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Epidemiology of Maxillofacial Trauma in Pediatric and Adolescent Population: An Institutional Experience of 6 Years

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Abstract

Introduction: Facial fractures are uncommon injuries in children. Pediatric maxillofacial fractures constitute 1% to 15% of all facial fractures, but show different clinical features when compared with adult patients. Worldwide, the major causes of fractures in children are accidents, falls, violence, and sports-related accidents. Facial trauma in children may result in injury to the facial growth centers, leading to subsequent developmental abnormalities in the injured area. **Patients & Methods:** Data of pediatric and adolescent patients (0 - 17 years), with a history of trauma, has been compiled over a period of 6 years. History, clinical and radiographic data records were analyzed. Compilation was done in the following categories; age and sex distribution, etiology, site of trauma and associated soft tissue injuries were recorded. The treatment rendered has also been mentioned. **Results:** A total of 340 patient records were assessed. Demographic data, etiology, type of fracture, associated injury and treatment rendered were recorded. It was found that males (54.7%) were more frequently affected than females (45.3%). Incidence of trauma was more in children belonging to the pre-school age group (38.5%) and the most common etiology was sports-related injuries (43.8%). Dentoalveolar fractures were the most common type (58.5%) of fractures seen in the patients. Most of the patients were managed by conservative treatment (35%) or closed reduction (48%), while a few required open reduction (7.9%). **Conclusion:** It is felt that this data will be useful in determining the pattern and etiology of maxillofacial trauma in pediatric patients in an Indian setting. Additionally,

an outline of the treatment plan in different types of fractures is also summarized.

Keywords

Maxillofacial Trauma, Pediatric Trauma, Open Reduction, Closed Reduction, Mandibular Fractures

1. Introduction

Pediatric maxillofacial trauma holds special significance over adult maxillofacial trauma. The management of the trauma patient, keeping in mind the growing facial skeleton, permanent dentition and delicate soft tissue, and the concern of the parents, is a challenging task. Moreover, considerations for the prevention of post traumatic sequelae like arrested growth or psychological impairment should be included in the treatment plan.

Children are rarely victims of facial trauma. As early as 1968, Rowe [1] analyzed 1500 fractures in which, children younger than 12 years of age sustained fewer than 5% of all injuries, and children younger than 6 years, fewer than 1%. Sawhney and Ahuja [2] found the incidence of pediatric facial fractures among Indians to be 5.5%.

Many factors contribute to the low incidence of facial fractures in children. These include, 1) relative flexibility of the bones, 2) the retruded position of the face relative to the skull (at birth, the ratio between cranial volume and facial volume is approximately 8:1. By the completion of growth, this ratio becomes 2.5:1) [3], 3) relative protection offered by the lack of pneumatization of paranasal sinus [4], 4) protection of the malar region by the prominent buccal fat pad in children [5], 5) the presence of multiple developing tooth buds of both the deciduous and permanent dentition within the maxilla and mandible increase the elasticity and stability of the paediatric facial skeleton and help to maintain the fractured bone fragments in their normal or close to normal positions following injury [1] [5]. Furthermore, young children are less likely to be exposed to the major injuries, occupational trauma, or interpersonal violence that are the typical feature of adult facial fractures.

These factors create a varied pattern and incidence of facial fractures in children. The following study was conducted to determine the epidemiology of pediatric and adolescent trauma.

2. Patients & Methods

Records of pediatric and adolescent patients (aged 0 - 17 years) reporting to the Department of Oral & Maxillofacial Surgery at our institute, with a history of trauma were compiled and included in this study. As per institutional protocol, all trauma cases need to be registered as medicolegal cases, thus records were easily available. The study period was from August 2015-July 2021. Their clinical

and radiographic records were evaluated and data related to age and sex distribution, etiology of trauma, type and location of injury, radiographic features and treatment given was recorded. The data was sorted into 3 groups; pre-school (0 - 6 years), pre-adolescent (7 - 12 years) and adolescent (13 - 17 years).

