

# Prevalence and Etiology of Pediatric Maxillofacial Injuries: A Unicenter-based Retrospective Study

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## ABSTRACT

**Background:** Children are uniquely susceptible to craniofacial trauma because of their greater cranial mass-to-body ratio. The craniofacial injuries comprise approximately 11.3% of an overall pediatric emergency, and its etiology affects the incidence, clinical presentation, and treatment modalities, which are influenced by sociodemographic, economic, and cultural factor of the population being studied.

**Materials and methods:** A retrospective review to analyze the epidemiology of facial injuries in pediatric population (age range 0–16 years), divided into three age groups, i.e., group I (0–5 years), group II (6–11 years) and group III (12–16 years), was carried out over a 3-year span, in order to determine the facial injury pattern, mechanism and concomitant injury by age.

**Results:** A total of 1,221 patients with facial injuries, reporting to our trauma center and outpatient department were identified. Majority of these injuries were encountered among boys (64%). Motor vehicle collision (46.5%) was the most common cause of facial fracture and dentoalveolar injuries in group II and group III, while fall was the most common cause among the group I (30.2%). Mandible was the most commonly fractured bone (34.7%) followed by nasal (33.3%), maxilla (17.5%), and zygoma (14.3%). More than 50% sustained concomitant injuries.

**Conclusion:** The importance of epidemiological analysis lies in the identification of trauma burden, which could help motivate and develop more efficient ways to plan resources allocation and deliver adequate care and preventive steps. Improvisation upon National Prevention Programs could lower incidences of such injuries.

**Keywords:** Concomitant injuries, Craniofacial injuries, Pediatric trauma, Treatment modalities.

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## INTRODUCTION

Trauma accounts for the principal cause of mortality and disability in children.<sup>1,2</sup> Approximately 11.3% of an overall pediatric emergency comprises of craniofacial injuries.<sup>3</sup> However, overall facial bone fractures are considerably less common in children than adults owing to the underdeveloped facial skeleton and paranasal sinuses and also an additional strength of maxilla and mandible due to unerupted dentition.<sup>4-7</sup>

Anatomic and developmental differences between pediatric patients and adult, not only alter the diagnosis and implement management challenges, but also hamper the subsequent functional and esthetic impact among the growing children.<sup>4,8</sup> The etiology of facial trauma affects the incidence, clinical presentation, and treatment modalities<sup>9</sup> and are influenced by sociodemographic, economic, and cultural factor of the population being studied. The importance of epidemiological analysis also lies in the identification of trauma burden, which could help motivate and develop more efficient ways to plan resources allocation and deliver adequate care and preventive steps.<sup>9,10</sup>

The aim of this unicenter-based retrospective study conducted over a period of three years in 1,212 patients, was to obtain a dependable epidemiological data focusing on the analysis of the variation in cause and characteristic of maxillofacial fractures managed at our center along with describing and quantifying trauma for use in planning and evaluation of preventive programs.

## MATERIALS AND METHODS

The present study was conducted in the Department of Oral and Maxillofacial Surgery, King George's Medical University, Lucknow, Uttar Pradesh, India, after obtaining ethical approval from the

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university. This study is based on a systematic computer-assisted database that allowed the extraction of retrospective data of the patients below 17 years of age, who reported to our trauma center and outpatient department, between January 2014 and January 2017. All the records were analyzed thoroughly, and data concerning the patient's age, gender, etiology, treatment was given, prevalence and type of associated injury were extracted.

The following categories of mechanism of injury were considered: motor vehicle collision (MVC), physical assaults (PA), falls, sports injury pedestrian, bites, and miscellaneous. Age group was divided into three categories, i.e., 0 year to 5 years (group I), 6 years to 11 years (group II), and 12 years to 16 years (group III).

Soft tissue injuries were categorized as closed and open. Fractures were determined with clinical evaluation assisted with conventional radiography and computed tomography scans (selective cases) and classified as fractures of the midface (according to system delineated by Le Fort)<sup>11</sup> zygomaticomaxillary complex (ZMC), orbit, nose, naso-orbito-ethmoidal (NOE). Mandibular

fractures included fractures of the symphysis, body, angle, ramus, coronoid, and condylar fracture.<sup>12</sup>

Statistical analyses were performed using Microsoft Excel (2007) and SPSS for windows version (11.0; SPSS, Inc.).

