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Pediatric Maxillofacial Trauma and its Management

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Pedodontics and Preventive Dentistry in Partial Fulfillment for the Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled "**Pediatric Maxillofacial Trauma**" was prepared by the fifth-year student **Ranya Osam Fadhil** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Assist. Lect. Asmaa M. Khammas
Date: /05/2023

Dedication

I dedicate this dissertation to my beloved parents who planted the learning passion in me and provided me all kinds of support throughout the ebb and flow of my academic journey. I am grateful for having you in my life.

I also dedicate this dissertation to my mentors, Dr. Yousif and Dr. Ibrahim, from whom I learned and am still learning so much on the personal and professional levels. Thank you so much.

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List of Abbreviations

CT	**Computed Tomography**
MMF	Mycophenolate Mofetil
NOE	Naso-Orbito-Ethmoid
ORIF	Open Reduction and Internal Fixation

Introduction

According to **Abhinav et al. (2019)**, maxillofacial trauma is any physical trauma to the facial region, and is often associated with high morbidity. Maxillofacial injuries can occur as an isolated injury or may be associated with multiple injuries in other body parts. Maxillofacial trauma cases in children are less common compared to the adult population; children have a reduced risk of interpersonal violence and a more elastic bone nature **(Vercruysse et al., 2023)**.

Despite the less serious nature of pediatric traumatic injuries with a possibility of facial fractures of 15% juxtaposed to adults, such injuries are associated with increased risk of mortality and disability **(Xue, Maricevich and Braun, 2017)**. Maxillofacial traumatic injuries can sever the facial growth centers, resulting in facial growth discrepancies, including facial hypoplasia and facial asymmetry with subsequent esthetic, developmental, and functional implications. Thus, the proper diagnosis and management of such cases are of utmost importance **(Tent et al., 2022).**

Another uncommon detrimental risk is cervical spine injury that might accompany facial fractures, emphasizing the importance of proper stabilization and assessment to rule out such injuries **(Goodenough et al., 2020)**.

Management of pediatric maxillofacial traumatic injuries often requires a multidisciplinary team of medical, dental, and surgical specialists **(Cagetti et al., 2019)**. Also, it involves different complicating factors than the management of similar injuries in adults, including anatomical differences, isolated or multi-trauma injuries, stage of dental and facial development, and the patient behavior and compliance **(Aldelaimi, 2012; Vercruysse et al., 2023).**

Aims of the Review

This review aims at providing an overview of the maxillofacial traumatic injuries in children. It involves the definition, etiology, epidemiology, classification, management, complications, and outcomes related to pediatric maxillofacial trauma cases.

Chapter one: Review of the Literature

1. Definition of Maxillofacial Trauma

Trauma is defined as a physical damage or wound caused by an outside force (external) which may cause death or permanent disabilities. Trauma to the maxillofacial region involves fractures of the skull and facial bones, dentoalveolar injuries (mandible and maxilla), teeth injuries (fractures, avulsions and luxation), and all soft tissue wounds (lips, gingiva and tongue) ranging from bruising to extreme laceration **(Younus and Ahmed, 2021)**.

2. Epidemiology

Incidence rates of maxillofacial trauma increase in older children and adolescents, probably due to the riskier lifestyle and the maturation of sinus aeration in the facial skeleton **(Wetmore et al., 2012).**

According to **Hawramy (2011)**, soft tissues were involved in (77.9 %) of the injured children, and the chin was the most affected area (26.7%).

Attyia et al. (2019) found that in the pre-school and school-aged populations, males are more affected than females with a male/female ratio of 2.3:1. Also, 72% of patients observed had combined skeletal and soft tissue injuries. As for facial fractures, the mandible was the most commonly fractured bone (54.2% of fractures), especially the mandibular condyle, followed by dentoalveolar fractures (30.1%) and upper and midface fractures. In the preschool-aged children, the prominence of cranium and more elasticity of facial bone renders the incidence of midfacial fractures less than adults. Nasal bone fractures were the least frequently recorded injury.

The peak occurrence of maxillofacial trauma cases is found in adolescents, with rare incidences below the age of five, with the most common injuries in children under five years being soft tissue injuries **(Vercruysse et al., 2023)**.

3. Etiology

Pediatric facial fractures are often of variable etiology. Although it mostly depends on the child's age, the most common causes include fall injuries, sport-related accidents, motor vehicle accidents, or child abuse. Such etiological factors vary widely according to the cultural, religious, and demographic background of the patient **(Tent et al., 2022).**

According to **Attiya et al. (2019)**, the most common cause of maxillofacial injury was fall from height (36.8%), followed by common fall injuries (28.1%), road traffic accidents (19.3%), hit by objects (8.8%), and violence (7%).

