Pediatric Maxillofacial Trauma Outcomes Based on a Survey of 65 Patients: A Prospective Study of Etiology, Incidence and Methods of Treatment

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Abstract

Background The purpose of this study was to assess the etiology, incidence, and various methods of treatment of maxillofacial injuries in children presenting at our centre and to compare our findings with literature.

Patients and methods We carried out prospective study of 65 pediatric maxillofacial trauma patients treated from January 2011 to October 2012 at our centre. Data was collected on age, gender, etiological factors, anatomic site and treatment methods. Follow-up was performed by recall survey.

Results Out of 65 patients 17 (26.15 %) presented with isolated soft tissue injuries and 48 (73.84 %) patients reported with 81 craniomaxillofacial fractures. Falls were most common mode of injury with 53 fractures (81.53 %). Treatment for fractures in our series comprised of periodic observation for non-displaced fractures (46.15 %), closed reduction (maxillomandibular fixation with IMF screws, acrylic cap splints) for minimally displaced fractures (15.38 %) and open reduction and internal fixation (ORIF) for grossly displaced fractures (12.30 %).

Conclusion Paediatric maxillofacial trauma can be managed conservatively and surgical treatment by ORIF is

required in a very small group of children with grossly displaced fractures as a result of high velocity injuries.

Level of evidence Prognostic study, Level II.

Keywords Pediatric · Maxillofacial · Trauma · Etiology · Treatment

Introduction

The purpose of this paper is to present an overview of paediatric maxillofacial trauma in our part of the world. Although the types of injuries sustained by children are similar to adults, the incidence of paediatric maxillofacial trauma is much less than adults possibly due to increased ratio of cranial volume to facial volume. 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 [1]. This translates into higher percentage of cranial trauma in younger age group of less than 3 years and a shift to higher incidence of maxillofacial trauma in children after 3 years of age as facial growth starts to overtake the cranial growth due to developing dentition and sinus pneumatization. Majority of fractures in spite of serious and often debilitating initial clinical presentation are minimally displaced due to elasticity of paediatric bones and this may lead to many of these patients requiring closed monitoring/observation only [11, 21]. The inherent growth potential in children also leads to functional adaptation in terms of dental occlusion, condylar growth, and overall remodelling of bone. However these patients need to be carefully followed up for any growth disturbances especially in nasal septal and mandibular condylar region for any future facial disfigurement by repositioning of the midface and mandible.

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The literature states that facial fractures in children are rare [2–7]. Even with extensive soft tissue injuries, there are often no markedly displaced fractures. It is well documented that trauma is the leading cause of morbidity and mortality in children [6]. Although percentage of head injuries is much higher, yet severe pediatric maxillofacial injuries are still moderate compared with that in adults due to increased amount of adipose tissue in children which dissipates the energy of impact. The frequency of dentoalveolar trauma and soft tissue injuries is higher in children as a result of trauma and the incidence of facial fractures is considerably low as already stated [6].

Children are a unique group of patients in comparison to adults, as far as facial skeleton is concerned. Small size of bones, developing paranasal sinuses, presence of developing tooth buds, a quicker healing process, as well as difficulty in cooperation and the need for general anaesthesia in more cases than in adults may require different strategies of treatment planning in children [8].

Clinical examination in these traumatized children is often difficult because of lack of co-operation and may require examining these children under sedation or anaesthesia. The radiographic examination including CT scans may also require intravenous sedation, and radiographic findings are often difficult to interpret because of overlapping of developing tooth buds in the fractured region. Unwarranted operative intervention in the child, including unnecessary internal fixation, inadequate treatment, or recognition of chondritis, hematoma, or seroma, may lead to greater long-term deficits and deformities in the child than in the adult [6].

The purpose of the present study is to evaluate and provide a comprehensive overview regarding the full scope of maxillofacial trauma in pediatric patients to assist the clinician in the assessment of this unique and highly specialized area of traumatology. The study will include evaluation of facial bone fractures, dentoalveolar trauma, and soft tissue injuries. It will be our endeavour to look specifically at nature and etiology of the injuries of facial skeleton, to analyze the location of fractures, radiographic and CT scan findings, and various open and closed treatment modalities required for the management of maxillofacial injuries in paediatric patients at various age groups between 0 and 14 years.

Patients and Methods

The present study included 65 patients under 14 years of age, with maxillofacial trauma treated in the Department of Oral and Maxillofacial Surgery, Government Dental College & Hospital, Shimla, India during the 1 year 10 month period from January 2011 to October 2012. Written

informed consent was taken from parents/guardians of all the patients to participate in this study. The patient records and all available documents and radiographs and mandatory computerized tomographic scans were reviewed. The data included age at the time of injury, gender distribution, mechanism of injury, soft and hard tissue injuries, anatomical site of fracture and treatment methods and the patients were divided into four age groups [group A: <3 years (7 patients), group B: 3–6 years (26 patients), group C: 7–9 years (18 patients) and group D: 10–14 years (14 patients)]. Group A comprised of children with erupting deciduous teeth, group B had complete deciduous dentition, Group C had mixed dentition stage with majority of teeth being deciduous teeth, whereas Group D had mixed dentition with majority of teeth being permanent alongwith completion of development of maxillary sinus. Follow-up was performed on most patients by recall survey.