## RESULTS

Patient's age at the time of injury ranged from 0 year to 16 years, with a mean of 9.8 years. Male patients (64%;  $n = 786$ ) outnumbered female patient (36%;  $n = 426$ ) consistently in all age groups. Among the total 1221 patients, 894 (73.2%) sustained facial bone fractures while the remaining had only soft tissue or dentoalveolar injuries. Considering the overall facial injuries, 36.3% ( $n = 441$ ) of the children were under 6 years (infants and toddlers), 38.2% ( $n = 465$ ) belonged to group II (school age) and 25.2% ( $n = 306$ ) to group III (adolescence). However, the proportion of patients with facial fractures showed the lowest proportion among group I and the highest among group II.

The most common bone fractured was mandible (34.7%), followed by nasal (33.3%), maxilla (17.5%), and zygoma (14.3%). Nasal and maxilla fracture were most commonly found in group I, and mandible fracture in group III. Among all patients with mandibular fracture ( $n = 311$ ), symphysis ( $n = 121$ ), and condyle ( $n = 108$ ) were the most common individual fracture (Fig. 1).

MVC (46.5%) was the most common cause of the facial fracture and dentoalveolar injuries in both the groups, II and III whereas, fall was the most common cause in group I (30.2%). However, exclusive soft tissue trauma was mostly due to animal bites, sharp objects, and other miscellaneous causes and was most prevalent among infants and toddlers (50.9%). Pedestrians struck by motor vehicle (38.5%) were the second most cause for school-aged children (6–11 years). Sports injuries and physical assault (36.6%) were the second most common cause among the older group (12–16 years) (Fig. 2).

About 80% of the patients received a closed reduction with the help of arch bars and IMF, mandibular acrylic cap splint, and nasal splints. 4% were kept under observation alone. A total of 16.5% of patients of facial fracture underwent open reduction and internal fixation under general anesthesia (GA). Isolated open soft tissue injuries were repaired under local anesthesia (Table 1).

More than 50% of patients with facial fractures sustained concomitant injuries. Associated facial soft tissue injuries were observed in more than 50% of the patients. Concomitant brain injury was found in 23.8%. Similarly, globe injury was reported in

20% of the patients with facial fractures and was most prevalent among group III. Skull base fracture was observed in 20.2% of patients followed by cervical spine injuries (9.8%) (Table 2).

## DISCUSSION

In this study, we describe the incidence and etiology of craniofacial injury in children over a 3-year-span to obtain a dependable epidemiological data focusing on analysis of the variation in cause and characteristic of maxillofacial fractures managed at our center along with describing and quantifying trauma for use in planning and evaluation of preventive programs.

Our result showed that boys were more prone to injuries than girls, which is similar to many other studies.<sup>12–16</sup> This could be attributed to maximum confinement to outdoor activities among the boys as compared to the girls.<sup>12,17,18</sup> Also the higher incidence of facial injuries among group II reflects their curiosity to explore the external world with a limited physical capacity to deal with the same.<sup>19</sup>

The percentage of patients with facial fractures increased steadily with age, which confirms other reports.<sup>4,13,14,16,18</sup> Similar to previous studies, mandible fracture was the most common fracture subtype overall<sup>18,20–22</sup> and occurred most frequently in school-age (6–11 years) and less frequently among the infants and toddlers. This lower prevalence among the youngest age group is likely a result of the increased relative strength of immature mandible because of the unerupted dentition and relative micrognathia and also indifference in the mechanism of injury among the different age groups.<sup>4,5,7</sup> However, midface fracture (nasal, maxillary, and frontal) was frequently found in younger age groups attributing to frontal projection and increased cranium-to-facial bone ratio in these children as they have the tendency to sustain central blunt injury rather than peripheral mandibular injury.<sup>7,23</sup> Consequently, in our study also, cranial vault fractures were more evident among these groups (44.1%).