The study results of **Hawramy (2011)** revealed that the most age group affected by trauma was (1-5) years old. Fall on the ground was the most cause of trauma (26.19%) followed by fall from height (25%). The dentoalveolar injuries were the most concomitant trauma (14.88%).

4. Classification of Maxillofacial Trauma Injuries in Children

According to the anatomic structures involved, maxillofacial traumatic injuries are broadly classified into fractures of skull and facial bones, soft tissue injuries, and traumatic injuries of the teeth and their supporting structures.

4.1 Fractures of the Skull and Maxillofacial region

Gómez Rosello et al. (2020) introduced a regional classification that is applicable for both children and adult patients. According to this classification, craniomaxillofacial include:

- Le Fort fractures
- Orbital blow out fractures
- Nasal fractures
- Alveolar process fractures
- Frontal sinus fractures
- Mandibular fractures
- Nasoseptal fractures
- Zygomaticomaxillary complex fractures
- Naso-Orbito-Ethmoidal fractures

Lim and Hopper (2021) introduced another regional classification with more emphasis on the pediatric maxillofacial traumatic injuries. According to this regional classification, maxillofacial traumatic injuries in children include:

4.1.1 Ping Pong and Growing Skull Fractures

When subjected to severe blunt trauma, pediatric patients may develop fracture patterns that are more challenging to detect and treat than adult fractures **(Naran et al., 2016).**

Ping-pong fractures are depressed skull fractures in newborn infants that occur as inward buckling of the skull bones, forming a cup shape or "ping-pong ball" shape as seen in Fig. 1. These fractures are often associated with maintenance of bone continuity. Such fracture pattern can have intracranial injury out of proportion to the degree of bone disruption, violation of the dural integrity, and need for a craniotomy for neurosurgical treatment **(Zalatimo et al., 2012).**

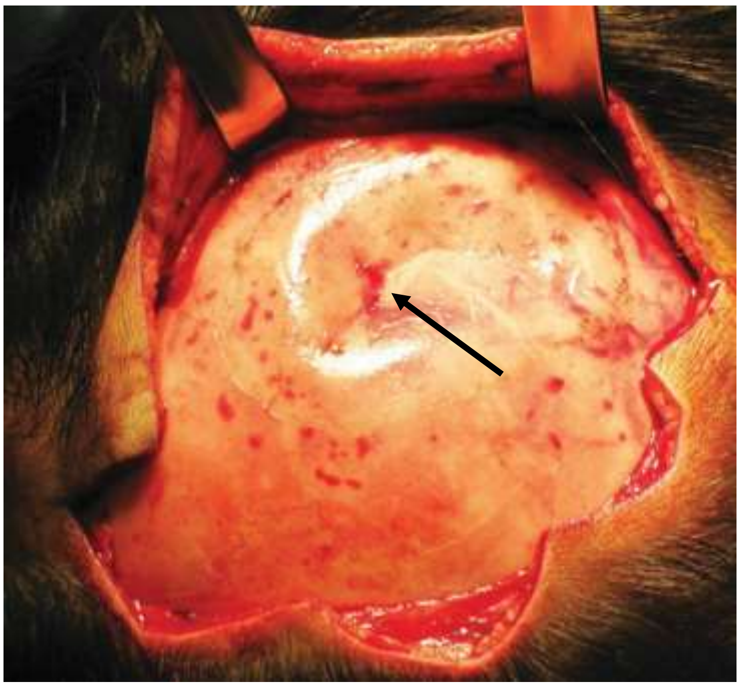

Figure 1: Intraoperative image of a “Ping pong” skull fracture in a 1-year-old prior to craniectomy and cranioplasty **(Lim and Hopper, 2021).**

Growing skull fractures represent less than 1% of pediatric skull fractures **(Naran et al., 2016)** and are common in first two years of life because of the thinner calvarium, increased skull malleability, and rapid cranial growth in this age group **(Vezina et al., 2017)**.

