or permanent), growth status and stage of development as well as on the dental and anatomic structures involved.[1-3] The maxillary incisors are the teeth most commonly involved in dental trauma incidents and are most prevalent in boys between ages 7-19. In addition, patients with Class II Division 1 malocclusion with excessive overjet and incompetent lip coverage are more at risk for dental trauma.[8-11] It is reported that an increase of the overjet from 0-3 mm to 3-6 mm doubles the risk of traumatic dental injury and when the overjet is more than 6 mm, the severity of these injuries triples.[11] Insufficient lip closure that leaves the maxillary incisors unsupported is also reported to be one of the most important factors in increasing the risk of traumatic dental injuries.[12,13]

Categories of dental trauma

Some categories of dental trauma include concussion, subluxation, lateral luxation, extrusion, intrusion, avulsion, and crown or root fracture.[14] Depending on the severity of the trauma, more or less periodontal damage occurs and the blood vessels of traumatized teeth can have reduced ability to react to the impairment of the pulpal blood flow in response to orthodontic movement than non-traumatized teeth.[15,16] The categories of traumatic tooth injury and management guidelines for treating them during orthodontic treatment are summarized in Table 1.

Signs and symptoms

Dental trauma that occurs more than 1 year before orthodontic treatment can be strongly associated with a higher risk of root resorption during orthodontic treatment.[17] Orthodontic tooth movement is known to create a certain degree of inflammation in the pulp, but this is usually reversible. However, in previously traumatized teeth, the inflammatory response of the pulp may be more pronounced than with a non-traumatized tooth.[6] In addition, it is reported that apical root resorption may occur independent of pulp

Table 1. A summary of management guidelines for traumatically injured teeth during orthodontic treatment *

Incident	Dental trauma during orthodontic treatment							
Medical care	Evaluations and treatment for neurologic problems, soft tissue damages, and head, neck, and craniofacial fractures and related complications							
Types of trauma	**Mild**		**Moderate**				**Severe**	
	Concussion	**Subluxation**	**Lateral luxation**	**Intrusion**	**Extrusion**	**Avulsion**	**Crown fracture**	**Root fracture**
Signs and symptoms	• Only sensitivity in the traumatized tooth	• The traumatized tooth is loose but not displaced	• Crown of the traumatized tooth is displaced palatally and the root displaced labially	• The periodontal ligament of traumatized tooth is compressed or obliterated and the tooth is partially or fully intruded	• The traumatized tooth is partially extruded	• The traumatized tooth is completely out of socket; very rare during orthodontic treatment with fixed appliances	• Crown fracture without pulpal involvement	• Clinical evidences and radiographic findings showing fractured root
Incident management guidelines	• Soft diet for few weeks • Continuing orthodontic treatment after 3 months	• Soft diet for few weeks • Continuing orthodontic treatment after 3-6 months	• Repositioning the tooth under local anesthesia and stabilizing by a light flexible splint • Endodontic treatment • Continuing orthodontic treatment after 6 months	• Repositioning the tooth under local anesthesia • Endodontic treatment • Continuing orthodontic treatment after 6 months	• Reposition under local anesthesia • Stabilizing by a light flexible splint • Continuing orthodontic treatment after 6 months	• Replantation • Rigid fixation • Endodontic treatment • Regular follow ups • Continuing orthodontic treatment after 6 months	• Continuing orthodontic treatment after 3 months • Restorative treatment	• Surgical and endodontic evaluations and treatments • Regular evaluations • Continuing orthodontic treatment after 1-2 year
Orthodontic/ dental care	• Applying proper modification in the orthodontic mechanics and appliances • Using light forces • Regular radiographic evaluations for the risk of root resorption • Consider surgical, endodontic, restorative, and prosthodontics alternative/combined treatment options • Regular post-operative visits							

* **Sources:** Kindelan et al. 2008 (4); Atack 1999 (6); Bauss, Rohling et al. 2009 (8); Bauss et al. 2008 (9); Turley 2009 (14); Mendoza et al. 2010 (16); Lee et al. 2003 (18); Erdemir et al. 2005 (19); Andreasen et al. 2007 (20).

obliteration and endodontic treatment, and it can occur at any time during the early or later stages of orthodontic treatment. It has also been suggested that lip and tongue dysfunction might be a source of persistent trauma, which can cause apical root resorption.[17] In addition, severe dental trauma during orthodontic treatment can cause severe periodontal injuries and total pulp obliteration, thus increasing the risk of pulp necrosis during later stages of orthodontic treatment. Therefore, it is important to frequently (usually every 3 months) monitor the pulpal condition by pulp tests and assess periapical condition using periapical radiographs before continuation of orthodontic treatment.[6,8,18]