3. Results

From August 2015 to July 2021, data was collected from the records of 340 patients. Due to the lockdown imposed for the Covid-19 pandemic, we found a marked decrease in the number of trauma patients after March 2020.

Sex distribution

Among the 340 patients, 186 were boys (54.7%) and 154 were girls (45.3%). Thus, incidence of trauma was more in boys as compared to girls, which is consistent to almost all reports relating to pediatric trauma [6] [7] [8].

Age distribution (**Table 1**)

In the present study, incidence of trauma was found to be greatest in the children of pre-school age, with 131 patients belonging to this group (38.5%). The pre-adolescent group had 111 patients (32.6%), while the adolescent group comprised of 98 patients (28.8%). This was in contrast to previous reports which recorded a greater incidence in the pre-adolescent or adolescent group [2] [5] [7] [8].

Etiology (**Figure 1**)

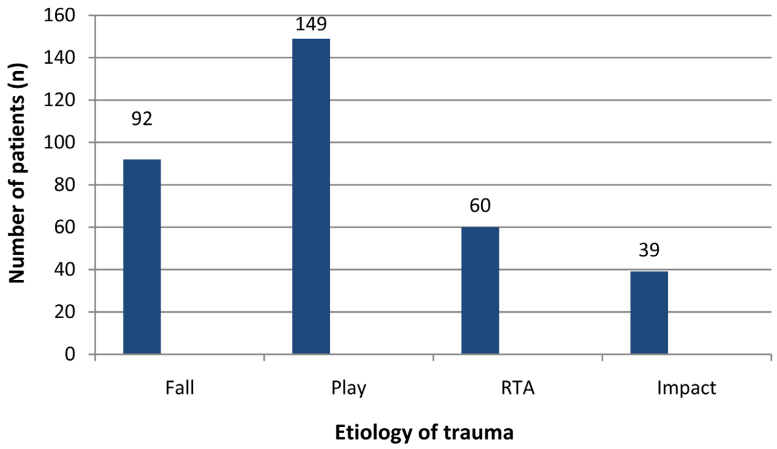


Figure 1. Depiction of the etiology of trauma, most common being sports related injuries and playground injuries.

Table 1. Distribution of patients as per their age group. The pre-school group had the highest number of patients.

Age group	No. of patients	Percentage
0 - 6	131	38.5%
7 - 12	111	32.6%
13 - 17	98	28.8%
Total	340	100%

The most common cause was injuries during play, sports injuries, playground injuries and bicycle injuries (149 patients, 43.8%). These are the leading causes of pediatric trauma worldwide [5] [6] [9]. The other common cause was fall due to other reasons than play, like fall from staircases, due to slipping, pushing, or due to hypoglycemia (92 patients, 27.05%). Injuries due to road traffic accidents are usually rare in children; however they are now on the rise due to a significant increase in speedy traffic, especially in cities. Out of the 194 patients in this study, 60 cases were due to RTA (17.6%). Another cause of trauma found in this study was impact of an external object like furniture, rods, and tree branches. These were unrelated to the play injuries and comprised of 39 patients (11.4%). Altercations and interpersonal violence is rare in children and we found no injuries related to the same.

Pattern of trauma (**Figure 2**)

Among the 340 patients, 184 fractures were reported in the mandible, and 156 fractures in the maxilla, (which included the dentoalveolar fractures). As most cases of trauma are due to fall, and the impact usually is on the prominent mandible, it follows that most fractures are seen in the mandible.

Dentoalveolar fractures, both in the maxilla and mandible were the most common type of fractures seen (199 fractures, 58.5%). They were seen as either isolated or concomitant with other fractures. Mandibular fractures were the next common type of fractures seen. Of the 184 mandibular fractures, condylar fractures were maximum (46 fractures), followed by fractures of the body (28 fractures) and parasymphysis (29 fractures). Only 24 symphysis fractures were seen.