In growing skull fractures, an initial trauma causes minimal bone disruption in the form of a linear fracture that could be undetected on computer tomography (CT) scan **(Singh et al., 2016)**. Yet, the underlying dural tear produces unrestricted progressive pulsations from the brain on the healing fracture, gradually enlarging the fracture with subsequent brain parenchyma herniation and neurological complications such as seizures, hemiparesis, mental retardation, and headaches. Thus, prompt recognition and management are key in minimizing these neurological complications. Treatment of a growing skull fracture with a bone defect involves a craniotomy around the injury zone to allow repair with a dural patch followed by overlying autogenous cranioplasty with fixation as seen in Fig. 2. Some cases of untreated growing skull fractures with porencephaly with or without hydrocephalus may require shunt operation with definitive surgery. Delayed treatment of growing skull fractures results in neurological deficits, such as seizures, hemiparesis, mental retardation, and headaches. Prompt recognition and management are key in minimizing these neurological complications **(Vezina et al., 2017).**

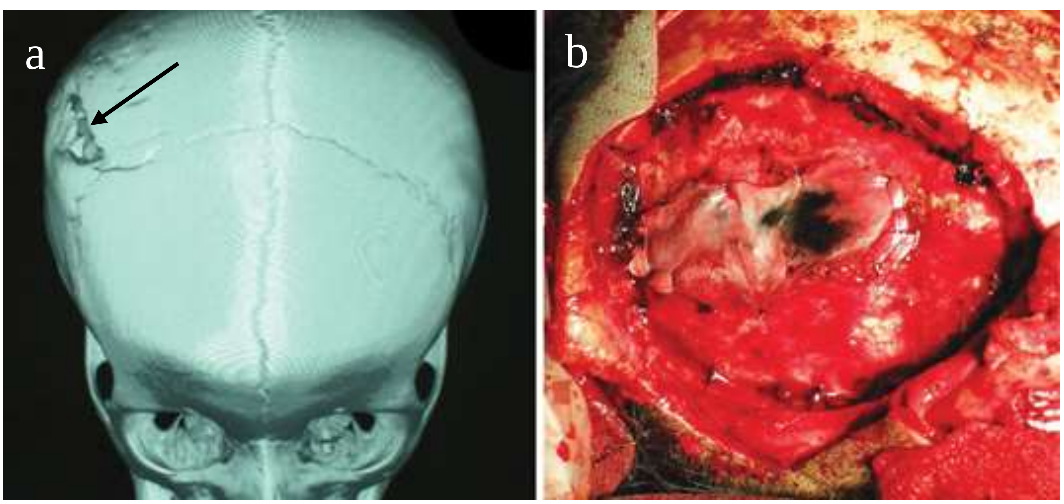

Figure 2: Growing skull fracture in a 2-year-old diagnosed and treated 8 months after the initial traumatic event (a). CT scan image of the right parietal bone erosion from progressive intracranial pulsations on an undiagnosed linear fracture with an underlying dural tear (b) **(Lim and Hopper, 2021)**.

4.1.2 Orbital Roof Fractures

Supraorbital fractures are more common in the young pediatric population than adults due to the lack of a pneumatized frontal sinus and are associated with high incidence of neurologic injury **(Lim and Hopper, 2021)**.

Prior to the complete maturation of the frontal sinus at the age of 19, which acts as a "crumple zone" to absorb a frontal force, a blow to the forehead in a child will propagate undiminished along the orbital roof and may continue back to the orbital apex, resulting in optic nerve and brain injury. The typical presentation of a displaced orbital roof fracture is hypoglobus and proptosis with restricted range of motion as seen in Fig. 3. Similar to growing skull fractures, if the overlying dura is violated from a supraorbital fracture, the progressive brain pulsations can worsen the symptoms of pulsatile exophthalmos **(Coon et al., 2014)**.

There are no standardized guidelines for surgical versus conservative management for supraorbital fractures. Symptoms that typically warrant surgical intervention include, but are not limited to intracranial injury, displaced bony fragments penetrating the brain parenchyma, exophthalmos, gaze restriction, refractory oculorrhea, or vision loss. A systematic review revealed that most orbital roof fractures were noncomminuted and thus managed expectantly, with close follow-up examinations and reimaging for new or worsening symptoms **(Lucas et al., 2020)**.

Bifrontal craniotomy with a coronal approach is the best treatment option for displaced fractures, especially with intracranial injury. Through this intracranial approach, the displaced roof fracture can be either reduced and fixated or removed and replaced with an autogenous bone graft. It is preferred to avoid titanium mesh for roof defects since periorbital tissue and dura can adhere to the mesh, making secondary dissection if needed. For this reason, autogenous bone graft with fixation is preferred **(Lim and Hopper, 2021)**.

Figure (3): Haematoma around the right zygoma and an inability of the right eye to elevate; the white lines show the line of sight of each (A). A CT scan shows the orbital floor fracture (blue arrow) with herniation (green arrow) of the inferior rectus muscle and orbital soft tissue surrounding the muscle (B) **(Kemps and Frank, 2020)**.

According to **Lucas et al. (2020)**, early recognition and proper management of supraorbital roof fractures are necessary to minimize the risk of intracranial and ocular complications, including , ocular motility alterations, exophthalmos, diplopia, and optic nerve damage.