The etiology of maxillofacial fractures in the pediatric patient appears to vary from one country to another.<sup>13,16,17,19</sup> We reported fall as the most common cause of maxillofacial injury among group I, which matches other studies.<sup>14,16,17,24,25</sup> This can be attributed to their lack of coordination and uncertainty of motion, which prevents them from adequately shielding themselves from sudden motions.<sup>19</sup> Also, most of the houses in the rural part of India are constructed without proper-barred-boundaries on the terrace

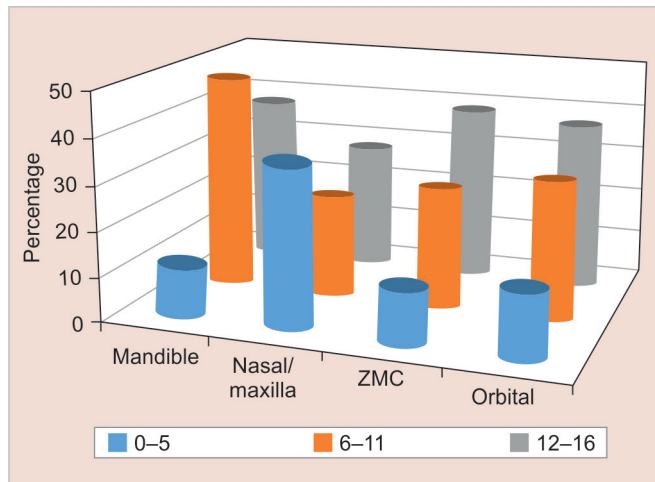


Fig. 1: Pediatric facial fracture type ( $n = 894$ ) by percentage of age group

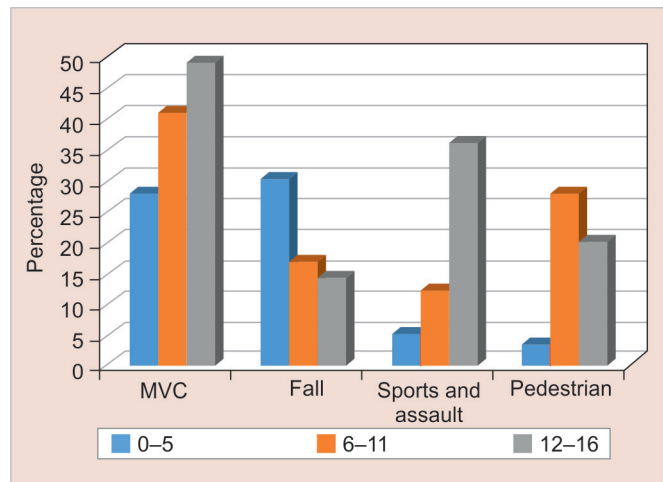


Fig. 2: Mechanism of facial fracture ( $n = 894$ ) by percentage of age group

**Table 1:** Various treatment methods employed in different age groups

Group	Observation	Dental splinting	Arch bar and IMF	Acrylic mandibular splint	CMW	ORIF	Nasal splint/ZA elevation	Suturing
Group I	38	–		32	02	–	03	188
Group II	09	152	138	52	14	63	36	224
Group III	07	161	188	–	–	139	63	208
Total no.	54	313	326	84	16	202	102	620

CMW, circum-mandibular wiring; ZA, zygomatic arch; ORIF, open reduction and internal fixation

**Table 2:** Concomitant injuries with facial bone fractures: (n = 894) along with incidences among different age group

Injuries	Total (%)	0–5 years (%)	6–11 years (%)	12–16 years (%)
Facial soft tissue	51.1	17.5	44.6	37.8
Dentoalveolar <sup>#</sup>	23	15	47	37.7
Brain injury	23.8	15	38	46.9
Cervical <sup>#</sup>	9.8	11.3	35.9	47.7
Lower extremity <sup>#</sup>	17.7	10.2	49.3	40.5
Upper extremity <sup>#</sup>	11.7	10.4	51.4	38
Skull base <sup>#</sup>	20.2	10.4	43.6	45.8
Cranial vault <sup>#</sup>	10.4	44.1	28.4	27.4
Globe injury	20.3	8.2	43.4	48.3

<sup>#</sup>Fracture

where children tend to play without proper parental supervision. Therefore, strategies to decrease the occurrence of falls by counseling parents to increase their supervision of play activities and to keep children from playing unsupervised on the terrace and stairs should be developed.

