ORIGINAL RESEARCH PAPER

Orthopaedics

PAEDIATRIC CRANIOFACIAL TRAUMA IN INDIA: UNVEILING THE HIDDEN FACTS.

KEY WORDS:

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ABSTRACT

The purpose of this retrospective study utilizing the hospital records was to assess the current scenario of pediatric craniofacial trauma in a northern Indian urban setting with dense population with special consideration to skull vault fractures (which, as per our knowledge has not been assessed in any such study from India) in the young pediatric patients. We concluded that overall, road traffic accidents were the main cause of injury. In children less than 6 years old the main cause of such injuries was fall from height. Mandible was the most commonly fractured bone (44%). Upper and middle facial bone fractures accounted for 34%. Skull vault fractures followed next with incidence of 15% and alveolar crest fractures accounted for 7% of all fractures. Single fractures were present in 71% patients and 2 or more fractures were seen in 29%. Most associated injuries were cerebral (concussions/ pneumocephalus/ hydrocephalus) which constituted 39% of such associated injuries.

INTRODUCTION

The reported incidence of facial fractures in children ranges from 1% to 15%.[1-7] The greater cranial mass to body ratio makes the children uniquely susceptible to craniofacial trauma. The elasticity of facial skeleton, lack of pneumatization of paranasal sinuses and presence of buccal fat are the factors that are responsible for lower incidence of facial fractures in the pediatric population when compared to that of adults.[8] Furthermore, occupational or violence related injuries are less common in young children.[9-11]

A wide variation is seen in literature with respect to the causes and incidence of maxillofacial injuries in children. [12-25] These variations possibly result from social, cultural, and environmental diversity. The main causes cited in various studies from India are traffic accidents, falls, violence, and sports-related accidents (Table 1). Skull vault fractures have recently been reported to be the most frequent fractures in the young pediatric patient,[23,26,27] whereas mandibular and midfacial fractures are predominantly seen in older children.[25,26]

The purpose of this study was to assess the current scenario of pediatric craniofacial trauma in a northern Indian urban setting with dense population with special consideration to skull vault fractures in the young pediatric patients. On the basis of history of paediatric craniofacial trauma patients reporting at our center which often revealed that the younger patients fell from roofs of their houses and older children were involved in RTA where they were commandeering the vehicle (mostly motorcycles) involved; we hypothesized that fall from unfenced roofs or stairs was major cause of such injuries in younger children and motorcycles were involved in most of the cases where RTA was the cause. We also went into detailed history of such patients to find out what was the root cause behind the unfortunate events that led to such injuries so that we could come up with ideas that will address the issues that require immediate attention to prevent these injuries. We also performed a literature review to compare our findings with similar studies done on Indian population.

MATERIALS AND METHOD

We reviewed the emergency and hospital records of pediatric patients falling in age group of 0-16 years and who had suffered maxillofacial and skull vault fractures between July 2010 and July 2016. For certain informations pertinent to our study which were missing in the record file (for eg. was the vehicle owned by the victim? who purchased that vehicle for him/ her? what safety precautions were adopted at the time of injury? who trained them to drive? what was the age of the person driving the vehicle in case the victim was not the driver?); telephonic interviews were conducted of the parents (in case of minors) and the victims (who had attained the age of 18 years at the time of study). A total of 431 patients were identified. Out of which 278 parents/ patients were available for the telephonic conversations and 191 agreed to answer the queries and hence only these were included in the study.

The patients (n =191) were divided into 3 groups according to age (under 6 years, 6 to 11 years, and 12 to 16 years). Cause of injury fell under 4 main categories: 1) road traffic accidents (RTA), 2) falls, 3) sporting injuries, and 4) violence. Fractures were determined from radiographic investigation records and operative reports. Maxillary and midface fractures were classified according to the system delineated by Le Fort.[28] Mandibular and zygomatic complex were categorized according to Killey.[29] They were further subclassified according to patient gender, mechanisms of injury and absence/presence of associated systemic injuries. Treatment data were also collected. For significance testing of categorical data, Chi square test was applied.

RESULTS

Age of the patients at the time of presentation ranged from 0 to 16 years, with a mean of 8.4 years. 11% per-cent (n = 22) of the patients were under 6 years (infants and preschool), 42% (n =78) were between 6 and 11 (school age), and 47% (n =91) were between 12 and 16 years (adolescents). Male patients (78%; n =149) outnumbered female patients (22%; n =42) consistently in all age groups. Chi square test applied on etiological factors gave statistically significant result (^{2}=62.6, df =6, $p < 0.001$). RTAs were the most frequent cause, accounting for 56% (n =106) of fractures (Table 1) and were predominantly found in adolescents (n=73) and a significant number of victims were themselves driving the vehicle involved in the accident or the vehicle was being driven by minor (which is not permitted by the law of the country) . Most of these patients were involved in motorcycle accidents (n=73) and car accidents (n=17). 9 injured patients were cyclists and 7 were pedestrians (Table 2). 29% (n =55) of the patients were injured by falls. (Table 1) These patients were predominantly of preschool age

and incurred their injuries mostly by falling from the unfenced roofs of house, or falling from the stairs. Only a handful of these patients sustained injuries by falling on the floor. Sporting related injuries accounted for 11% (n=21) of accidents, which occurred mostly while playing team sports. Finally, violence accounted for 4% (n=9) of injuries. (Table 1)