4.1.3 Orbital Trapdoor Fractures

Trapdoor fractures are greenstick fractures of the orbital floor and are more likely to occur in children than adults. The hallmark of trapdoor fractures is ‘‘minimal bony displacement and a lack of true defect’’ which may be linear or hinged medially. Trapdoor fractures have also been described as “white eye' fractures due to the increased scleral show of the unaffected eye from the restriction in upward gaze of the injured eye and lack of typical symptoms **(Firriolo et al., 2017).**

Blunt injury to the globe can increase intraocular pressure, causing temporary displacement of the orbital floor with herniation of orbital contents into the maxillary sinus, thus opening the “trapdoor.” As pressure quickly normalizes, the trapdoor fracture segment snaps back into its anatomical position but the periorbita and/or inferior rectus muscle remain trapped inside the sinus **(Grant et al., 2002).**

Pediatric orbital floor fractures are more susceptible to entrapment of periorbital tissue due to the increased bone elasticity and potential for greenstick fracture. The most prominent symptoms of muscular entrapment include extraocular movement restriction and diplopia as seen in Fig. 4 (**Lim and Hopper, 2021).**

Even when a CT scan is performed to evaluate for an orbital injury, a pediatric trapdoor fracture can be easily missed due to the anatomical reduction of the bone of the orbital floor to detect a pediatric trapdoor fracture on CT scan, the inferior rectus muscle needs to be traced back on the coronal slices to ensure that it is located above the orbital floor and not trapped in a rounded fashion in the maxillary sinus. An absence of the inferior rectus muscle despite what appears to be intact orbital floor should raise a high index of suspicion of a pediatric trapdoor fracture. **(Firriolo et al., 2017).**

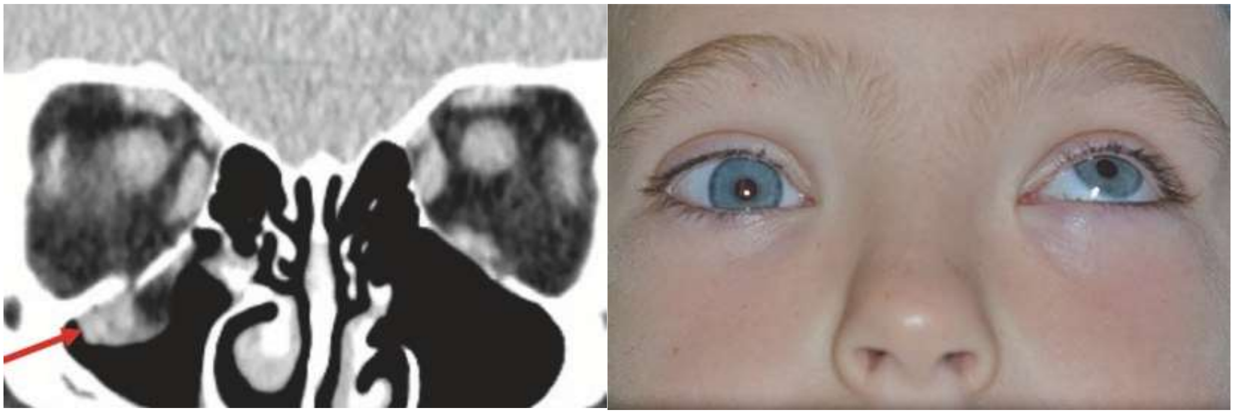

Figure 4: Coronal CT scan view of a pediatric trap door fracture in which the size of the orbital tissue herniating into the maxillary sinus is much smaller than the hole in the orbital foor. The inferior rectus muscle lies beneath the plane of the orbital foor (red arrow) (a). Marked restriction in upward gaze results (b) **(Shinder, 2020).**

While rare, pediatric trapdoor fractures require urgent treatment within 48 hours to prevent fixed motility issues. The transconjunctival approach is often used for orbital fractures to minimize risk of external scar, ectropion, and eyelid retraction; however, a transcutaneous incision may be required in complex cases needing greater visualization **(Lucas et al., 2020).**

Iliac, rib, or skull donor sites can be used for autogenous orbital reconstruct in immature calvarium when the absence of a calvarial diploe space prevents harvesting split calvarial grafts, a pericranial shave graft can be harvested with a sharp osteotome as seen in Fig. 5 **(Grant et al., 2002)**.

A systematic review by **Azzi, Azzi and Cugno (2018)** reported increasing use of resorbable materials in pediatric orbital floor reconstruction with a similar complication profile as autologous grafts as seen in Fig. 5.