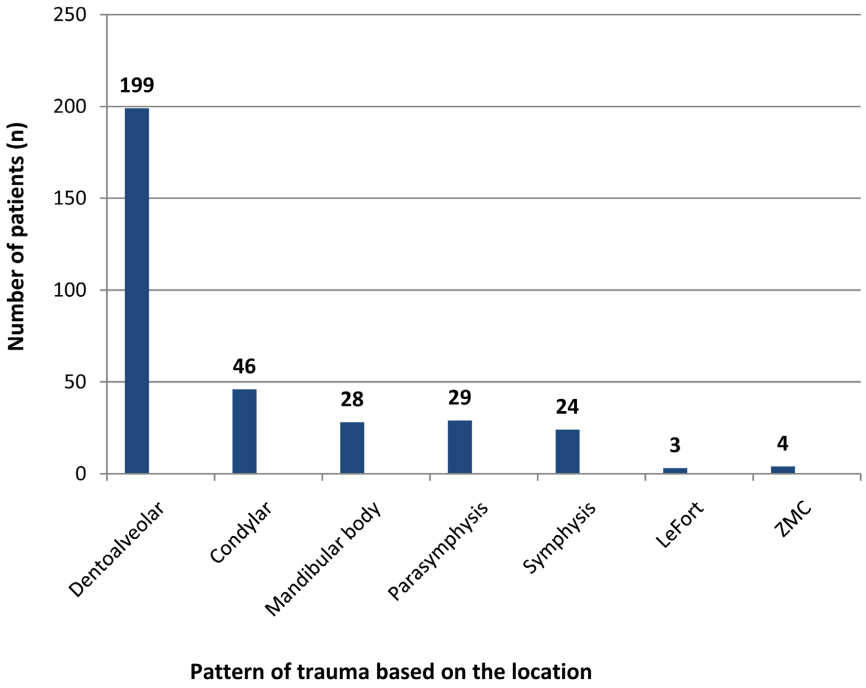


Figure 2. Types and patterns of fractures seen in the pediatric population. The dentoalveolar fractures are the most common type.

Maxillary fractures were rare, with only 3 LeFort II fracture and 4 fractures of the zygomaticomaxillary complex.

Many of the trauma patients had associated soft tissue injuries. Intra oral lacerations were seen in 58 patients, while extra oral lacerations were seen in 128 patients. Extraoral lacerations were commonly noted at the chin (56 patients), lip (38 patients) and scalp (7 patients). Abrasions were seen in 27 patients.

Injuries to the teeth are commonly seen in maxillofacial trauma patients. We noted that avulsion (87 patients) was the most common injury followed by intrusion (34 patients), fracture (58 patients), extrusion (25 patients) and subluxation (13 patients).

Treatment rendered (**Figure 3**)

The relative elasticity of bones and the inherent growth potential usually sums up to an excellent healing process of both, bony and soft tissue injuries in children. Most of the injuries require only periodic evaluation and no active treatment. If surgical treatment is necessary, special considerations are to be made in keeping in mind the anatomical factors and growth pattern of children.

In the present study, 119 patients (35%) needed nil active treatment and were kept under periodic follow up. Patients were prescribed prophylactic antibiotics and special instructions regarding diet. Closed reduction was done in 163 patients (48%); this included arch bars or splinting of teeth. Closed reduction under general anesthesia was performed for 29 patients (8.5%), and included lateral compression splints, palatal splints or wiring. Open reduction with osteosynthesis plates was needed in 27 patients (7.9%). Some patients required only dental treatment for injured teeth (82 patients, 24.1%).