Out of the total of 276 fracture sites recorded, mandible was the most commonly fractured bone (44%, n=121). Upper and middle facial bone fractures accounted for 34% (n=94). Skull vault fractures followed next with incidence of 15% (n=41) and alveolar crest fractures accounted for 7% (n=20) of all fractures. (Fig.1) Association between skull vault fracture and age was found to be significant with age on applying Chi square test (^{2} = 53.5, df =2 p<0.001).

Single fractures were present in 136 (71%) patients and 2 or more fractures were seen in 55patients (29%). Eighty one patients (43%) suffered a total of 228 associated injuries. Approximately two third of these (n =59) had only single concomitant injury and the others (n=22) more than one. Most associated injuries were cerebral (concussions/pneumocephalus/hydrocephalus) which constituted 39% of such associated injuries. Of these, 69% were because of RTA and 26% were caused by falls. Dental injuries (luxation/fracture/ avulsion) were found in 34% (n=78) and made up one third of associated injuries. (Table 3). Sixty seven patients (35%) were managed by observation alone and 78 patients (41%) received closed reduction in the form of acrylic splints, Risdon wiring or maxillomandibular fixation utilizing arch bars, orthodontic brackets and elastics or Gilmer wiring. 46 patients (24%) underwent surgery involving open reduction and osteosynthesis where stainless steel wires or Titanium miniplates and microplates and mesh were utilized depending on the location and pattern of fracture. The mean duration of the hospital stay was 5.9 days (range, 1 to 32 days).

DISCUSSION

Numerous studies exist in the literature which has been done to assess paediatric maxillofacial trauma in Indian population but without special consideration to skull vault fractures. (Table 4)

We found that skull vault fractures had significantly higher incidence in the paediatric population, especially in the younger age group (<6 years). (Table 5) With increasing age, the incidence of skull vault fractures declined and that of maxillofacial skeletal fractures increased. This could be attributed to the fact that in younger children the craniofacial ratio is higher which could be responsible for the skull bones to be the first ones to bear the impact of traumatic force. As the child grows this ratio declines and maxillofacial skeleton becomes more "projected" causing them to become the primary impact bearers. Further features of elasticity of the bone, sinus development and stages of development of the dentition influence the fracture patterns.[40] A study by McGraw and Cole [41] reported that fractures shifted from the upper to the lower region of the face with increasing age and midface injuries were common in younger children and mandibular fractures in the older age group.

We concluded that overall, road traffic accidents were the main cause of injury. This is in contrast to similar previous studies on Indian population.[30-33, 35, 38] However it was in agreement with the findings of studies by Arvind, Waknis and Verma et al. [34,36,37]

In children less than 6 years old the main cause of such injuries was fall from height which seems to be an apparent reason in accordance with other Indian studies. [30-33,35,38] However, one interesting fact that we came across was that in a considerable number of fall from height cases, the children fell from the unfenced roofs of their houses, located mostly in rural areas. This brought us to the conclusion that uncertainty of motion and lack of coordination in children coupled with failure to adopt child safety protocols during construction of houses, especially in the rural areas was responsible for higher incidence of fall related injuries.

In the school going children (6-11 years), road traffic accidents and fall had almost equal role as the causative factor followed by sports related injuries. This could be attributed to the fact that with neuromotor development, the child gets more involved in independent as well as outdoor activities and hence becomes more susceptible to direct trauma and road traffic accidents. Increased social interactions predispose the children to injuries caused by sports related accidents and interpersonal violence. The children of this age group who were involved in RTA were either passengers in the vehicle or they were pedestrians. Only a handful of them sustained injuries while riding bicycles. We came to know that most of these children were travelling with their relatives or friends on motorcycles or cars without any safety precautions for pediatric passengers. The injured cyclists also had not had their safety helmet put on.

In contrast to this in the age group of 12-16 years, majority of the injuries were sustained during RTA and it was surprising for us to know that most of the individuals from this group were driving the vehicles (especially motorcycles) involved in RTA which is illegal according to the traffic rules of the country. On further detailed assessment of history, another interesting and disappointing fact came to light which was that these individuals were either "gifted" the vehicles by their parents or their parents did not stop them from driving and also they were "taught" driving by either their friends or parents.

The incidence is much higher in males compared to their female counterparts as has already been proved by other Indian studies.[30,31,33,34] This could be attributed to inherent aggressive behavior and more outdoor activities involvement of boys.

When considering associated injuries, we found that cerebral injuries took the major share. High impact collision and neglect of safety precautions like helmets and seat belts could be the reason behind this. Also, in cases of falls; most of the subjects of our study fell from a significant height further adding to higher incidence of cerebral injuries.