Figure 5: Intraoperative peri-cranial shave graft in a 2-year-old patient. A sharp osteotome was used to harvest a composite pericranium-particulate cortex graft for treatment of an orbital trap door fracture **(Lim and Hopper, 2021)**.

Trapdoor fractures may or may not lead to tissue entrapment, which manifests as restriction of extraocular muscle movement causing diplopia **(Xue, Maricevich and Braun, 2017).**

Entrapment of the inferior rectus muscle can activate the oculocardiac reflex, with vagally mediated symptoms including nausea, vomiting, headache, and bradycardia with potential for progression to syncope or asystole **(Firriolo et al., 2017).**

4.1.4 Nasoseptal fractures

The nasal bones are the most fractured facial bones due to their prominence and relative fragility. Compared with adults, children have less projecting nasal dorsum, a higher proportion of cartilage, and relatively reduced risk of fracture. The increased flexibility of the immature nose, however, can make septal distortion more common with an increased risk of nasal septal hematoma **(Hoffmann, 2015).**

The septum is a critical growth center prior to adolescence, and should be conservatively managed, if possible, with closed reduction or observation. It is important to counsel families that secondary deformities may result with growth following early nasal trauma, and patients may benefit from an open septorhinoplasty at maturity **(Lim and Hopper, 2021)**.

A treatment algorithm described by **Hoffmann (2015)**, described unilateral/bilateral nasal bone displacement with either mild or no septal deviation as a mild nasal bone fracture to be treated by closed reduction alone. If the septum is moderately displaced, it may require closed septal reduction or limited open septoplasty. Open treatment is typically reserved for cases of severe trauma involving surrounding structures such as the orbits and midface. A study by **Kang et al. (2020)** showed that in mild pediatric nasal fractures, bony contour improved through remodeling alone without intervention in 15 out of 16 patients.

Although nasal fractures are typically treated within a week to prevent early healing, a retrospective study comparing early (≤7 days) versus delayed (>7 days) treatment of nasal bone fractures reported no differences in cosmetic outcome or nasal obstruction **(Lee and Jang, 2013)**.

4.1.5 Naso-orbito-ethmoid Fractures

Naso-orbito-ethmoid fractures are less common in children due to the presence of larger fat pads, increased skeletal flexibility, compliant sutures, and incomplete pneumatization of the sinuses in comparison to adults **(Grunwaldt et al., 2011)**.

Although the widely used Markowitz classification seen in Table (1) can be applicable to both pediatric and adult NOE fractures, Burstein classification seen in Table (2) provides a more thorough appreciation of pediatric NOE fracture patterns with concomitant skull fractures **(Balaraman, 2021)**.

In a retrospective study, a treatment algorithm was developed based on Markowitz grading of NOE severity. Type I fractures were often observed with nonoperative management. Type II fractures were repaired on a case-by-case basis with indications for open reduction and internal fixation (ORIF) including presence of permanent dentition, severe displacement, or open fracture. Type III fractures always required operative management with ORIF and transnasal wiring versus suture canthopexy **(Lopez et al., 2019).**

Due to the complex structure and differential growth trajectories of the nose, orbit and zygoma, reconstruction of the NOE complex is challenging . One review by **Singh and Bartlett (2004)** reported that 40% of patients required additional surgeries to correct deformities after NOE repair, including grafting of the nasal dorsum and secondary canthal repositioning.

Patients who did not undergo operative management for medial canthal disruption all exhibited telecanthus on follow-up **(Lopez et al., 2019).**

Table (1) Markowitz and Manson Classification of Pediatric NOE fractures **(Balaraman, 2021)**

Type I	Simple fracture with canthal ligament attachment intact
Type II	Comminuted fracture with intact canthal attachment in the large fragment (positioning this fragment helps in securing the canthus in the right place)
Type III	Gross comminution with the canthal attachment in a small fragment or detached canthus both necessitating canthopexy

Table (2) Burstein Classification of Pediatric NOE fractures **(Balaraman, 2021)**

Type I	Localized to the upper NOE complex and frontal bone, medial to superior orbital foramen.
Type II	involves half of the superior orbital wall, although it does not involve the NOE
Type III	Bilateral and involves the superior orbital wall, upper NOE, and bilateral frontal bones.

4.1.6 Zygomatic fractures

Fractures of the pediatric zygoma are uncommon and are often associated with high-impact trauma, as evidenced by the relatively increased prevalence of concomitant injuries. The incidence of zygomatic injury much less common in young children due to the elasticity of the craniofacial skeleton and the presence a higher buccal fat content, which cushions the impact and protects the midface by reducing the force transmitted to the bony architecture **(DeFazio et al., 2013).**

Displaced zygoma fractures require open treatment and internal fixation similar to the adult population. Care must be taken to minimize the risk of damage to the unerupted permanent tooth follicles during fixation. In many cases, fixation can be limited to one or two upper plates due the healing and remodeling capacity of the pediatric skeleton as seen in Fig. 6 **(Lim and Hopper, 2021)**.

