

Management of Complications after Traumatic Injuries to Immature Permanent Maxillary Incisors: A Five Years Follow up case report

Halima Abukabbos¹, Faisal AlSineedi², Marcio Guelmann³

¹BDS, Fellow, Department of Pediatric Dentistry, University of Florida, Gainesville, Florida, USA. ²DScD, Consultant Pediatric Dentist, King Fahd Military Medical Complex, Dhahran, KSA. ³DDS, Associate Professor, Chair and Residency Program Director, Department of Pediatric Dentistry, University of Florida, Gainesville, Florida, USA.

Abstract

The management of traumatic injuries to the teeth and soft tissues represent a challenge for the dental practitioner requiring knowledge and expertise necessary for adequate diagnosis and treatment. The purpose of this case report is to illustrate the emergency, short and long-term management of young permanent teeth involved with complex luxation injuries. Emergency management, orthodontic forced eruption and pulp therapy approaches used are described in details. The case was followed-up clinically and radiographically for 5 years.

Key Words: Intrusion, Orthodontic extrusion, Apexification, MTA

Introduction

Intrusive luxation injury is the axial displacement of the tooth into its socket with possible extensive damage to the pulp and Periodontal Ligament (PDL) based on the severity of the injury and stage of root formation. In case of immature young permanent teeth, spontaneous repositioning is allowed to take place. If no movement is noted within a few weeks, orthodontic repositioning is recommended. If tooth with an incomplete root formation is intruded more than 7 mm, immediate surgical or orthodontic repositioning should be initiated. On the other hand, if a tooth with complete root formation is intruded less than 3 mm, eruption without intervention may be allowed. If no movement is noted after 2-4 weeks, surgical or orthodontic repositioning is required. Root canal therapy using calcium hydroxide should begin 2-3 weeks after repositioning of teeth with complete root formation since pulp will likely become necrotic [1]. The purpose of this report is to discuss the emergency treatment of a 9-year-old boy with multiple dental injuries and the management of their complications.

Case Report

A 9-year-old boy was referred to the dental clinic in November 2008 from the emergency room for emergency evaluation and dental management. Medical history revealed a healthy child, with up to date immunizations, no known drug allergies and a tetanus booster given when he was 6 years old. The child's chief complaint was fracture of maxillary anterior teeth during

sport class in the school early that morning. Time elapsed since injury was 45 minutes before his arrival to the Emergency Department at King Fahd Military Medical Complex, Dhahran, Saudi Arabia. No previous dental treatment has been provided to the child. Child's height was 133cm and his weight 29 kg.

Extraoral assessment revealed an alert boy with a convex profile, competent lips and symmetrical face, laceration and swelling of lower lip, abrasion of the cheeks and contusion of the chin with no bone fractures or abnormalities, and normal TMJ motion. Intraorally, tongue, lingual frenum, soft and hard palate, tonsils were all within normal limits. Dental findings showed tooth # 7 with concussion and enamel crown fracture, # 8 with subluxation and an uncomplicated crown fracture, # 9 with total intrusion and an uncomplicated crown fracture, # 10 with intrusion and an uncomplicated crown fracture (*Figures 1 a-d*). Thorough centric occlusion evaluation revealed class I molar and canine relationship bilaterally, symmetrical midline, 20% overbite and 2 mm overjet. Radiographic assessment included a panoramic radiograph, periapical and occlusal images of the involved teeth as well as soft tissue exposure of the lower lacerated lip to disclose any foreign body or tooth fragment (*Figures 2 a- d*). Vitality tests were performed (*Table 1*).

For the emergency treatment, iodine cleaning of the skin, intraoral saline irrigation and suture of lower lip were performed. The exposed dentin of # 8, #9 and #10 was covered with a resin-modified glass ionomer liner and a composite



Figure 1. (a, b, c and d): Laceration & swelling of lower lip, abrasion in the cheek and contusion in the chin. # 9 had uncomplicated crown fracture with intrusion to the gingival level, # 10 had uncomplicated crown fracture with intrusion, # 8 had uncomplicated crown fracture with subluxation, # 7 had enamel crown fracture with concussion.

