NARRATIVE REVIEW

Traumatic dental injuries in the primary dentition — a review

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Abstract

Traumatic oral injuries in children involve trauma to the dentition and the surrounding oral soft tissue structures. They usually present as an emergency hence their management poses a challenge globally. Treatment of a tooth fracture, displacement or loss is determined by the type and severity of the injury independent of the etiology. It necessitates the experience for behavior management in a child, ascertaining a patient centered diagnosis, formulating a definitive treatment plan, explanation and consent of oral care to the parents or carer with optimal operator skills. This article provides an overview on the types of oral injury in a child patient, their recognition, diagnosis and management based on credible, practical and readily understandable evidence.

Keywords: Primary, Tooth, Trauma, Fracture, Luxation, Avulsion.

Introduction

Trauma to the oral and maxillofacial region in children leads to injuries of teeth, periodontium and the associated anatomical structures. The most frequent injury is dental tissue trauma followed by trauma to the oral soft tissues. Sequelae of dental trauma including loss of tooth structure, fracture, displacement or complete loss of tooth which effect aesthetics, psychology and oral function.[1-3]

Facial trauma accounts for almost 5% of the overall injuries sustained.[4] Somatic injuries comprise almost 18% of all injuries in children over six years. The highest incidence of primary dentition trauma occurs between 2-3 years[5] and luxation injuries are found in 1-3 years. Almost 40% pre-school children comprise of head and non-oral trauma.[6,7] Trauma to permanent teeth is secondary to traffic accidents, falls, sports and violence.[8-10]

Treatment plan for a damaged primary tooth is influenced by the safety of the developing dentition. The fear and lack of cooperation render it difficult to examine and treat a young child. A dentist should immediately assess and deliver optimal care for a child presenting to the emergency with a dental trauma with improved outcomes.[11,12] Hence it is essential to determine the cause, recognize/diagnose the type of injury and ascertain the extent and complexity of the injury in a systematic approach.[13,14]

A holistic initial evaluation at the time of injury should incorporate a comprehensive medical and dental history, diagnostic information, treatment plan and follow up. Diagnostic information is based on clinical assessment, radiographic evaluation, vitality tests, palpation, percussion and mobility. Extent of the injury can be evaluated by an intraoral radiograph of injury in the dentoalveolar complex whereas an extra oral imaging is necessitated beyond.[15,16] Additional information should contain neurological status, episode of nausea/vomiting, haemorrhage, airway compromise or a loss of consciousness. All this information should be maintained in the dental record of a patient. A standardized trauma form allows the orderly and consistent recording of patient care.[15-18]

The management of a child can furthermore be influenced by the time of dental injury presentation, fear, lack of child cooperation, economic and social variation. Hence the treatment should be specific to the needs of a child and in their best interest.[19-21]

Methods

Dental trauma in the primary dentition- fracture of teeth and alveolar bone:

Dental infraction: It is defined as a crack or an incomplete enamel fracture without any tooth surface loss. The clinical diagnosis is based on a normal appearance of the gross anatomy, radiograph and appearance of craze lines on transillumination. The outcome is favourable and complications are unusual. Treatment entails smoothening of sharp edges, maintaining tooth structure integrity and preserving pulp vitality.[22-25]

Enamel dentine fracture/uncomplicated fracture: It is defined as a fracture of enamel or an enamel-dentin fracture sans involvement of the pulp. A clinical diagnosis is based on loss of the tooth structure either within the

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enamel or affecting both the enamel and dentine. A radiograph does not specify any relation between the fracture line and the pulp wall.[13-15,17,26-30,42]

Treatment warrants restoration of normal tooth aesthetics, preservation of pulp vitality and assessment for tooth fragments in the region of injured soft tissues like lips, gingiva and tongue. Small dentinal defects require smoothening of rough margins and edges with a GIC seal. Large fractures require restoration of the lost tooth structure.[6,14] The prognosis depends upon the extent of concomitant injury to the supporting periodontal ligament and the degree of dentin exposure. A clinical follow up at 3-4 weeks monitors optimal treatment outcomes.[30,31,33]