Orthodontic management

Orthodontic forces on a traumatized tooth should be lighter than normal orthodontic forces,[8] with particular biomechanical and biological considerations in teeth with a fractured root.[19] The archwire sequence should be altered depending on the severity of the trauma and condition of the patient's oral soft and hard tissues.[8]

Orthodontic patients with traumatic extrusion and palatal displacement of their permanent maxillary incisors in the course of active orthodontic treatment can be successfully managed by a multidisciplinary approach and by applying proper modification in the orthodontic mechanics depending on the type and severity of the trauma. It is also very important to carefully evaluate the traumatized teeth on a regular basis before continuing orthodontic treatment and during treatment. It is recommended that there be a 3-24 month observation period before treatment continues depending on the severity and type of the traumatic injury,[14,20] and then when treatment does resume, only light forces should be used.[8] In spite of this advice, we are reporting on a unique situation where the decision was made to use light orthodontic force immediately after trauma to move teeth to alleviate an anterior cross-bite and successful reposition the displaced teeth while preserving their vitality.

Figure 1. Pre-treatment intraoral photograph.

CASE REPORT

A 17-year-old Caucasian male presented to the postgraduate orthodontic program at the Arizona School of Dentistry & Oral Health for an emergency appointment due to trauma to his permanent maxillary central incisors caused by a bicycle accident two years into an orthodontic treatment program (Figure 1). Intraoral findings demonstrated an anterior cross bite due to palatally displaced and extruded maxillary central incisors as well as a fractured mesio-incisal margin of the maxillary right central incisor (Figures 2A, B). The patient had visited an emergency room of a local hospital the evening of the accident. Medical and dental evaluations were performed and unsuccessful attempts were made to reposition the displaced teeth into their original location and antibiotics and pain medication were prescribed.

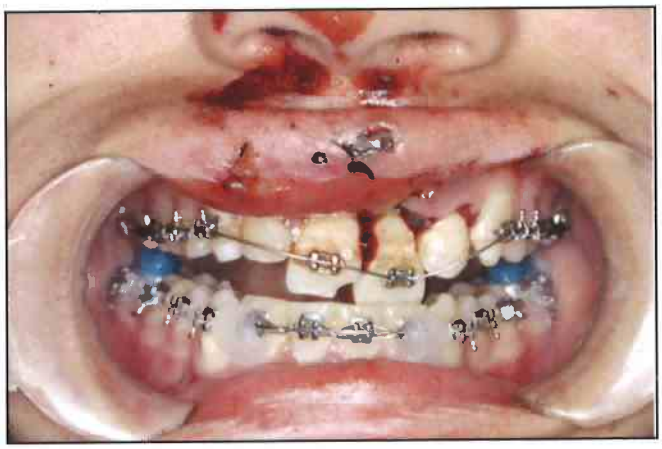
A day after the accident, a clinical examination at the orthodontic clinic found Grade 1 mobility of the traumatized teeth. A cone-beam computed tomography (CBCT) scan ruled out any jaw or root fractures (Figure 2C). The traumatized teeth were firmly fixed in their displaced locations and could not be moved manually under local anesthesia. So instead of waiting for 6 months for orthodontic treatment as recommended in the trauma management guidelines,[14,20] a decision was made to immediately start the treatment with light orthodontic forces to alleviate the anterior cross-bite and prevent further palatal displacement due to the traumatic occlusion with the mandibular incisors which in turn would prevent the posterior teeth from occluding. The teeth were moved into the desired positions using light intrusive and labial orthodontic forces with a 0.014-in nickel-titanium stop arch wire that was piggybacked on a stiff posterior segmental wire (0.019 X 0.025-in titanium molybdenum alloy) from the canine to the first molar. Posterior bite blocks were placed to prevent further palatal displacement of the maxillary central incisors caused by biting forces and assistance with correction of

Figure 2. Intraoral photographs a day after the accident: **A,** extrusion, palatal displacement and anterior cross-bite of the maxillary central incisors. Also note the fracture on the mesio-incisal line angle of the maxillary right central incisor and missing brackets on the maxillary lateral incisors due to trauma. **B,** palatally displaced maxillary central incisors. **C,** CBCT sagittal view: cross-sections 5-7 show palatal displacement with fracture of the palatal cortical bone of the maxillary central incisors. Also, note the radiolucent space at the apex of the central incisor roots (arrows) as a result of the possible severance of the periodontal ligament due the axial displacement of the teeth from the socket during the trauma.

