Review Article

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A Narrative Review on the Management of Luxation Injuries

Abstract:
Luxation injuries, a significant subset of traumatic dental injuries (TDIs), frequently affect children and young adults, resulting in complex damage to both the periodontium and dental hard tissues. This narrative review provides a comprehensive overview of the major types of luxation injuries,highlighting their clinical characteristics, diagnostic criteria, management protocols, and long-term prognosis. Each injury type exhibits distinct pathophysiological features that necessitate tailored clinical responses. The review integrates evidence from current literature, clinical guidelines, and case studies, emphasizing the importance of early diagnosis, appropriate treatment strategies, and regular follow-up to minimize complications such as pulp necrosis, root resorption, and pulp canal obliteration. By consolidating contemporary knowledge and practices, this review aims to support clinicians in enhancing treatment outcomes and informing future research directions in dental trauma care.

Key-words: Tooth luxation, Tooth avulsion, Dental trauma, Traumatic dental injuries, Tooth root resorption, Endodontics

Introduction:

Traumatic dental injuries (TDIs) occur in 18% to 25% of permanent dentition and rank among the top five most common injuries, with most cases happening before age 19. Luxation injuries are the most frequent TDIs in primary dentition. In contrast, crown fractures are more prevalent in permanent teeth. Maxillary incisors are the most commonly affected teeth in any TDI.

Luxation injuries are a type of dental trauma where a tooth is dislodged from its usual position in the alveolar socket. These injuries commonly result from external impacts, such as accidents, falls, sports incidents, or other forms of trauma. The impact of a traumatic force on a tooth depends on factors such as its strength, direction, point of contact, and timing. Such force can loosen and dislocate the tooth, causing damage to the periodontium and fracturing hard tissues like the pulp, dentin, enamel, and cementum.[1]

2. Types of Luxation Injuries:

Subluxation: Injury to the supporting tooth structure results in the increased mobility, but without displacement of the tooth.

Intrusion: Intrusion occurs when a tooth is forcibly pushed into the alveolar bone, the bone that houses the tooth socket. This results in the tooth appearing shorter than its neighbouring teeth and may cause damage to the tooth root and surrounding tissues.

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Extrusion: Extrusion involves partial displacement of a tooth from its socket, causing it to appear longer than usual. The tooth may be loose and sensitive to touch, and there may be damage to the supporting periodontal ligament.

Lateral luxation: Lateral displacement refers to the sideways movement of a tooth within the dental arch. This type of injury may cause misalignment of the affected tooth and potentially damage neighbouring teeth or supporting structures.

Avulsion: Avulsion is the complete displacement of a tooth from its socket, resulting in the tooth being knocked out entirely from the mouth. Avulsion is considered one of the most severe types of dental luxation injuries and requires prompt intervention to improve the chances of successful re-implantation.

3. Subluxation:

Definition and characteristics:

Subluxation is an injury impacting the structures that support a tooth, leading to increased tooth mobility and bleeding around the marginal gingiva.[2] Although the subluxated tooth remains in its original position within the dental arch, showing no vertical or horizontal displacement, the loosening can cause significant discomfort.

Subluxation can result in pulp sequelae by altering the vascular component, leading to increased vascular permeability, hyperemia, hemorrhage, or ischemia. These changes may cause pulp hemorrhage, potentially resulting in crown discoloration due to erythrocyte migration and hemoglobin breakdown.[3] Additionally, dystrophic calcification might occur as a result of the hemorrhagic effects combined with odontoblast differentiation.[3] The risk of pulp being permanently affected by necrosis[4] after isolated subluxation may reach 27.1 %,[4] especially in cases of delayed treatment,[5] lack of containment,[6] root canal infection[7] and traumatic occlusion.[8] In the case of subluxation, when the dental pulp is injured but not ruptured or the blood vessels are compressed, the nutrition of the pulp is compromised. This contributes to the aging process through the loss of pulp cells, reduction of cell nutrition, the formation of pulp fibrosis and nodules.[9] Pulp canal obliterations following subluxation occur in 8 %- 11 % of teeth, and a delayed complication after pulp obliteration is necrosis.[10,11]

Table 1-Clinical Presentation and Diagnosis: [12]

Clinical findings	Mobility	Sensibility test	Radiographic appearance
Tooth is not displaced Bleeding from gingival crevice	Increased mobility	Negative response indicates transient pulp damage	Appearance is usual

Treatment:[12]

Normally no treatment is needed .If the tooth is in occlusion, the antagonist can be slightly ground out of the occlusion and the patient is placed on a soft diet for 2 weeks. A passive and flexible splint to stabilize the tooth for up to 2 weeks may be used but only if there is excessive mobility or tenderness when biting on the tooth. Pulp condition should be monitored for at least one year, but preferably longer .

Pulpal complications are uncommon, but the stage of root development is a crucial factor in prognosis. The likelihood of pulp necrosis increases significantly if there is an accompanying crown fracture.