Enamel dentine pulp fracture/ complicated fracture: It is defined as a fracture of the enamel-dentin complex with pulp exposure. Diagnosis is based on the clinical and radiographic appearance of loss of tooth structure, pulp exposure and tooth fragments at the site of soft tissue injury. The level of root development is verified by a radiograph.[4,5,13]

The treatment aims to restore aesthetics, function and preserve pulp vitality.[32] The factors influencing a treatment plan comprise of life expectancy of the traumatized primary tooth, pulp tissue vitality and compliance of a child. Pulp treatment options may include vital pulp therapy like partial pulpotomy whereby a calcium hydroxide paste applied over the pulp is covered with a reinforced glass ionomer lining and a composite restoration; pulpotomy; pulpectomy with zinc oxide eugenol or calcium hydroxide/ iodoform paste and tooth extraction. A follow up is recommended after 1 week, 6-8 weeks and after 1 year for a clinical and radiographic evaluation. A favourable outcome indicates continuity in root development in teeth with immature open apices. An unfavourable outcome like apical periodontitis indicates discontinuity in the root development followed by a pulpectomy or an extraction. The prognosis of the tooth is subject to the duration of pulp exposure, extent of dentine exposure and developmental stage of root at the time of injury.[4,5,13,14,26,33-35,39,43]

Crown root fracture: It is defined as a fracture of the enamel, dentin and cementum with or without exposure of pulp. The tooth fragment may become loose and stay attached or experience a mild to moderate displacement. A clinical and radiographic diagnosis is based on the mobile coronal fragment attached to the underlying gingiva with or without pulp tissue exposure. A root fracture manifests on an X-ray only hence appears as an oblique radioluscent line in the primary crown and root which is vertical to the radiographic beam whereas permanent teeth show perpendicular line.[3,6,21,25,26,31]

The treatment aims to preserve pulp, restore function and esthetics.[35] A very small coronal fragment may be removed and the remainder of the tooth sealed. If the tooth is beyond the scope of restoration the entire tooth should be extracted atraumatically to safeguard the tooth bud of the succedaneous tooth when retrieving the apical fragments. A follow up at 1 week, 6-8 weeks and 1 year allows monitoring of the permanent tooth eruption, continuation of root growth in immature permanent teeth and appearance of any unfavourable symptoms like apical periodontitis or a discontinuity of growth of root in immature teeth.[5,33,44]

Root fracture: It is defined as a dentin and cementum fracture with pulpal involvement. Clinical diagnosis is based on the mobility of a coronal tooth fragment and a probability of fragment displacement. The fracture may be located in the middle or apical third of the root. In a horizontal root fracture a radiograph may indicate one or more radiolucent lines disconnecting the tooth fragments. Radiographic diagnosis requires multiple exposures at various angulations since the permanent tooth bud may obscure the visualization of a root fracture.[4,6,30,36]

An undisplaced coronal fragment does not require treatment however a displaced coronal segment should be extracted and the apical root fragment allowed to resorb. Repositioning and stabilization of the coronal fragment may be considered but it is not recommended. An undisplaced tooth should be evaluated at 1 week, 6-8 weeks and 1 year till it exfoliates. An extracted tooth should be evaluated after one year to check for apical root resorption. The evaluation should continue 1 year after the eruption of the succedaneous tooth.[6,30,37,40,41,45]

Alveolar fracture: It is defined as a fracture involving the alveolar bone of a tooth with or without an extension into the surrounding bone. Clinical diagnosis is based on occlusal interferences due to the alveolar bone segment dislocation and mobility.[4,6] A lateral radiograph reveals a horizontal fracture line approximating with the apices of the primary teeth and the succedaneous teeth. A radiograph simultaneously verifies the labial displacement of a segment.[14,26,33]