the anterior cross-bite (Figure 3). A soft diet was prescribed for the patient until the anterior cross-bite was resolved and the teeth were stabilized. The patient and his parents were also advised of the increased risk for root resorption, ankylosis and devitalization of the affected teeth as well as the possibility of tooth loss and the need for future root canal treatment and restorative treatment due to trauma to the teeth.[6,8,17,18]

The orthodontic treatment was completed and the appliance was removed 6 months after the accident. The patient was given removable maxillary and mandibular retainers for post-orthodontic retention. The periodontal assessment at the completion of orthodontic treatment demonstrated gingival recession and loss of the scalloped gingival architecture on the facial surface of the maxillary central incisors due to bone loss after trauma (Figure 4A). The fractured maxillary right central incisor was monitored and vitality tests were performed 1, 3, 6 and 12 months post-treatment. The result of each vitality test was positive which suggests that the affected teeth were vital. A periapical radiograph and CBCT sections of the final scan showed widening of the periodontal ligament space due to possible severance during axial displacement from the socket caused by the traumatic force as well as blunting of the root tips possibly due to orthodontic treatment (Figures 4B, C).

Figure 3. Posterior segment from the canine to the first molar stabilized with a .019 X .025 titanium molybdenum alloy segmental arch wire and a 0.014-in nickel-titanium stop arch wire piggy-backed over the posterior segmental wire to maxillary central incisors. Posterior bite blocks were placed on the posterior teeth to assist in the correction of the anterior cross-bite.



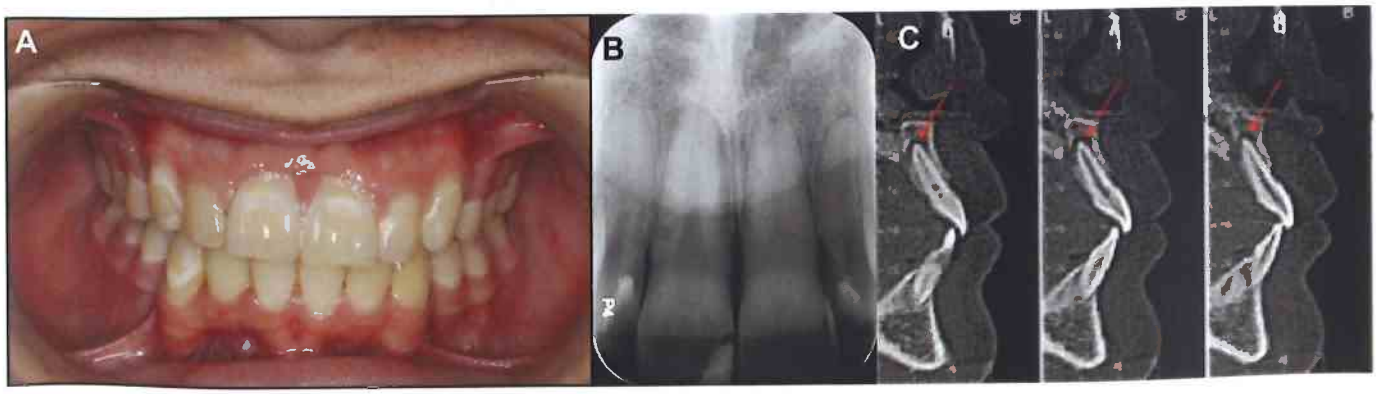
CONCLUSION

As each dental trauma case presents a unique set of circumstances, an individualized treatment planning by a multidisciplinary approach is required to manage these cases. In addition, it is usually recommended the root and pulp status of the traumatized teeth be monitored every 3 months.

Depending on the severity and type of traumatic injury, it is recommended to wait 3-24 months before continuing with orthodontic treatment, and when treatment does resume, there should be biological considerations and only light forces should and individualized biomechanical modifications should be used in the orthodontic force systems.

In the specific case reported here, light orthodontic forces were applied immediately following trauma to move teeth and alleviate an anterior cross-bite. The method used resulted in successful repositioning of the displaced teeth as well as a preservation of their vitality.

Figure 4. A, Post-treatment intraoral photograph; note the gingival recession and loss of the scalloped gingival architecture on the facial surface of the maxillary central incisors due to bone loss on the labial cortical plate after trauma; **B,** Note the widening of the periodontal ligament space and blunting of the root apices of all the incisors, which may have resulted as a combination of trauma and orthodontic treatment. **C,** CBCT sagittal view: cross-sections 6-8 show movement of the central incisors to their original position after being displaced within the socket after trauma. Radiolucency at the apex of the central incisor roots (arrows) similar to the immediate post-trauma scan could be a result of the possible severance of the periodontal ligament from the axial displacement of the teeth from their sockets during the trauma.



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