Follow up:

All patients were kept under periodic checkups till a minimum of one month post intervention. Healing and recovery was assessed clinically by checking

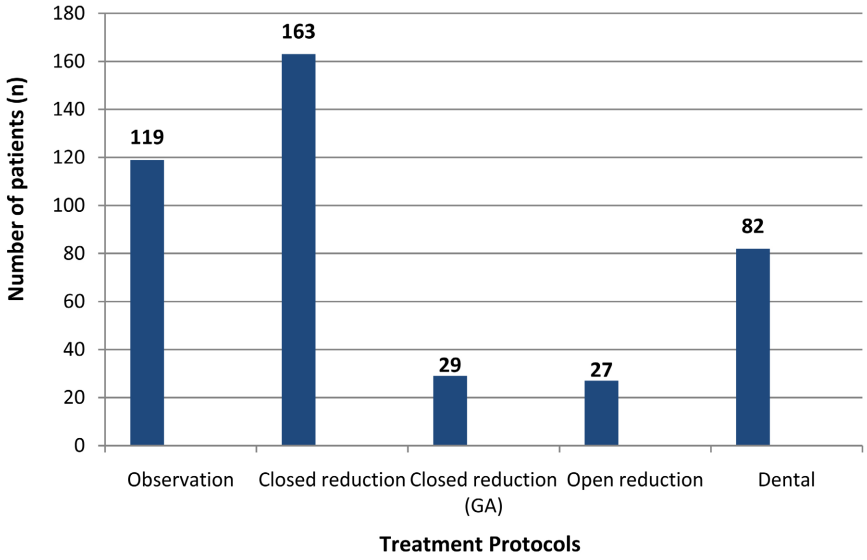


Figure 3. Treatment protocols followed for different patterns of trauma.

stability of occlusion, mouth opening and absence of mobility of jaws or teeth. OPG was advised wherever indicated. Wirings and splints were removed after 3 weeks under local anesthesia, whereas miniplates were removed after 6 months under general anesthesia.

4. Discussion

Although pediatric trauma is rare, it is nevertheless of utmost importance to diagnose and plan the appropriate treatment. There is no predictable trauma pattern and thus treatment protocols also vary. In addition, children are being exposed to new environments due to increasing industrialization and urbanization, which may lead to an increase in the incidence of pediatric trauma.

In March 2020, a nationwide lockdown was imposed due to the Covid-19 pandemic, resulting in closure of schools and movement of people. This was reflected in the incidence of trauma, which reduced significantly. This can be attributed to the fact that children spent a majority of their time confined to their homes.

In this study, incidence of trauma was found to be more in boys than in girls, which is universal to all literature on pediatric trauma. Boys indulge more frequently in outdoor sports and activities as compared to girls, although this is now steadily diminishing [6] [7] [8].

Age distribution was divided into 3 groups, preschool (0 - 6 years), pre-adolescent (7 - 12 years) and adolescent (13 - 17 years) to facilitate data collection. This division also demarcates the transition of the child through different stages of growth.

Most studies demonstrate an increase in trauma in the pre-adolescent age group [2] [5] [7] [8], representing the beginning of school life and exposure to playground injuries. However, we found an increased incidence of trauma in the preschool age group. This may be due to the fact that many Indian children are encouraged to play outdoors since an early age.

Playground and sports related injuries are the leading cause of pediatric trauma worldwide. Children are not subject to work related injuries, occupational hazards that are some of the causes of trauma in adults. Interpersonal violence and altercations are also not common in children, thus these factors are not commonly seen in pediatric trauma. Road traffic accidents contribute to some cases of trauma, which is now of significant concern, in cities. There has been a definitive increase in RTAs over the past few years and inevitably it may cause a change of trend in pediatric fractures. Apart from these factors, children may trip and fall, especially when toddling or learning to walk. Falls from stairs, beds or walls also contribute to injuries.

There was a predilection towards the dentoalveolar fractures in the pediatric population [10]. These fractures were found either isolated or concomitantly with other fractures. This may be attributed to factors like elasticity of the bones, tooth size discrepancy in the mixed dentition phase and low velocity injuries.