Treatment under general anaesthesia involves repositioning and splinting of the segment for 4 weeks and monitoring the teeth in the line of fracture. A follow up at 1 week, 3-4 weeks, 6-8 weeks and 1 year monitors

the erupting succedaneous tooth. Favorable primary tooth outcomes include a normal occlusion, absence of an apical periodontitis, disturbance free development of the permanent tooth bud and an absence of external inflammatory root resorption in the primary teeth. Splinting is recommended only for an alveolar bone fracture and intra-alveolar fractures of the root.[18,22,38-41]

Dental trauma in the primary dentition-luxation injuries

Concussion: It is defined as an injury to the structures supporting a tooth without causing mobility, gingival bleeding or tooth displacement. The clinical diagnosis is based on tenderness of tooth to percussion or pressure attributable to absorption of the force by the periodontal ligament therefore there is no appreciable periodontal space widening on the radiograph.[5,13,14,27,33,44]

The teeth are observed for an optimum periodontal ligament with maintenance of pulp vitality.[5,13,14,22,27,33,44] A follow up at 1 week, 6-8 weeks monitors for a favourable continuous root development as well as unfavourable outcomes like dark discolouration, periapical periodontitis and arrested root development. Pulp therapy is therefore indicated for periapical periodontitis. The permanent teeth with closed apices may undergo pulpal necrosis owing to injured apical blood vessels.[44,47]

Subluxation: It is defined as an injury to the structures supporting a tooth resulting in an increased mobility, absence of tooth displacement but presence of crevicular bleed. A radiograph does not reveal any apparent abnormality and help rule out root fractures or future complications.[5,13,14,27]

The treatment encompasses observation to allow self-resolution and healing of the periodontal ligament and neurovascular supply, maintaining oral hygiene with soft brushing and applying topical 0.12% chlorhexidine. A clinical follow up after 1 week and 6-8 weeks enable monitoring of continuous root development, tooth discoloration, periapical periodontitis or fistula formation. Yellow discoloration due to pulp obliteration has a good prognosis. A primary tooth resumes normality within 2 weeks however permanent teeth with closed apices may develop pulpal necrosis owing to the damaged apical blood vessels.[5,13,14,22,27,33,44,47]

Lateral luxation: It is defined as a displacement of a tooth directed in an axis other than its own. A tooth may be directed lingually/palatally or labially, be immobile or tender to touch. A clinical diagnosis is ascertained by the direction of the crown displacement and firm lock in the new found position. The tearing of the periodontal ligaments and contusion or fracture of the supporting alveolar bone presents as a widened periodontal space in the radiograph. The X-ray also validates the displacement of the apical tip towards or through the labial cortical plate and its relation to the bud of the permanent successor.[4,13,14,33,44,50,52]

The treatment entails passive or spontaneous repositioning of the tooth in the absence of occlusal interferences.[27] Occlusal interferences may be gently repositioned or reduced under local anaesthesia.[54] An extraction is recommended if the injury is severe or if the tooth is close to exfoliation.[5,22,26,33,34,51]

A follow up at 1 week, 2-3 weeks, 6-8 weeks and after 1 year observes optimum healing, continued root development, transient colour change, dark discoloration or apical periodontitis. A risk of pulp necrosis is higher in primary tooth repositioning than spontaneous repositioning.[5] Similarly a permanent tooth with a closed apex has a higher likelihood of pulp necrosis and pulp canal obliteration as compared to inflammatory root resorption.[52]

Extrusion: It is defined as an injury resulting in a partial axial displacement of a tooth from the socket. It is a partial avulsion secondary to tearing of the periodontal ligaments.[14,27,46,56] The clinical diagnosis is based on the elongated appearance and excessive tooth mobility. An apical widening of the periodontal space is present on the radiograph.[5,13,33,44,56]