Corresponding author: Halima Abukabbos, College of Dentistry, Department of Pediatric Dentistry, PO BOX 100426, Gainesville, FL 32610-0426, USA, Tel: +352-339-8024; e-mail: h_kabbos@hotmail.com

restoration. Then, teeth were splinted with a 0.016" NiTi flexible orthodontic arch wire using acid-etch composite technique. The child was instructed post operatively to eat a soft diet, brush teeth with a soft tooth brush after each meal, chlorhexidine mouth rinse (0.12%) twice daily for 1 week. Amoxicillin 40 mg/kg tid for 5 days and paracetamol 15 mg/kg tid as needed was also prescribed. At a subsequent appointment, a metallic button was bonded to the intruded central [tooth #9], elastic traction was activated in axial direction (Figures 3 a and b). Follow-up appointment was performed after 2 weeks, 8 weeks, 6 months, 1 year and then yearly for 5 years. Pulp extirpation of # 9 was done within 2 weeks after trauma since the tooth apex opening was less than 0.5 mm [2]. The canal was cleaned, irrigated with 0.5% sodium hypochlorite (NaOCl), dried with paper points then filled with a creamy mix of non-setting calcium hydroxide with lentulo-spiral instrument which was replaced every 3-6 months (Figure 4). In the meantime, # 7, 8, 10 were subjected to periodic evaluation of pulpal and periodontal status through vitality tests, percussion, palpation and pocket depth measurement.

Full mouth radiographs had been taken along with two bitewings, four periapical radiographs for the posterior teeth. Radiographic examination revealed multiple carious teeth. Comprehensive treatment plan was divided into four phases including preventive measures, such as brushing twice daily, professional topical fluoride application bi-annually and diet counselling to decrease refined carbohydrates intake. The restorative phase was accomplished on multiple visits (Figures 5 a and b). During orthodontic treatment, a more efficient rapid method was used utilizing a heavy stainless steel arch wire complemented by a Ni-Ti overlay wire for rapid tooth movement which was accomplished within 4 weeks (Figures 6 a and b).

Three months after the dental trauma, the child returned with a second trauma and a swollen upper lip. Pulp and PDL status were re-evaluated (Table 1). As shown in the table, # 7 showed positive response to pulp and PDL tests whereas

8 had negative response to both cold and electrical pulp tests. Endodontic consultation advised to initiate root canal treatment. Pulp extirpation revealed a necrotic pulp and root canal was performed in 2 appointments (Figure 7). Tooth # 10 at subsequent visits was continually evaluated for pulp and PDL status since the tooth was an immature with chance for revascularization.

In May 2009 [7 months after trauma], # 10 was still showing negative pulpal response (Table 1). After endodontic consultation, the pulp was extirpated and filled with non-setting calcium hydroxide to induce apical closure. The dressing was replaced every 3-6 months (Figures 8 a and b). In November 2009 (one year post trauma), # 9 and #10 were evaluated. A periapical radiograph showed # 9 with completely closed and healed apex, however, clinically when instrumented with K-file, the apical closure was still weak. It was then decided to place MTA as an apical root end filling followed by obturation of the canal with gutta-percha/sealer for both teeth (Figures 9 a- e). Composite restorations were used to build up # 8, # 9, # 10 and to restore esthetic, function and occlusion and the child was provided with athletic mouth guard to protect his teeth during sport class activity (Figures 10 a-c).

Since the child was classified as high caries risk patient, anticipatory guidance and recall visits occurred every 3 months during the maintenance phase. Preventive measures were applied to reduce the number of new carious lesions and to improve the gingival health through oral hygiene instructions, with brushing twice daily for both parent and child with scrub technique and youth multi-tufted soft nylon toothbrush and an ADA approved fluoride toothpaste, diet analysis to reduce refined fermentable carbohydrates ingestion and snack frequency as well as to increase healthy food intake. Prophylaxis and application of professional topical fluoride bi-annually until caries rate decreases substantially. Child's growth was observed during the recall visits with the growth chart percentile. Intra oral examination revealed good oral hygiene practice and the debris index score decreased