Figure 6: Displaced right zygoma fracture in a 2-year-old patient (a). Coronal CT scan view demonstrates tooth follicles in the maxilla with early maxillary sinus formation (b). CT scan after reduction and fixation with a single titanium plate acr oss the fronto-zygomatic suture (c) **(Lim and Hopper, 2021)**

4.1.7 Maxillary fractures

Pediatric midface fractures are uncommon. The incomplete pneumatization of the maxillary sinuses and presence of unerupted dental follicles make the maxilla more resilient in patients younger than 5 years **(Lim and Hopper, 2021)**.

The treatment goal of accurate restoration of the facial buttresses remains the same; however, the surgical approach should minimize subperiosteal dissection, when possible, to avoid iatrogenic growth disturbances as seen in Fig. 7. A prospective study to assess growth and development after severe pediatric midface trauma with surgical management showed that 86% of patients had growth disturbances. Such disturbances included midface (maxillary and nasal) hypoplasia, telecanthus, and vertical growth deficiency **(Davidson et al., 2015)**.

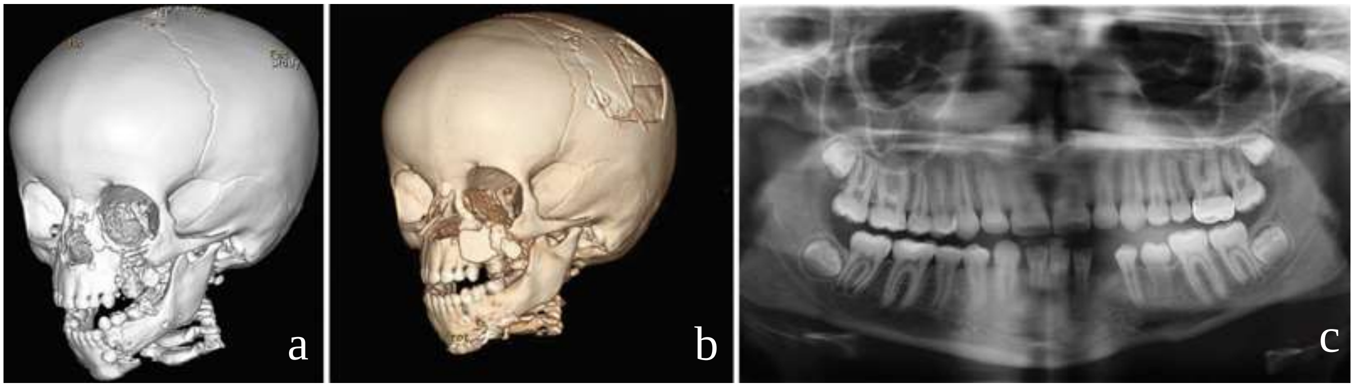

Figure 7: CT-Scan of displaced fractures of the maxilla and mandible in a 2-year-old following a dog bite attack (a). At presentation (b) following open treatment, reduction, and titanium fixation of the inferior border of the mandible fracture, and cranial bone grafting of the maxillary defect with resorbable fixation (c) **(Lim and Hopper, 2021)**.

4.1.8 Mandibular fractures

Mandibular fractures account for 20 to 50% of all pediatric facial fractures with condylar fractures representing 21% to 72% of all mandibular fractures in children and adolescents as seen in Fig. 8. The chin impact of a fall, for instance, will reach the condyle and crushes the broad, highly vascularized condylar head, or less commonly the short, thick pediatric condylar neck as seen in Fig. 9 **(Bae and Aronovich, 2018)**. Hence, children who have more propensity for falls than adults, are more likely to develop condylar fractures**(Kang et al., 2020)**.

Pediatric patients 13 years and older have a higher risk of more complex fractures with displacement, requiring open reduction with minimal periosteal manipulation for restoration of form and function **(Lee, Tannyhill and Peacock, 2021)**.

Figure 8: CT scan of a severely displaced left mandible angle fracture in a 4-year-old **(Lim and Hopper, 2021)**.