This treatment decisions for extrusion are based on the degree of tooth mobility, degree of displacement, root development and compliance of a child. If minor extrusion >3mm then the immature primary tooth is allowed to reposition and align spontaneously. Extraction is the treatment of choice in severe extrusion with excessive mobility, in a tooth close to exfoliation, when a child is not compliant or when the root formation is incomplete.[5,14,22,26,34,48,56]

The tooth should be evaluated for continued root development in immature teeth, transient discoloration, yellow discoloration in pulp obliteration and dark discoloration for fistula formation or periapical peridontitis. There is a scarcity in the evidence for extruded primary teeth hence careful monitoring is important.[5] The risk of pulp necrosis and pulp canal obliteration is comparatively higher in mature permanent teeth with closed apices.[56]

Intrusion: This in an injury which results in the displacement of tooth in an apical direction towards the alveolar bone of the socket with a concomitant

compression of the periodontal ligament and a crushing fracture of the alveolar socket.[14,27,55] Clinical diagnosis arises from a tooth appearing shorter than the contralateral tooth or a completely missing tooth in severe cases. This is ascribed to the labial displacement of the tooth apex resulting in the apex traversing the buccal cortical plate in primary teeth and driving into the alveolar process in the permanent dentition. A radiograph reveals a discontinuous periodontal space, apical tooth displacement, tip of the apex and the proximity of a primary tooth to the permanent tooth follicle. An apical tip displaced palatally towards the succedaneous tooth germ will not be visible on an X-ray and will make the tooth appear elongated. Detection of the apical displacement towards the labial bone plate or through it can be aided by an extraoral lateral radiograph. An intruded primary tooth mimics the eruption pattern of young permanent teeth.[13,33,44,55]

The treatment plan is conservative and allows spontaneous re-eruption of the primary intruded tooth. An extraction is indicated if the apical displacement is towards the permanent tooth germ. A follow up is carried out at 1 week, 3-4 weeks, 6-8 weeks and after 1 year. This monitors the re-eruption of intruded tooth, absence or presence of transient discoloration, radiographic signs of apical periodontitis and damage to the developing tooth bud.[13,33,44,55,57,58]

More severe cases of complete intrusion and displacement through the bone may take over 36 months. Ankylosis due to severe periodontal ligament damage may delay or alter the eruption of a successor. The risk of pulp necrosis, inflammatory root resorption and pulp canal obliteration is higher in permanent teeth. Immature permanent teeth which reposition spontaneously have the lowest risk for healing complications. If the intrusion is equal to 7 mm or greater than the healing is delayed due to the adjacent teeth.[5,14,46,55,59,60]

Avulsion: This is defined as an injury which displaces the tooth completely out of the socket leading to severed periodontal ligaments with/without a fractured alveolus. Clinical diagnosis is confirmed by the clinical absence of tooth and verified on the radiograph if the socket is empty. Since reimplantation of an avulsed primary tooth potentiates damage of the developing tooth germ it is not recommended. The follow up is scheduled after 1 week, 6 months and 1 year. This allows the development of the succedaneous tooth to be monitored.[13,14,33,43,61]

Discussion

There is a lack of consensus in the literature regarding the management of trauma in primary dentition. Some clinicians opt for a more conservative management whereas others prefer a more invasive management.[5,62] Permanent successors with incomplete enamel calcification are at a higher risk of developmental disturbances induced due to trauma in the primary dentition. A multitude of factors influence treatment selection. The close proximity between the apex of the root of an injured primary incisor and the succedaneous tooth follicle may result in development of potential sequelae such as discolouration of a crown (white or yellow-brown), hypoplasia of permanent incisors, malformation, impaction and eruption disturbances in the permanent dentition. It will also take into account the cognitive ability of a child to cope with the treatment, time of presentation of an injury (immediate or delayed), occlusion, recurrent trauma and time till exfoliation of a primary tooth. Hence selection of treatment plan should limit the risk of further impairment to the developing successors.[5,33,36,37,43,57,60,63-66]