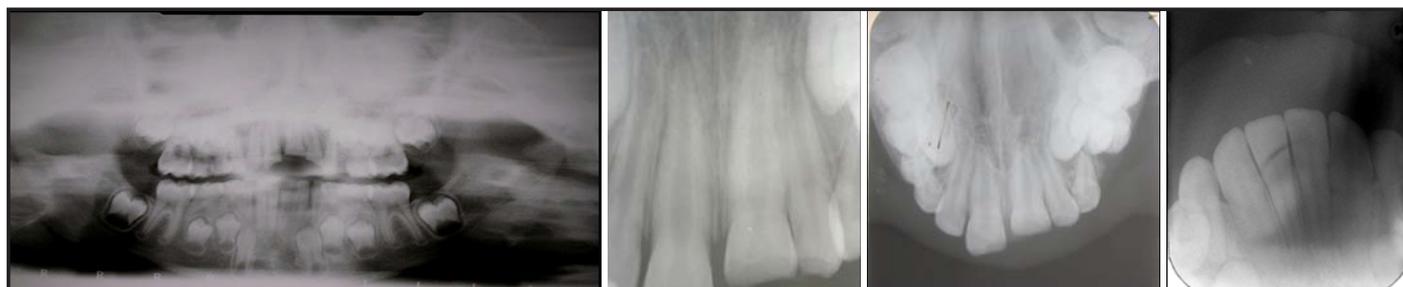


Figure 2. (a, b, c and d): Several radiographs were taken include panorama, periapical and maxillo-occlusal x-ray for the involved teeth, as well as soft tissue x-ray for the lower lacerated lip with one fourth exposure to detect entrapment of any foreign body or tooth fragment.

Table 1. Tooth Response, pulp and PDL in Nov. 2008, Jan. 2009 and May 2009.

| Time periods | Nov.2008 | | | | Jan. 2009 | | | May 2009 | |
|--------------|----------|----------|---------------------|---------------------|-----------|------------|------------|----------|-------------|
| | 7 | 8 | 9 | 10 | 7 | 8 | 10 | 7 | 10 |
| Cold | +ve | -ve | -ve | -ve | +ve | -ve | -ve | +ve | -ve |
| Electrical | 35 | 40 | 70 | 45 | 48 | No resp.80 | No resp.80 | 35 | No response |
| Percussion | +ve | +ve | High metallic sound | High metallic sound | -ve | -ve | -ve | -ve | -ve |
| Mobility | Garde I | Grade II | No | No | No | No | No | No | No |



Figure 3. (a and b): Teeth were splinted with 0.016" NiTi flexible orthodontic arch wire using acid-etch composite technique, a button were placed afterward on the intruded central, elastic traction was activated in axial direction.



Figure 6. (a and b): A heavy stainless steel arch wire complemented by a NiTi overlay wire for rapid tooth movement which was accomplished within 4 weeks.