4. Intrusive Luxation:

Intrusion is one of the most severe luxation injuries affecting the permanent dentition. Trauma can cause a tooth to be driven axially into the alveolar socket. These injuries occur in approximately 0.5% to 2% of all dental trauma cases, with a higher incidence in male.[13] Notably, 97.2% of these cases occur in the anterior maxilla, specifically in the upper canine-canine region.[14] It involves intricate damage to the periodontium and dental pulp. Acute injuries cover various conditions, including damaged gingival epithelium, loss of epithelial attachment, torn and crushed cementum, strained, sheared, or torn periodontal ligament, and compression of the alveolar bone and dental pulp vessels. These injuries may also lead to fractures of the crown or root. Potential complications include pulp necrosis, inflammatory root resorption, dentoalveolar ankylosis, loss of marginal bone support, pulp tissue calcification, disruption or cessation of root development, and gingival retraction.

Table 2-Clinical and Radiographic Findings:[12]

Visual sign	Percussion test	Mobility	Sensibility test	Radiographic findings	Radiographs recommended
Tooth displaced axially	Metallic sound	Immobile	Usually gives negative response	Periodontal ligament space is missing.	1)One parallel periapical radiograph 2)Two additional radiographs of the tooth taken with different vertical and/ or horizontal angulations. 3)Occlusal radiograph

Treatment and Management:

Treatment approaches vary and include spontaneous re-eruption as well as interdisciplinary methods like endodontic, orthodontic, and surgical interventions.[15]

Teeth with incomplete root formation (immature teeth):

Allow re-eruption without intervention (spontaneous repositioning) for all intruded teeth independent of the degree of intrusion.If no re-eruption occurs within 4 week, initiate orthodontic repositioning.[12]

Monitor the pulp condition in immature teeth as there are high chances of spontaneous pulp revascularization.If the pulp becomes necrotic and infected or if there are signs of inflammatory external resorption during follow-up appointments, root canal treatment should be initiated promptly, provided the tooth's position permits. Endodontic techniques appropriate for immature teeth should be employed, such as direct pulp capping, partial pulpotomy, cervical pulpotomy, or pulpectomy.Cervical pulpotomy is the treatment of choice for traumatized immature intruded teeth with pulp exposure. It allows the development of the roots to continue, with apical closing and strengthening of the root structure.[16]

Teeth with complete root formation (Mature teeth):

Allow re-eruption for teeth intruded by less than 3 mm without any intervention. If re-eruption does not occur within 8 weeks, perform surgical repositioning and apply a passive, flexible splint for 4 weeks. Treatment guidelines based on the degree of intrusion has been summarized in table 3.

Table 3-treatment Recommendations For Intruded Teeth Based On Uk Guidelines:[17]

SEVERITY OF INTRUSION	MANAGEMENT
Mild(<3mm)	Passive repositioning
Moderate(3–6mm)	Surgical or orthodontic repositioning
Severe(>6mm)	Surgical repositioning

Orthodontic Management:

Orthodontic extrusion must be considered for moderate to severe intrusion (6-7 mm) cases.[18,19] All severely and moderately intruded teeth with closed apices should be repositioned rapidly to allow access for extirpation of a non-vital pulp within three to four weeks after trauma to prevent inflammatory root surface resorption.[18,] When a sectional fixed appliance is planned to realign intruded teeth, bracket positioning on the adjacent teeth should be passive, as its role is only to assist in correcting the position of traumatized teeth and not aligning the adjacent teeth. An observation period of 6-12 months before comprehensive orthodontic treatment is recommended for complete periodontal healing.[18]

In teeth with complete root formation, the pulp almost always becomes necrotic. Root canal treatment should be started at 2 weeks or as soon as the position of the tooth allows, using a corticosteroid-antibiotic or calcium hydroxide as an intracanal medication, to prevent the development of inflammatory (infection-related) external resorption.

5. Extrusive Luxation

It is defined as the partial displacement of the tooth out of its socket.[21] An injury to the tooth characterized by partial or total separation of the periodontal ligament resulting in loosening and displacement of the tooth. Extrusion has been reported to account for around 3% of all cases of traumatic dental injury.[22]

Extrusive luxation injuries are caused by the action of an oblique force, and they are characterized by high mobility and partial dislocation of the tooth outside its socket.[23] Apart from axial displacement, the tooth typically exhibits a protrusion or retrusion component. The retrusion/protrusion factor can be quite noticeable in severe extrusion injuries.[24]

The degree of extrusion was measured in millimeters using radiographic reference points, specifically the distance from the apical foramen to the base of the alveolar socket.

Table 4- Classification Of Extrusion[22]

Mild	0–2 mm
Moderate	3–5 mm
Severe	–6 mm

Extrusion results from the total disruption of the pulp's neurovascular supply and the severing of periodontal ligament fibers which can result in mobility of teeth and pulp infarction. Oblique forces displace the tooth out of its socket.