Motor vehicle collision (MVC) accounts the highest among the cause in the other two groups, which confirms other studies.<sup>12,14,16,25–27</sup> Greater use of automobiles and public transport, negligence upon strapping the children to seats, occupancy of these age groups with multiple activities like cycling, etc., can all be attributed to higher percentage of road traffic accidents. Additionally, two-wheelers (motorcycles) are very common in India, and children here develop a tendency to ride one, prior to attaining the legal age to do so. This to a larger extent, reflects upon parents' responsibility for not being able to supervise vehicle use in their children. Legislative measures of law enforcement to ensure proper driver's license-issue-age could benefit in reducing such kind of injuries. Pedestrians struck by motor vehicles were found to be the second most predominant cause in group II. This could be owed to a dramatic increase in the number of cars and two-wheelers, badly maintained roads, and drivers carelessness. Also, it illuminates the condition of our traffic system and people's attitude towards abiding proper traffic rules and regulations. Hence, a special focus on modifying the attitude of general public to ensure safe driving measures along with educating school-going children to abide proper road crossing rules is required, including special attention towards parental guidance upon the supervision of vehicle use.

Treatment planning should be seen from different perspectives in children, keeping in mind the following criterion: age, anatomic site, and complexity, development stage of dentition, timing of intervention, and associated injuries. Studies show that in the course of eruption of the permanent teeth, the occlusal imperfections can be corrected by the adaptive potential of alveolar bone that can bring about various degrees of self-correction.<sup>13,14</sup> Conservative approach was preferred in most of our cases, keeping in mind

the complication of interrupting the osteogenic potentials. Reproducibility of adequate occlusion and minimal displacement of fractures was considered criteria for conservative treatment.

The successful use of IMF is dependent upon stable supportive dentition, and the dentition stage varies among the different age groups.<sup>14,28</sup> Closed reduction was done in almost 80% of our patients while 4% were kept under observation alone. Open reduction with internal fixation with the bioresorbable system is deemed necessary in patients with complex fractures of mandible and midface where conservative treatment fail to reproduce the form and function.<sup>29</sup> In our study, 16.5% underwent open reduction and internal fixation, which seemed to increase with age, with the oldest pediatric subgroup (12–16 years) being the most commonly treated with operative fixation (86%). Different studies show variation in treatment modality among the pediatric population.<sup>16,18,25,30</sup> This might be due to the varying experience of surgeons with different epidemiology of craniofacial trauma worldwide.

These differences in age-related operative fixation reflect upon the degree of displacements in fractures caused due to high-velocity trauma in older age groups. Studies show fracture of mandibular condyle can affect the growth and development of mandible.<sup>11,14,19,25,26</sup> In our study, all the condylar fractures either in isolation or in combination were managed conservatively with a limited period of immobilization followed by aggressive mouth-opening exercise. Studies have shown that conservative treatment of these injuries can result in good function and remodeling of the condyle.<sup>16,29,30</sup>

Mechanism of injury plays a key role in predicting potential concomitant injury, which can be grouped into low-energy (falls, assaults, and sports injury) and high-energy (road traffic accidents) categories.<sup>19</sup> Associated brain injuries were the most common (23.8%) after facial soft tissue injuries (51.1%) and were more prevalent among the adolescent group (48%) who suffered predominantly from MVC. Skull base fracture showed a strong

association with a facial fracture with an incidence of 20.2%, most commonly affecting the group III individuals, with MVC being the prime reason. Upper and lower extremity fractures were recorded highest among group II, a large number of which was caused due to pedestrian struck by the vehicle. Our study showed a strong association of high-velocity traffic accidents with severe concomitant injuries. The time of definite intervention for facial fracture was withheld until a significant resolution of severe concomitant injuries in all the age groups. Length of hospital stay was prolonged among patients in those who underwent operative fixation for bony injuries and were significantly extended further among those who had concomitant brain or other organ-specific injuries.

Trauma is the leading cause of injury and death among the pediatric population. Although facial fractures are relatively low among these populations, they are associated with increased mortality and morbidity. Despite the attention the facial injuries have received in the literature, the epidemiology of these injuries is not well characterized in children.

## CONCLUSION

A methodical system of surveillance must be applied in every trauma patient to effect a favorable outcome. Also, the presence of concomitant injuries may be challenging for the clinicians, and hence a vigilant approach is required every time. Proper restraint use and future research with accident prevention is important and needs to be worked upon. Additionally, improvisation upon National Prevention Programs could lower such incidences.

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