Results

Age and Gender Distribution

Patient age at the time of injury ranged from 0 to 14 years (mean age 6.95). The detailed age wise distribution is shown in Table 1. 3–6 years age group was the most common to be injured (40 %), followed by 7–10 year age group (27.69 %). Boys were affected more commonly (60 %) than girls (40 %).

Etiology

The most common cause of maxillofacial injuries was falls with 53 (81.53 %) patients, followed by road traffic accident (RTA) affecting 10 (15.38 %) patients, animal assault-2 (3.07 %) patients (dog bite one, equestrian injury one). The causes of injury by gender showed that fractures from falls were significantly more common in males possibly due to more outdoor activities seen in boys.

Type of Injuries

Isolated soft tissue injuries like abrasions and lacerations without bony involvement were there in 17 (26.15 %) patients. Forty-eight (73.84 %) patients had hard tissue injuries (maxillofacial fractures and dental injuries). Isolated facial bone fractures without dental involvement were the commonest in our series (32.3 %), followed by isolated soft tissue injuries (26.15 %). All the rest of the injuries were combined soft tissue, bony and dental injuries.

Table 1 Association between velocity of impact and the type of injuries sustained (n = 65)

Velocity of impact	Fracture		No fracture		Total		RR (95 % CI>)	p value ^a
	n	%	n	%	n	%		
High	21	100.0	0	0	21	100.0	1.63 (1.30–2.06)	0.002
Low	27	61.4	17	38.6	44	100.0		
Total	48	73.8	17	26.2	65	100.0		

Prospective data where information on velocity of impact could be obtained

RR risk ratio, CI confidence interval

^a By Yates corrected Chi square

Anatomic Location of Fractures

There were 81 fracture sites in 48 patients treated during the period studied. Mandibular fractures were the most common fractures with 25 subjects sustaining 33 mandibular fractures, followed by 17 dentoalveolar fractures in 11 patients.

Treatment of Paediatric Facial Fractures

Out of a total of 75 fractures, 47 fractures (62.66 %) were managed conservatively and only 10 fractures (13.33 %) required open reduction and internal fixation (ORIF) whereas 11 fractures (13.58 %) were managed by maxillo-mandibular fixation by various methods. Four patients required acrylic cap splint fixation with circum-mandibular wiring for mandibular fractures whereas three patients required dental splinting for dento-alveolar fractures.

Discussion

The primary management of maxillofacial trauma by maintaining airway, breathing and circulation in children is more critical and time dependent than in adults as they have a higher surface-to-body volume ratio, metabolic rate, oxygen demand and cardiac output than adults. Decreased total blood and stroke volumes predispose them to greater risk of hypothermia, hypotension and hypoxia after blood loss [1].

Etiology and incidence of maxillofacial injuries tend to vary from one country to another, perhaps because of the differences in social, cultural, and environmental factors [14]. Many studies showed accidental falls to be the most common cause of maxillofacial injuries in children [5, 6, 12, 13, 14, 15, 20, 22]. This corresponded to the findings of this study where accidental falls were responsible for 81.53 % of maxillofacial injuries. This fact can be attributed to hilly geographic topography of our area and children's underdeveloped motor skills and coordination, mainly those aged less than 6 years. Other studies,

confirmed that motor vehicle accidents were a leading cause of facial injuries, although in our study they comprised only 15.38 % of the injuries [17, 18]. The reason for lower rate of RTAs is the tough land terrains in the far flung areas of this hilly state with hardly any access to traffic. Some authors [2, 14, 15] have reported that mandibular fracture accounted for most common facial bone fracture encountered in children. Our study corroborated with these studies and mandibular fractures accounted for 50.61 % of facial fractures. Dentoalveolar fractures were found to account for 25.92 % of the cases in our study and were also frequent in other investigations [7, 14].

Condylar fractures were the most common site of mandibular fractures in our series with 42.55 % of all mandibular fractures as reported by many authors [7, 14, 15]. The higher incidence of condylar fractures in children may be explained by the higher proportion of medullary bone with only a thin rim of cortex. Nonsurgical management of condylar fractures of the mandible in children is still the method of choice [10]. Para-symphyseal fractures at 19.14 % were the second most common site in our series. This difference can be explained because of accidental falls is the most common etiology in our study and, generally, when children fall, the symphyseal region is the first place to be injured. The impact is first dissipated to the condyle and then to para-symphyseal region.