Only the palatal gingival fibers prevent the tooth from being avulsed.[25]

Table 5-Clinical And Radiographic Findings: [12]

Visual sign	Percussion test	Mobility	Sensibility test	Radiographic findings	Radiographs recommended
Tooth appears elongated	Tender and dull sound	Excessively mobile	Usually give negative response except for teeth with minor displacement	Increased periodontal ligament space both apically and laterally .	1)One parallel periapical radiograph 2)Two additional radiographs of the tooth taken with different vertical and/ or horizontal angulations. 3)Occlusal radiograph

Treatment and Management:[12]

Reposition the tooth by gently pushing it back into the tooth socket under local anesthesia. A radiograph is then taken to verify repositioning and to register the level of the alveolar bone for later comparison. This is recommended in order to monitor eventual loss of marginal bone support in the follow-up period. Stabilize the tooth for 2 weeks using a passive and flexible splint. If breakdown/ fracture of the marginal bone occurs, splinting should be done for an additional 4 weeks. Monitor the pulp condition with pulp sensibility tests, If the pulp becomes necrotic and infected, endodontic treatment appropriate to the tooth's stage of root development is indicated.

Orthodontic management involves a recommended observation period of 6-12 months before starting treatment to ensure complete periodontal healing and to prevent extra-inflammatory stimuli that could damage the protective cementum layer and increase the risk of ankylosis. Another review suggests waiting at least three to six months before initiating orthodontic movement.[18,26] Delayed repositioning of traumatized teeth can lead to complications during orthodontic intrusion, such as loss of vitality, reduced crown-to-root ratio, and diminished bone support.[27] If the extrusion was minimal, a three-month observation period is advised.[20]

5. Lateral Luxation:

It is defined as displacement of the tooth other than axially. Displacement is accompanied by comminution or fracture of either the labial or the palatal/lingual alveolar bone. One of the most frequently experienced traumatic dental injuries is lateral luxation injuries. These injuries make up 29.5% through 57.0% of all traumatic dental injuries.[28]

Lateral luxation injuries, similar to extrusion injuries, are characterized by partial or total separation of the periodontal ligament. However, lateral luxation is complicated by fracture of either the labial or the palatal/lingual alveolar bone and a compression zone in the cervical and sometimes the apical area. In most cases of lateral luxation the apex of the tooth has been forced into the bone by the displacement, and the tooth is frequently non-mobile.[24]

A fracture of the labial bone plate and a contusion to the lingual cervical periodontal ligament occur in conjunction with the periodontal damage in cases of lateral luxation. Horizontal forces displace the crown palatally and the root apex facially.

Table 6-clinical and Radiographic Findings:[12]

Visual sign	Percussion test	Mobility	Sensibility test	Radiographic findings	Radiographs recommended
Tooth displaced usually in a palatal or labial direction	High metallic sound	Immobile	Usually give negative response except for teeth with minor displacement	Widened periapical ligament space seen	Occlusal, periapical and 2 eccentric exposures from different horizontal angulations.

Treatment and Management:[12]

Tooth is repositioned digitally or with forceps by disengaging it from the locked position into its original location under local anesthesia. This is done by palpating the gingiva to feel the apex of the tooth using one finger to push downwards over the apical end of the tooth, then use another finger or thumb to push the tooth back into its socket.

Once the tooth is repositioned, the labial and palatal bone plates should also be compressed, to ensure complete repositioning and to facilitate periodontal healing. The tooth should be splinted in its normal position. A radiograph is then taken to verify repositioning and to register the level of the alveolar bone for later comparison. Stabilize the tooth for 4 weeks using a flexible splint.

Monitor the pulpal condition with pulp sensibility test at follow up appointments. At about 2 weeks post injury, make an endodontic evaluation.

Teeth with incomplete root formation-spontaneous revascularization may occur. If the pulp becomes necrotic and there are signs of inflammatory external resorption, root canal treatment should be started as soon as possible.

Teeth with complete root formation- the pulp will become necrotic. Root canal treatment should be started to prevent root resorption.

Pulp necrosis appears to be the most frequent complication, occurring in 44.2% of cases, but it is less common in immature teeth with lateral luxation injuries, where it occurs in 17.5% of cases.[29]

6. Conclusion:

Luxation injuries in dental trauma present a complex challenge that requires timely and appropriate intervention to prevent long-term complications. Each type of luxation injury—subluxation, intrusive luxation, extrusive luxation, and lateral luxation—has distinct pathophysiological characteristics and necessitates specific treatment protocols. Early diagnosis and prompt management are crucial to mitigate adverse outcomes such as pulp necrosis, root resorption, and periodontal damage. Clinical and radiographic evaluations play vital roles in determining the extent of injury and guiding treatment decisions. Continued monitoring and interdisciplinary approaches, including endodontic, orthodontic, and surgical interventions, are essential to ensure the successful rehabilitation of luxated teeth. By understanding the nuances of luxation injuries, dental professionals can enhance patient care and contribute to better prognostic outcomes for individuals affected by traumatic dental injuries.

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