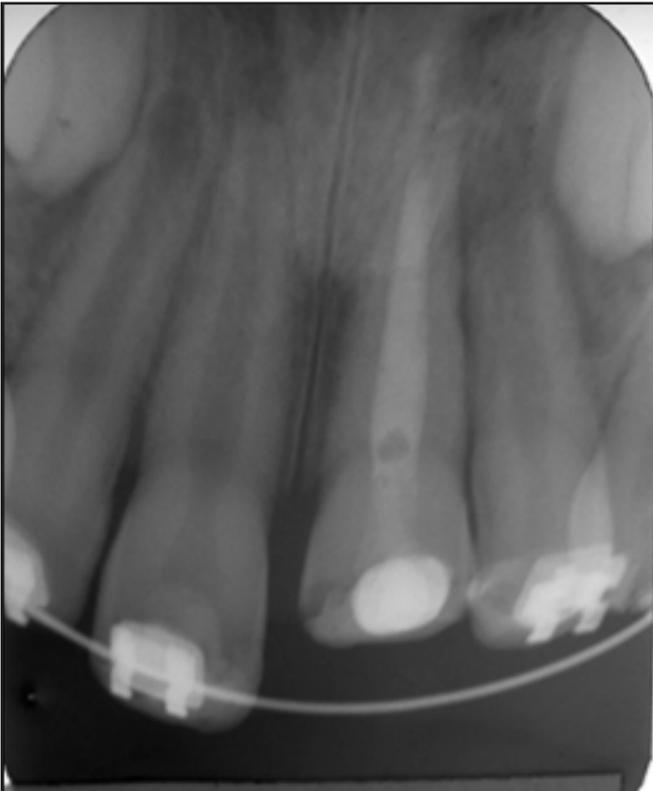


Figure 4. #9 pulp extirpation and non-setting calcium hydroxide dressing.



Figure 7. Pulp extirpation of #8 and dressing with non-setting calcium hydroxide then obturation with gutta-percha in different visit.



Figure 5. (a and b): Comprehensive restorative phase.

dramatically from 32 in the initial visit to 18 in the last recall visit (Figures 11 a and b and Figures 12 a and b).

In October 2013 (5 years after trauma), the child was presented with his parent for a recall visit. He was healthy with no concern or complaint; clinical extra-oral examination showed no abnormalities with skeletal class I profile while intraorally, the child is in permanent dentition with class I molar and canine relationship in both sides. Some fracture of the composite restoration of #8, #9 which required mild adjustment of both restorations. Periapical radiograph of



Figure 8. (a and b): Pulp extirpation of #10 and dressing with non-setting calcium hydroxide.

upper anterior teeth showed normal healthy periapical tissues of #8, #9 and #10 (Figures 13 a-c).

Discussion

Traumatic injuries to young permanent teeth are common

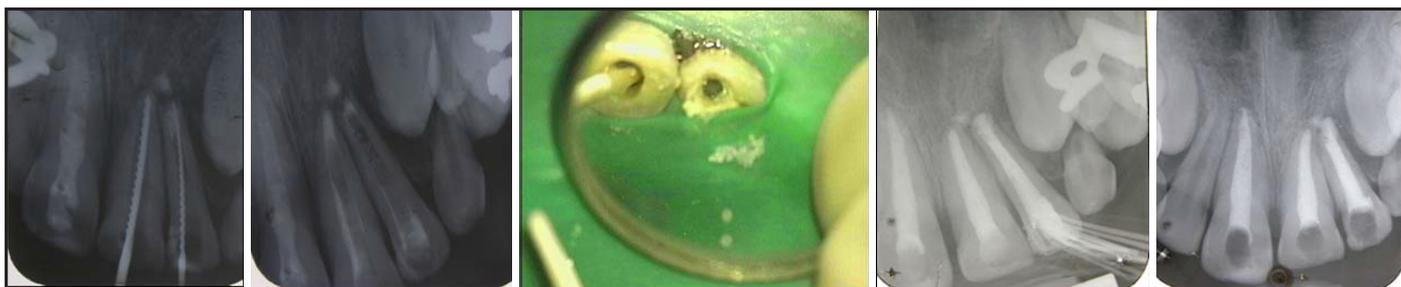


Figure 9. (a, b, c, d and e): MTA placement then obturation with gutta-percha of #9,10.



Figure 10. (a, b and c): Composite restoration of #9,10 and insertion of athletic mouth guard.

and affect about 30% of children [3]. Maxillary central incisors are most commonly injured and children with class II malocclusion, protruding incisors and increased incisal overjet are more likely to suffer dental trauma than children with normal overjet [4]. The outcome of healing of most dental trauma has been related to the severity of injury and the stage of root development [5]. Complications following trauma to the teeth may include pulpal necrosis, progressive inflammatory external root resorption, replacement resorption, pulp canal obliteration and loss of marginal bone support [3]. With respect to pulp survival, immature teeth with open apex have demonstrate pulp survival following intrusion but however, it should be remembered that pulp necrosis is a very frequent finding after intrusion, irrespective to the stage of root development [1,3]. In regard to periodontal healing, high risk of root resorption about 58% for immature teeth and 70% for mature teeth [3]. Unfortunately, this case is an example of the complications occurred after severe intrusive injury to young permanent incisors where loss of pulp vitality is not uncommon.