Since our major group of patients sustaining facial fractures was that of fall, so we categorized these fall patients into two categories that is high velocity fall and low velocity fall. High velocity fall was designated to the group who immediately after the fall lost contact with hard surfaces and their fall was mainly aerial in nature such as falling from a tree or roof top. Low velocity fall group was designated to those patients who maintain contact with hard surfaces and the fall was not aerial such as rolling down a hill. It was observed that patients belonging to high velocity group often sustained serious injuries and facial fractures requiring surgical intervention, whereas patients in the low velocity group sustained soft tissue injuries or minimally displaced fractures requiring to be kept under periodic observation only.

Fig. 1 Maxillo-mandibular fixation using IMF screws

Fig. 2 Stabilization of parasymphysal mandibular fracture with a bone plate at lower border and tension wire at upper border

Boys suffered more high velocity trauma (23.07 %) compared to girls (9.23 %) possibly because of more outdoor activities by boys than girls. High velocity injuries almost always resulted in 100 % fractures in all the cases whereas low velocity trauma resulted in 61.4 % fractures only. In this study it was observed that all the 21 patients (100.0 %) in high velocity group have bony involvement which is statistically significant ($p < 0.002$), whereas 44 patients in the low velocity group 27 (61.4 %) have bony (hard tissue) involvement and 17 (38.6 %) cases have exclusively soft tissue injuries as summarized in Table 1.

In patients who presented with minimally displaced facial injuries, the treatment was categorised into two categories. First group was of fractures involving occlusion and the second group was of patients having fractures not involving occlusion. The first group was treated by dental splinting/MMF or periodic observation only (Fig. 1). In the second group of patients having facial fractures not involving the occlusion the protocol of periodic observation only was followed [11, 21]. Those who presented with displaced facial fractures the international standard protocol of open reduction and rigid internal fixation was followed. 38.1 % patients belonging to high velocity trauma group required ORIF whereas none of the patients in low

Fig. 3 Stabilization of maxillary fracture with a bone plate

velocity group required ORIF (Table 2). Furthermore long term follow-up by oral and maxillofacial surgeon, the orthodontist, and the pediatric dentist was emphasized to these patients. Small titanium plates were chosen for fixation of pediatric facial fractures as they have better mechanical properties and small dimensions at the same time and although it is not easy, they can be at least

Table 2 Association between velocity of impact and the type of treatment given for fractures (n = 48)

Velocity of impact	Open reduction		Closed reduction		Observation only		Total		p value
	n	%	n	%	n	%	n	%	
High	8	38.1	7	33.3	6	28.6	21	100.0	<0.001
Low	0	0.0	5	18.5	22	81.5	27	100.0	
Total	8	73.8	12	26.2	28	100.0	48	100.0	

No. of patients with fractures from prospective data

Fig. 4 Stabilization of a comminuted parasymphysal fracture with a bone plate and a lag screw

Fig. 5 Dissection and preservation of mental nerve in a parasymphysal mandibular fracture

removed completely if necessary, even after many years [19]. All the patients undergoing ORIF were treated with 2.0 mm titanium mini plates which were removed subsequent to healing of fractures if required (Figs. 2, 3). Polylactic and polyglycolic resorbable plates and screws can also be used effectively in pediatric patients [9]. Bioresorbable plates were used in very few cases due to cost constraints. Some patients having comminution of fracture segments required a combination of bone plates and lag-screws (Fig. 4). Careful dissection to expose the fractures is required in children to avoid damage to tooth buds and neurovascular structures (Fig. 5).

In our study it was observed that patients belonging to high velocity group have displaced fractures and often required surgical intervention (38.1 %) statistically significant ($p < 0.001$), whereas patients in the low velocity group have undisplaced or minimally displaced fractures

and 18.5 % were treated by closed reduction and 81.5 % were kept under periodic observation only as displayed in Table 2.

Conclusion

In our study boys more commonly sustained maxillofacial injuries (60 %) compared to girls (40 %) possibly due to more outdoor activities by boys. Our study showed that the incidence of maxillofacial fractures in children peaked in the 3–6 year-old age group (mean age 6.95). The most frequent cause was accidental fall (81.53 %). Increased incidence of falls seen in our study could be attributed to the hilly terrain of the state with pedestrian paths through the hills, specially, the vast majority of the area of the state being rural with low socio-economic status and parental neglect. This was also probably the reason for seeing lesser incidence of RTAs in children (13.58 %). Similar to the findings of Qudah and Bataineh [14], the most common bone to be fractured was the mandible in our series. Of these, 43.9 % of the fractures were found in the condylar region and 24.39 % in the parasymphysal region [16]. Most of the fractures were neither severe nor complicated and were followed-up by observation only followed by closed reduction with conventional means like acrylic splinting and maxillomandibular fixation by IMF screws, whereas surgical intervention was reserved for only severely displaced fractures. ORIF using 2.0 mm titanium mini plates and screws was carried out under general anaesthesia in severely displaced fractures sustained due to high velocity impact. Bioresorbable implants were used in only one patient because of cost constraints.

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Conflict of interest None.

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