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British Journal of Oral and Maxillofacial Surgery 57 (2019) 1009–1013

BRITISH Journal of Oral and Maxillofacial Surgery

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Patterns of facial fractures in children

S.R. Khan [a,1], Z.A. Khan [b,*], S. Hanif [a], N. Riaz [a], R.A. Warraich [a]

[a] *Department of Oral & Maxillofacial Surgery King Edward Medical University/Mayo Hospital Lahore, Punjab, Pakistan*
[b] *College of dentistry, University of Jouf, Sakaka 72345, Al Jouf, Saudi Arabia*

Available online 7 September 2019

Abstract

Morbidity and mortality among children is usually the result of trauma. Because a child's face is retruded relative to the protecting skull, has a thicker layer of adipose tissue, more elastic bones, flexible sutures lines, the presence of tooth buds within the jaws, and the lack of pneumatisation of the sinuses, the facial bones fracture less commonly than in adults. Our aim was to assess the patterns of such fractures in children who presented to the department of Oral and Maxillofacial Surgery, King Edward Medical University/Mayo Hospital Lahore, Pakistan. All 535 eligible children between the ages of 1-16 years who presented during the two years December 2009 - December 2011 were included in the study. Facial fractures were diagnosed by clinical examination, plain radiographs, and computed tomography, and the pattern of fractures of the facial bones including the frontal bone, orbital bones, maxilla, zygoma, naso-orbito-ethmoidal complex, mandible, and dentoalveolar region was documented. The male:female ratio was 2:1 with 369 male (70%) and 166 female (31%) patients. Fall was the cause in 212 (39%), and in 167 (31%) it was road traffic accidents, while sports were the cause in 135 (25%). The naso-orboto-ethmoid complex was fractured in 37 cases (7%) while 104 children (19%) presented with isolated fractures of the zygomatic bone. The maxilla was fractured in 195 cases (36%), the mandible in 380 (71%), and dentoalveolar trauma was the cause in 256 (50%). The mandible was the bone that was most often fractured (mostly in boys and usually as a result of falls during summer vacations), with the peak occurring in those aged 8-12 years.
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Keywords: Facial fractures in children; Trauma; Falls; Road traffic accidents; Mandible; Maxilla

Introduction

Morbidity and mortality among children are usually the result of trauma, but the incidence of facial fractures is much lower than that in adults as only about 5%–15% of all facial fractures occur in children.[1,2] The protected location of the face relative to the shielding skull, thicker layer of adipose tissue, more elastic bones, flexible sutures lines, presence of tooth buds within the jaws, and lack of pneumatisation of the sinuses, are some of the reasons that facial fractures are less common than in adults.[2,3] The protected environments under parental supervision also make them less likely to be exposed to the major injuries, occupational trauma, or interpersonal violence that are typical of adult facial fractures.[4]

The most common causes include falls, road traffic accidents, sports-related injuries, and injuries by firearms, while interpersonal violence is rare.[5] In Pakistan in general, and in Lahore in particular, kite-flying on the rooftops of small, multistory houses and tree-climbing are common recreational activities, particularly during vacation periods for school-children. This could be part of the reason for the higher incidence of facial fractures after falls.[5]

Attention to the morphological and physiological state specific to a growing child is required for the diagnosis and management of these fractures, as specialised care is essential to evaluate and treat them accurately.[6,7] Oral and maxillofacial surgeons are trained in the diagnosis, treatment, and management of facial trauma in both adults and children, but

* Corresponding author.
E-mail addresses: shammasraza@yahoo.com (S.R. Khan), dr.zafar.khan@jodent.org (Z.A. Khan), sabaumar14@gmail.com (S. Hanif), drnabeelariaz@yahoo.com (N. Riaz), riazwarraich@yahoo.com (R.A. Warraich).
[1] Present Address: King Salman Specialist Hospital, Hail, Saudi Arabia.

https://doi.org/10.1016/j.bjoms.2019.08.020
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Table 1
Aetiology of trauma and distribution in each sex and age group. Data are number (%).