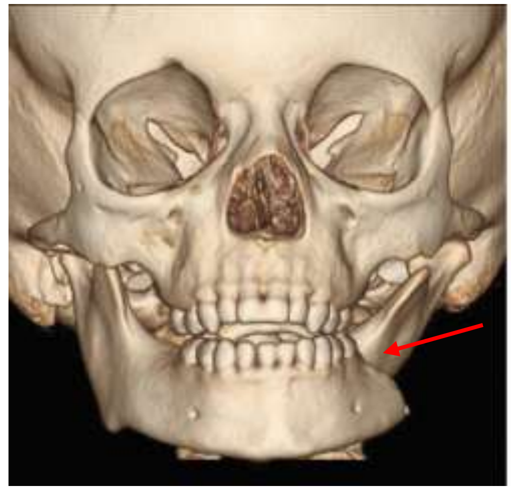

Figure 9: CT scan of a displaced fracture of the right condylar neck in a 3-year-old **(Lim and Hopper, 2021).**

Due to the growth centers in the condylar cartilage, posterior border of the ramus, and alveolar ridge, nonoperative management with 3 weeks of observation and a soft, no-chew diet is more common than in adults to preserve their vascular supply **(Wheeler and Phillips, 2011).**

In the absence of standard interdental fixation techniques, a lingual splint secured with circum-mandibular wires can be used to control splaying of the mandible. If intermaxillary fixation is required, circum-mandibular wires can be placed around the zygomatic arch or around the piriform through the palate with a passing trocar. Due to presence of developing tooth buds, intermaxillary fixation screws are typically not used **(Lim and Hopper, 2021)**.

While resorbable plate fixation is more commonly used in the pediatric cranium or maxilla, they can also be used in mandible fractures as long as stability is not compromised **(Chocron, Azzi and Davison, 2019)**.

If titanium plating is used in a young, growing patient, hardware is typically removed 6 to 8 weeks after surgery to prevent growth restriction and bone overgrowth. It is exceedingly rare to perform open reduction of pediatric condylar fractures due to the remarkable remodeling capacity of the condylar growth center **(Lim and Hopper, 2021)**.

Children under the age of 3 have an increased risk for ankylosis due to rapid bone healing during prolonged immobility from guarding or iatrogenically through mycophenolate mofetil (MMF). If MMF is required in young patients, it should be for no longer than 7 to 10 days followed by release of fixation, and 7 to 10 days of guiding elastics with functional therapy **(Bae and Aronovich, 2018).**

In the mixed dentition stage, between ages 6 and 12, primary teeth can undergo significant root resorption, rendering teeth more mobile and prone to avulsion from circum-dental wires. Primary teeth are also more conical which decreases the stability of circum-dental wires. When used in primary or mixed dentition, extreme care must be taken to avoid complications **(Lim and Hopper, 2021)**.

Complications of pediatric condylar fractures include temporomandibular joint pain, noises, limited mandibular opening, masticatory dysfunction, facial asymmetry, malocclusion, and ankylosis **(Bae and Aronovich, 2018).**

4.2 Traumatic Injuries to Teeth and Supporting Structures

Dentoalveolar injuries are among the most common traumatic injuries in the pediatric age group. Dental injury may include teeth, lips, gingiva, and tongue- and commonly incorporates a broken or lost tooth as seen in Fig. 10 **(Younus and Ahmed, 2021)**. **Powell and Louis (2021)** classified traumatic injuries according to anatomical structures involved as seen in Table (3).

Table (3): Andreasen classification of Traumatic Injuries to Teeth and Supporting Structures **Powell and Louis (2021)**.

Category	**Criteria**
Injuries to the dental hard tissue, pulp, and alveolar process	1. Crown infraction (i.e., craze line or crack, no loss of tooth substance 2. Uncomplicated crown-root fracture Fracture involving enamel, dentin, and cementum without pulp involvement 3. Complicated crown-root fracture: Fracture involving enamel, dentin, and cementum with pulp involvement 4. Root fracture involving dentin and cementum with pulp exposure 5. Alveolar fracture 6. Maxillary or mandibular fracture
Injuries to the periodontium	1. Concussion: injury to the periodontium that causes sensitivity to percussion but does not loosen or displace the tooth 2. Subluxation: tooth is loosened but not displaced 3. Luxation: tooth is loosened and displaced: • Intrusion: displacement into the socket • Extrusion: partial displacement from the socket • Lateral luxation: displacement into mesial or distal direction 4. Avulsion: tooth is displaced completely from the socket
Injuries to the gingiva and/or oral mucosa	1. Laceration to the gingiva or oral mucosa 2. Contusion 3. Abrasion

Wire, acrylic splint, and arch bars methods of stabilization provide satisfactory outcomes. Avulsed primary teeth should not be replaced, whereas avulsed permanent teeth should be reimplanted within 2 hours (preferably 30 minutes) and stabilized for 4 weeks as demonstrated in Fig. 10 **(Singh et al., 2011).**