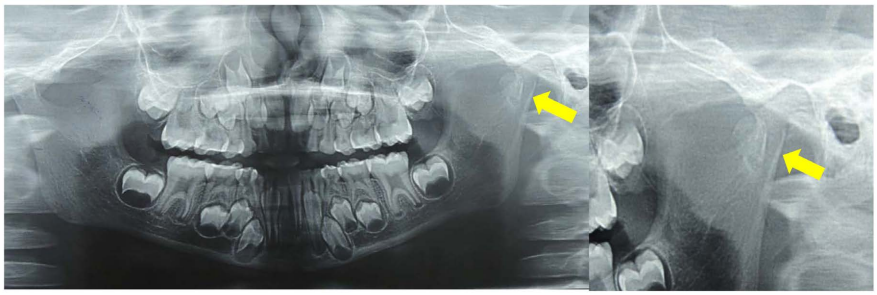
Mandibular fractures are also very common in children due to the prominent position of the mandible during a fall. In the mandible, condylar fractures occur because of the thin condylar neck and high vascularity of the head in children [11]. Most fractures of the condyle are intracapsular.

Maxillary fractures are less common due to the underdeveloped sinuses which offer rigidity. There is also a well developed layer of fat protecting the maxillary region in children. The large cranium and relative retrusion of the midface complex also offers some protection to maxillary and midface fractures, and theoretically increasing the risk for cranial fractures [3] [4] [5]. However, we did not encounter any cranial fractures in this study.

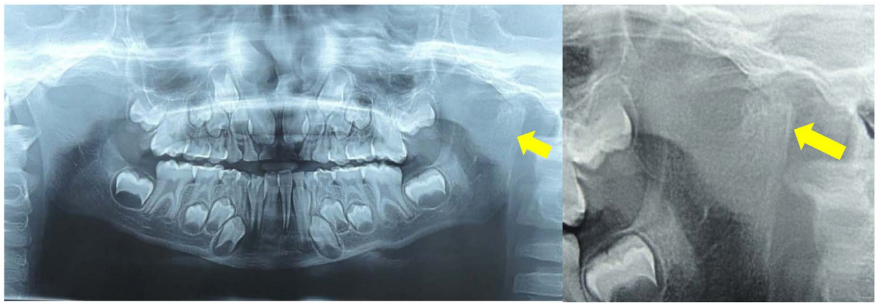
Treatment of pediatric injuries varies according to the type and pattern of injury, and also the age of the patient. For the sake of convenience, treatment modalities were divided into 3 categories; conservative treatment and observation, closed reduction (under local or general anesthesia) and open reduction (under general anesthesia).

1) Conservative treatment: This included prescription of prophylactic antibiotics and analgesics, soft diet and periodic follow up at a weekly interval. Undisplaced dentoalveolar fractures, undisplaced or minimally displaced mandibular symphysis and parasymphysis fractures, condylar fracture and maxillary fractures were treated by this approach. (**Figure 4**)

In addition, patients with condylar fractures were given active physiotherapy for mouth opening at 2 days interval till satisfactory mouth opening was achieved.



(a)



(b)

Figure 4. (a): Orthopantomogram of a 10-year old male patient showing a displaced fracture of condylar head (arrows); (b): follow-up orthopantomogram after 1 month of active jaw physiotherapy showing union of condylar head with the neck (arrows).

2) Closed reduction: Included in this approach are various techniques like composite splinting of teeth, arch bars and acrylic splints wired to teeth. These were used in case of minimally displaced mandibular fractures, dentoalveolar fractures, palatal fractures; and were carried out under local anesthesia. Short roots and low crown height of the deciduous dentition remain a hindrance to satisfactory closed reduction.

In case of displaced mandibular fractures, a lateral compression splint was secured by circumandibular wiring and kept in situ for minimum 3 weeks. This procedure was performed under general anesthesia (Figure 5). Another indication for the use of general anesthesia was an uncooperative patient, in which case either wiring or splinting would be performed.