When planning treatment in children's fractures, conservative treatment of the growing bone is preferred whenever possible as internal fixation implies an open approach with subsequent subperiostal dissection, which interrupts the osteogenic potential of the periosteum and creates scarring, which may further restrict growth. [2,41]

In our study, maxillofacial and skull vault fractures were treated with observation or closed reduction techniques in three fourth of total number of cases and only one fourth required open reduction.

CONCLUSION:

Our findings are confluent to similar studies done in developed nations in terms of presentation and the mode of injuries but the scenario in which they occur are entirely different. Concerned authorities should ensure that proper safety protocols are adopted during construction of houses and fines should be imposed on the defaulters. Negligence of the laws by younger individuals as well as by their parents coupled with low penalty amounts and lack of vigilance by the concerned authorities lead to higher incidence of craniofacial injuries due to road traffic accidents. Diminution of safety protocols and poorly maintained roads further add to it. Legislative measures in the form of higher penalties for violation of rules should be implemented. Improved road construction measures and encouragement of use of protective devices through audio visual and print media, could lead to long-term benefits in reducing such injuries. Further informational and educational programs for both parents and children should be promoted at school and community level to improve both compliance in the use of safety features and parental supervision of vehicle use.

Table 1. ETIOLOGY OF CRANIOFACIAL FRACTURES (N)

Age group(in years)	RTA	Falls	Sports	Violence/Others
<6	9	29	1	0
6-11	24	17	9	3
12-16	73	9	11	6
Total	106	55	21	9

Table 2.TRAFFIC ACCIDENTS RESULTING IN CRANIOFACIAL FRACTURES (N)

Motorcyclists	73
Car/Public Transport Vehicle	17
Bicyclist	9
Pedestrian	7

Table 3. ASSOCIATED INJURIES

	RTA	FFH	Sports	Violence	Total
Dental					78
Luxation*	23	8	4	-	
Fracture†	17	6	3	-	
Avulsion	12	3	1	1	
Cerebral					89
Concussion	51	21	4	1	
Pneumocephalus	5	2	0	0	
Hydrocephalus	4	1	0	0	
Thorax	16	1	1	0	18
Abdomen	8	1	0	0	9
Extremeties	18	11	3	2	34
Total	154	54	16	4	228

***Intrusion and lateral luxation**
† Root or Crown fracture

Table 4. LITERATURE REVIEW

Study (Year of study)	Year (s)	No. of patients	Etiologies					Mean age (Years)	Skull vault # assessment (Yes/No)
			RTA%	Fall%	Violence%	Sports%	Others%		
Kumaraswamy SV et al (2009)	**05**	**95**	**30**	**41**	**04**	**22**	**03**	**0-16**	**No**
Karim T et al (2010)	**03**	**45**	**29**	**53**	**11**	**07**	**-**	**0-12**	**No**
Joshi SR et al (2013)	**05**	**156**	**16**	**43**	**24.3**	**13.5**	**3.2**	**1-15**	**No**
Kambalimath HV et al (2013)	**10**	**112**	**10.71**	**71.42**	**-**	**15.17**	**2.68**	**0-14**	**No**
Arvind RJ et al (2013)	**04**	**500**	**35**	**24**	**10**	**22**	**09**	**6-16**	**No**
Gupta H et al (2014)	**05**	**35**	**22.8**	**45.7**	**-**	**31.3**	**-**	**0-16**	**No**
Waknis PP et al (2014)	**13**	**38**	**65.7**	**26.3**	**-**	**-**	**7.8**	**0-16**	**No**
Verma S et al (2015)	**02**	**84**	**47.5**	**17.4**	**-**	**-**	**-**	**2-18**	**No**
Srivastava S et al (2016)	**03**	**100**	**34**	**60**	**04**	**-**	**02**	**0-15**	**No**
Rahman T et al (Present study)	**06**	**476**	**56**	**29**	**4**	**11**	**-**	**0-16**	**Yes**

Table 5. DISTRIBUTION OF SKULL VAULT FRACTURES

Age group (in years)	Number of patients with skull vault fracture (number of fractures)	Number of patients without skull vault fractures
<6 (n=22)	16 (21)	6
6-11 (n=78)	8 (9)	70
12-16 (n=91)	9 (11)	82

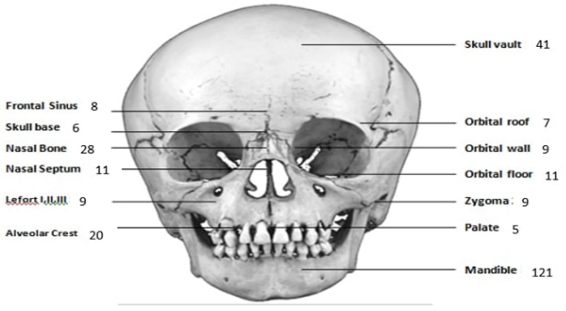

Fig. 1: Sitewise distribution of fractures

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