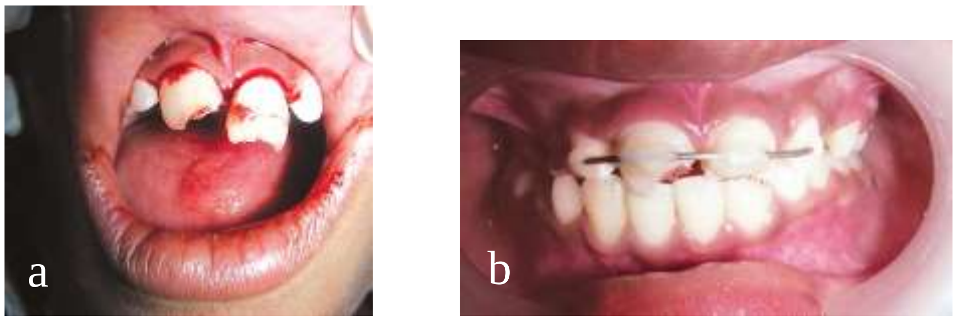

Figure 10: Avulsed tooth (a) and the technique of bringing it back to the arch and occlusion, and using composites to splint it (b) **(Singh et al., 2011)**.

Soft tissue injuries comprise lacerations and contusions - the most common injuries, abrasions, bites, and burns. According to location, such injuries are categorized as injuries to the palate, lips, tongue, cheek, and other sites **(Rogan and Fang, 2022)**.

The management protocol of such injuries involves functional assessment of anatomic structures, for example the facial nerve or the parotid duct superficially overlying the masseter muscle. Any soft tissue wound is then anesthetized and thoroughly explored to determine its extent and visualize any underlying bony injuries. After thorough debridement and irrigation with chlorhexidine or povidone-iodine, wound edges are aligned properly with a tacking suture. Afterwards, wound closure is meticulously done in layers with a resorbable suture in the deep tissues, and a fine nylon 5/0 to 6/0 suture in the skin **(Durham et al., 2017)**.

5. **Management**

The decision to proceed with operative management of pediatric facial fractures is complex **(Xue, Maricevich and Braun, 2017)**. Multiple factors dictate the decision-making process regarding operative management of pediatric facial fractures, such as **(Oleck et al., 2019):**

1. The patient’s age
2. extent of fracture displacement
3. injury pattern
4. potential growth disturbances
5. concomitant injuries
6. psychosocial considerations

The presence of intramaxillary teeth and the topography of lesions also dictate the choice of a specific therapeutic approach for pediatric facial fractures **(Tent et al., 2022).**

According to **Durham et al. (2017)**, proper treatment of facial injuries depends on a correct diagnosis and a thorough assessment of the patient. Detailed history and a primary survey to identify and prioritize the management of life-threatening injuries is indicated for all trauma patients. Such survey should involve:

- Airway and cervical spine
- Breathing
- Circulation
- Disability
- Exposure

Treatment options for pediatric facial fractures can range from non-surgical treatment to ORIF with the use of variable osteosynthesis materials **(Vercruysse et al., 2023)**. Yet, such fractures pose numerous different challenges compared to adult injuries due to multiple factors, such as **(Daniels et al., 2020)**:

1. The difference in the constitution of bones
2. More tissue elasticity
3. Smaller bones with incomplete ossification.
4. Developing paranasal sinuses
5. The existence of growth centers and the risk of growth deficiencies
6. Faster healing period
7. Possible presence of developing teeth germs
8. Difficulties in the application of rigid maxillomandibular fixation.

El-Anwar et al. (2022) found that closed treatment, which preserves the soft tissue and periosteum, is preferred in pediatric patients. However, displaced fractures especially with co-existing condylar fractures should be treated by ORIF. The basic management principles of maxillofacial fractures are similar in both children and adults, including reduction, fixation, immobilization, prevention of infection, and rehabilitation, with the least disability and smallest risk for the patient.

Conclusions

- While the maxillofacial injuries in the pediatric population is less than that of adults, comprehensive assessments to rule out concomitant injuries and proper management approaches are necessary to minimize the risk of complications like facial growth disturbances.

- Pediatric maxillofacial injuries have a male predilection and increasing occurrence rates with age. Also, the incidence rates of soft tissue injuries and dentoalveolar injuries are more than that of facial fractures.

- Although multiple factors affect the etiology of maxillofacial traumatic injuries in children, the most common causes -according to local studies- are fall injuries, followed by road traffic accidents.

- Most pediatric fractures are mildly displaced or nondisplaced due to the presence of tooth buds and the elasticity of pediatric bone.

- Management of pediatric maxillofacial traumatic injuries should consider the anatomical differences between children and adults and the possible growth-related complications.

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