This case represents an intruded tooth #9 with complete root formation which was orthodontically repositioned immediately after trauma. The recommended wait and see strategy in anticipation of spontaneous re-eruption should cease to be an option. However, orthodontic extrusion or surgical re-positioning should be considered a valid alternative when the former fails [6].

Apexification (Frank procedure or Root-End closure) is used to induce apical closure by mineralized tissue formation in the apical region of necrotic tooth with an open apex while apexogenesis (Vital pulpotomy) is used in vital young permanent tooth to maintain the radicular pulp's viability to allow apical closure by placing calcium hydroxide directly on the radicular pulp stump after removing the infected coronal portion of the pulp [7]. The tissue formed in the apex after apexification procedure may be composed of osteodentin, osteocementum, bone or combination of all [8]. Calcium hydroxide apexification technique has been studied and proven to have a very high success rate [9,10]. The reactions of the periapical and pulp tissues to calcium hydroxide are

similar. Calcium hydroxide with its antimicrobial properties and high pH (11.8) produces necrosis sufficient to produce mineralization [11]. Calcium hydroxide was successful in 74-100% of cases for apical barrier formation [12]. However, apexification with calcium hydroxide has some disadvantages which include the need of 6-18 months for the hard tissue barrier to form. The needs of patient compliance to report every 3 months to evaluate the presence of calcium hydroxide and if the barrier is complete or not to act as a stop for a filling material. In addition, calcium hydroxide weakens the resistance of the dentin to fracture so the patient may sustain root fracture [13,14].

A comparative study of root end induction using three different materials was done by comparing the efficacy of osteogenic protein-1, mineral trioxide aggregate and calcium hydroxide in the formation of hard tissue in immature roots of dogs. Mineral trioxide aggregate produced apical hard tissue formation with significantly greater consistency. Although; the difference in the amount of hard tissue formation was not statistically significant [15].

Mineral trioxide aggregate is used for one-visit apexification of non-vital teeth with open apex and it composed of powder consisting of fine hydrophilic particles of tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide. It set in 3-4 hours in moist environment with its high pH (12.5), it can be used as indirect pulp capping, repairing an internal resorption, root end filling and apexification [16-18]. The aim of a one-visit apexification is to provide an apical stop that enables immediate root canal filling, although there is no root end closure. MTA produced hard tissue formation and better biological seal [19,20]. In addition, the potential for fractures of thin roots of immature teeth is reduced when a bonded core is placed immediately within the root canal [21]. However, it does not allow for continuation of root development. For this reason, one-visit apexification cannot be used for teeth. With excessively short roots [22]. In this case, calcium hydroxide was used as dressing materials in both #9 and #10 for its antibacterial effects for several months. MTA was placed in the apical region of both teeth as root end filling where obturation was done in different visit because MTA requires



Figure 11. (a and b): Recall visit after 3 months.



Figure 12. (a and b): Recall visit after 6 months.



Figure 13. (a, b and c): Recall visit after 5 years.

adequate time for setting in the presence of the moisture, and final obturation should be delayed until final setting of MTA [23].

The aim of restoring these immature teeth following obturation with gutta percha has favorable outcome since acid etch and a composite resin strengthen the tooth and make it more resistant to fracture. Whereas, preparation and

placement of posts within the canal significantly weaken the remaining tooth structure and thus should be avoided unless no other means of restoration is achievable [24]. Five years follow up of the case clinically and radiographically with evidence of hard tissue formation and good healing process apically.

Conclusion

Knowledge, experience and judgment are necessary for diagnosis and treatment of dental emergencies. The clinical and radiographical successful outcomes in the treatment of immature permanent teeth with luxation injuries depends on the initial emergency management, subsequent treatment of the resulted complications of dental trauma such as pulp necrosis, orthodontic forced eruption, mechanical debridement of the canals and the antibacterial and calcific barrier inducing actions of calcium hydroxide and mineral trioxide aggregate. Immature permanent teeth with intrusion, should be followed-up clinically and radiographically yearly up to 5 years to ensure successful outcomes of the treatment measures used during management.

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Conflicts of Interests

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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