3) Open reduction: This was performed under GA and entailed the use of osteosynthesis plates for fixation. It was performed for cases with moderate to severely displaced mandibular body and angle fractures, cases where tooth loss precluded the use of wiring or splints or in cases where intermaxillary fixation was not feasible. Metal plates were used and were removed after 6 months of surgery to prevent growth retardation.

(a)

(b)

Figure 5. A lateral compression splint fabricated for a patient with a displaced mandibular body fracture (a); lateral compression splint in situ, fixed with circumandibular wiring (b).

Osteosynthesis plates were fixed at the inferior border of the mandible, to prevent injury to the developing tooth buds. In addition, this was an attractive option in pediatric patients where intermaxillary fixation (IMF) is uncomfortable or contraindicated (e.g. mentally challenged patient, epileptic patient).

Another viable option is the use of resorbable plates made of poly L-lactic acid and polyglycolic acid [12]. These plates do not require removal after surgery and thus create no growth modification.

Healing was uneventful in all our patients and no adverse sequelae were noted. Regular follow-up was done to address any complaints.

Preventive measures:

The most common cause of pediatric fractures is sports related injuries, thus it would be beneficial to introduce preventive measures like use of appropriate gear (e.g. mouth guards, helmets) early in the school life. Supervision of children on the playground and adherence to rules should be implemented.

Seat belt designs in most vehicles are not suited for complete protection of children. Customized restraints or seats should be included in cars to offer maximum protection.

Parents and children should be educated about the various preventive measures. The importance of early treatment in case of trauma should be emphasized, to prevent any complications.

Sequelae of pediatric trauma:

Management of pediatric fractures holds a similar, if not more important, significance than adult fractures. This is due to the fact that the pediatric skeleton is a dynamic structure undergoing growth changes and any alteration may have far reaching and undesirable changes in the development of the face.

Malocclusion is the most common complication following trauma which may occur due improper positioning of dentoalveolar segments while reduction or failure to achieve proper intercuspation during open reduction. It may also result from an insufficient period of IMF or a non-rigid splint which permits tooth movement [13]. However, it is of little significance as many pediatric patients are in the mixed dentition phase and spontaneous correction is usually seen as deciduous teeth shed and permanent teeth erupt.

Growth retardation and facial asymmetry are rare but distressing complications, especially seen in condylar fractures. As the condylar head forms the growth centre of the mandible, injury to this area may lead to conformational changes and resulting growth modification.

Ankylosis is perhaps the most important complication following trauma, which can be prevented by early diagnosis and prompt treatment [14]. Fractures of the condylar head cause a hematoma, which results in limited mouth opening. Resolution of the hematoma may lead to the formation of fibrous or bony adhesion to the base of the skull and thus Ankylosis. This can be prevented by correct diagnosis and initiation of active jaw physiotherapy to aid in mandibular movement.

5. Conclusions

Pediatric maxillofacial trauma is an emerging branch of maxillofacial surgery. Increased awareness among parents has fortunately led to early diagnosis and management in many centres. However, this awareness is lacking in many parts of the country, especially the remote areas.

Once a patient experiences trauma, meticulous diagnosis and careful treatment planning should be done to prevent the untoward complications of trauma. The surgeon must assess each case and decide which treatment will be appropriate based on the various factors discussed above. Differences in the pattern of maxillofacial fractures between children and adults must be recognized to provide for appropriate diagnosis and treatment.

Long term follow up is essential in all cases to gauge the success of treatment and for early detection of any growth alteration.

Prevention of trauma begins at home. Parents must be properly educated regarding the various preventive measures available. Schools should also follow strict protocols to prevent sport related injuries.

Thus the field of pediatric trauma is an ever evolving area, and continuous research will help to better understand the pattern of trauma and treatment options for betterment of patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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