A holistic evaluation should incorporate a comprehensive medical and dental history, clinical and radiographic evaluation, investigation for vitality testing, palpation, percussion and mobility. Sensibility and percussion tests in primary teeth are not reliable due to their inconsistent results. Intraoral radiographs evaluate the extent of injury in the dentoalveolar complex whereas an extraoral imaging is necessitated in an extent beyond the dentoalveolar region. The diagnosis maybe augmented by advanced behaviour management techniques. The evaluation should also include information regarding the neurological status nausea/vomiting, haemorrhage, airway compromise or a loss of consciousness at the time of injury.[15-18] When assessing a child less than 5 years age presenting with intra-oral soft tissue trauma involving the lip, palate, gums, tongue and severe tooth injuries it is also important to consider a possibility of child abuse.[67-72]

A radiographic examination is mandatory for confirmation of diagnosis. It ascertains the extent of injury to the structures supporting a primary tooth, the stage of primary root development and proximity of the apex with the succedaneous tooth follicle. Radiograph selection depends on factors such as the amenability of a child and the type of injury surmised. Several angles with a minimum risk of radiation exposure are recommended. It may be a 90° horizontal angle with central beam through the tooth (horizontal view, size 2 film) or an Occlusal view (horizontal view, size 2). Extra-oral lateral image is seldom indicated however it may specify the continuity between the apex of the displaced tooth and the permanent tooth follicle along with the direction of dislocation (vertical

view, size 2 film).[5,13,33,44]

A continued periodic clinical and radiographic monitor's successful intervention (asymptomatic, positive sensitivity to pulp test, continued root development in immature teeth, absence of both the tooth mobility and periapical pathology). Tooth discoloration following luxation injuries is a common complication. It is an aesthetic concern for both the child and parents.[26,74-76] This may fade and the original shade of the tooth is regained.[26,50,77,78] A persistent dark discoloration in a primary tooth may remain clinically and radiographically asymptomatic or transition into apical periodontitis.[79,80] Traumatized primary teeth have an association between crown discoloration and pulp necrosis.[75,81] A root canal treatment is initiated when an spontaneous pain ensues, pulp sensitivity tests do not have a normal response, root formation or apexogenesis discontinues or the supportive periradicular supporting tissues break down in a traumatized primary tooth.[82] Pulp canal obliteration with a yellowish hue is another common sequelae in a primary tooth luxation injury. It indicates pulp vitality and occurs in 35-50% cases.[75,77,80,83] Reattachment of crown fragment may be an alternative consideration when restoring the normal aesthetics of enamel in a fractured tooth. The use of systemic antibiotics is not recommended for luxation injury management in the primary dentition.[50] If the injury to the oral soft tissues is significant and accompanied by other injuries, it may require a surgical intervention and an antibiotic cover. If the child has an underlying systemic medical consideration then the paediatrician may prescribe the requisite.[13,22,27,33,44,73]

Optimum hard and soft tissue healing following a tooth injury depends on good oral hygiene as well. The parents or carers should be informed about preventive advice which prevents plaque accumulation and debris buildup. It includes information regarding brushing the teeth with a soft brush, topical application of an alcohol-free 0.1% chlorhexidine gluconate with cotton swabs twice a day for 1 week, intake of soft diet for 10 days and restricting the use of an intra-oral pacifier. They should also be informed about the occurrence of unfavourable complications like gum swelling, increased mobility or periapical sinus tract formation following more severe injuries such as alveolar fractures, avulsion and intrusion with documentation. Children may not provide accurate information regarding pain and may not complaint about it however this does not imply that the infection is not present. Hence the parents or carers should monitor for signs of any pathology that may arise and seek treatment at the earliest.[33,44,83]

Conclusion

Traumatic dental injuries in primary dentition are different from permanent dentition. These special problems need immediate and correct emergency management for accurate diagnosis, treatment planning and regular follow-up. This results in an improved prognosis with maximum chances of a favourable outcome. Dentists should provide the best care based on current best evidence and practice effectively and efficiently.

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