Upper incisor trauma and the orthodontic patient—Principles of management

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A proportion of children referred for orthodontic treatment have a history of previous trauma to their anterior teeth. Some can suffer trauma whilst undergoing fixed appliance therapy. The aim of this article is to familiarise the reader with some common dentoalveolar traumatic injuries that can have important implications for orthodontic treatment. Multidisciplinary care for long-term management of such cases with the involvement of orthodontists and paediatric dentists working in a team is also discussed. (Semin Orthod 2015; 21:59–70.) © ***2015 Elsevier Inc. All rights reserved.***

Introduction

Many children sustain accidental damage to their incisors, and trauma is reported to affect 5–13% of children 8–15 years of age according to the latest United Kingdom Children's Dental Health survey.[1] Boys were more likely to be affected than girls were especially between 12 and 15 years of age.

Almost 10% of children referred for orthodontic treatment had suffered dental trauma to one of their anterior teeth.[2] These authors reported a significantly higher frequency of dental trauma to anterior teeth in patients with increased overjet, with or without adequate lip coverage.[2] Systematic review of the relationship between overjet size and traumatic dental injuries concluded that children with an overjet >3 mm have approximately twice the risk of trauma to anterior teeth than children with an overjet <3 mm.[3] The aim of this article is to discuss some commonly encountered traumatic injuries and their implications for orthodontic treatment planning and appliance therapy. The possible effects of orthodontic tooth movement of teeth with history of previous trauma are also discussed. In addition, severe traumatic injuries such as intrusion and avulsion require interdisciplinary long-term management. Successful outcomes are dependent on close liaison between orthodontists and paediatric dental specialists managing the case.

History, examination and diagnosis of incisor trauma

It is crucial to assess the history of dental trauma including any management provided as part of an orthodontic assessment. Orthodontists should evaluate the anterior teeth for signs of dental trauma even in the absence of such history, as children might not recall such events. Clinical examination should include the following:

1. Hard tissue assessment
   a. Crown colour assessment:
      - Dark hue might indicate loss of pulp vitality.
      - Yellow colour might indicate pulp canal obliteration.
      - Pink colour might indicate internal resorption.
   b. Transillumination assessment can reveal enamel infraction lines and colour changes in traumatised teeth.
   c. Assessment of tooth mobility in both horizontal and vertical directions.
   d. Percussion tests:
      - Tenderness to touching or tapping a tooth is suggestive of PDL damage.
      - High metallic percussion note is often diagnostic of ankylosis.
      - Dull percussion note may be suggestive of a root fracture.

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2. Soft tissue assessment:
   a. Sinus tracts or swellings indicate loss of pulp vitality and peri-radicular infection.
   b. Palpation over the tooth apex for tenderness as it might indicate a periapical infection.
3. Radiographic assessment:

   Reproducible long-cone periapical radiographs are best for the accurate diagnosis of dental trauma. Two radiographs taken at different angulations are usually required to detect a root fracture. Radiographs are also important to detect any root resorption or pulp canal obliteration due to previous trauma.
4. Sensibility tests:

   Sensibility tests should be considered in association with other clinical and radiographic findings but not in isolation. Electric pulp testing (EPT) is the most useful test to assess the neurovascular supply to the pulp of a traumatised tooth.[4] This is; however, a subjective measurement tool and relies on patient understanding of and cooperation with the instructions given. The electrode should be placed as close to the incisal edge as possible to avoid contact with the gingival tissues and hence obtaining false-positive results. The use of the EPT in developing teeth is unreliable. The use of laser Doppler flowmetry is sometimes indicated especially when cooperation is lacking, the patient's responses are unreliable to cold and EPT testing, or when the results are inconsistent. Laser Doppler flowmetry is the only objective measure of pulp vitality available and is shown to be reliable in assessing pulp blood supply. However, the machine is expensive, requires patient cooperation and a splint needs to be fabricated for a reproducible placement of the probe between visits for accurate longitudinal assessment.

Endodontic management of traumatised anterior teeth

Pulp necrosis following dental trauma is usually dependent on the type of injury, root development stage and treatment provided (Table 1). An endodontic intervention is required when there are clinical and radiographic signs of pulpal necrosis and infection associated with traumatised teeth. Failure of continued root formation and presence of external inflammatory (infection related) root resorption, internal resorption or sinus tract are indicative of either a state of pulp inflammation or root canal infection.

The choice of endodontic management technique is dependent mainly on the stage of root development, presence of root fracture and root resorption. Teeth with complete root formation and no associated root resorption are endodontically treated and obturated using Gutta-percha. The use of calcium hydroxide as an intracanal medicament is acceptable on short-term basis as the long-term use of calcium hydroxide may be detrimental to the dentine making it more brittle and liable to fracture.[5]

Endodontic management of non-vital immature teeth has always been challenging. These teeth have short roots and thin dentinal walls that render these teeth weak and unable to withstand the physiological forces of mastication. This

Table 1. Three-Year Predicted Risks of Healing Complications Following Different Types of Dental Trauma in Permanent Teeth With Immature (Two-Thirds Root Formation) and Complete Root Formation as per the Trauma Guide (http://www.dentaltraumaguide.org/Permanent_teeth.aspx)

Type	*Pulp Necrosis (%)*		*Inflammatory Root Resorption (%)*		*Ankylosis (%)*		*Tooth Loss (%)*	
	ICR	*CR*	*ICR*	*CR*	*ICR*	*CR*	*ICR*	*CR*
E/D fractures	0	5.1	0	0	0	0	0	0
E/D fractures (complicated)	6.2	0	0	0	0	0	0	0
Root fractures	0	30.9	0	0	0	1.5	0	7.2
Concussion	0	0	0	0	0	0	0	0
Subluxation	0	12.5	0	0	0	0	0	0
Extrusion	5.9	56.5	2.9	0	0	0	0	0
Lateral luxation	4.7	72.8	0	33	0	1	0	0
Intrusion	61.1	100	33.3	4.8	5.6	26.1	5.6	5.3

E: enamel; D: dentine; CR: complete root; ICR: incomplete root.