Cause of fracture	No. (%) of patients	Sex		Age (years)			
		Male	Female	<4	4-8	8-12	12-16
Fall	212 (40)	150 (71)	62 (29)	58 (27)	85 (40)	65 (30)	4 (2)
Road crash	167 (31)	83 (49)	84 (50)	10 (6)	30 (18)	59 (35)	68 (40)
Sports injury	135 (25)	117 (87)	18 (13)	0	5 (4)	61 (45)	69 (51)
Fire-arms	16 (3)	14 (88)	2 (13)	0	2 (13)	4 (25)	10 (62)
Interpersonal violence	5 (0.9)	5 (100)	0	0	0	1 (20)	4 (80)
Total	535 (100)	369 (69)	166 (31)	68 (12)	122 (23)	190 (35)	155 (29)

not all tertiary care hospitals in Pakistan have an operational oral and maxillofacial surgery department.[5,7]

The lack of properly-trained medical staff, the difficulty in taking a history from, and evaluating, an agitated child, the trouble in obtaining plain radiographs of reasonable quality, the overlap of multiple anatomical structures in the small skull, and the presence of other more serious, acute, associated injuries in the rest of the body may add to the difficulty of diagnosis.[7,8]

Limited data are available about the incidence of various patterns of facial fractures among the local population, and this is essential for understanding the causes, severity, and specific characteristics of these fractures. This information is indispensable for preventing potential aesthetic and functional deficits and for improvement in our ability to prevent such injuries.[2,8]

The purpose of the present study was to provide a comprehensive overview of facial fractures in children among the local population to facilitate the identification of the size of the problem in relation to sociodemographic characteristics, so that appropriate preventative measures can be developed and managed.

Patients and methods

This study was done at the department of oral and maxillofacial surgery, King Edward Medical University, Mayo Hospital, Lahore, with the approval of the ethics committee of the Mayo Hospital. All children between the ages of 1-16 years of either sex who presented with facial fractures were included in the study. Verbal and written informed consent for inclusion were given by the parents or guardians. We recorded the age, sex, and address of each patient. Facial fractures were diagnosed by clinical examination, plain radiographs, and computed tomographic scan. The pattern of fractures of the facial bones (including the frontal bone, orbital bones, maxilla, zygoma, naso-orbito-ethmoidal complex, mandible, and dentoalveolar region) was documented.

Analysis of data

Data were analysed using SPSS for Windows (version 11.0, SPSS Inc). Patients were divided into four age groups: less than 4 years, 4 to 8 years, 8 to 12 years, and 12 to 16 years. Analyses were made for each age group and for both sexes. These included aetiology of trauma (falls, road traffic crashes, injuries from firearms, interpersonal violence, or sports); and fractures of the facial bones (including the frontal bone, orbital bone, naso-orbito-ethmoid complex, zygomatic bone, maxilla, mandible, and dentoalveolar area).

Results

Details of patients

A total of 535 children with facial fractures presented to our department during the two-year period from December 2009 to December 2011. The overall male:female ratio was 2:1 with 369 male (69%) and 166 female (31%) patients (Table 1). The aetiology of the fractures is also shown in Table 1.

Site of fracture and bone involved

The distribution of site of fracture and bones involved in each age group and each sex is shown in Table 2.

Distribution of patients/month

The monthly distribution of facial fractures is shown in Table 3. The number of patients with facial fractures was the lowest during January, March, May, and October, and highest during June, July, August, and December, which coincided with the summer and winter vacations, respectively, when there is increased recreational activity among schoolchildren. There was a slightly raised peak in February, which coincided with spring festivals when children actively participate in kite-flying at roof tops of small multistory houses.

Discussion

This study included 535 children with facial fractures who presented to the Mayo Hospital, Lahore, which is the largest tertiary care centre covering the second most populous metropolitan area in Pakistan. It covers numerous, thickly-populated towns, and several vast rural areas of Punjab province, thereby providing a sample that reflects the general

Table 2
Distribution of fractured bones in each sex and age group. Data are number (%).

Fractured bone	Incidence	Sex		Age (years)			
		Male	Female	<4	4-8	8-12	12-16
Frontal bone	35 (7)	33 (94)	2 (6)	0	0	8 (23)	27 (77)
Orbital bone	13 (2)	12 (92)	1 (8)	0	3 (23)	6 (46)	4 (31)
Naso-orbito-ethmoid complex	37 (7)	35 (95)	2 (5)	0	3 (8)	16 (43)	18 (49)
Zygoma	104 (19)	90 (87)	14 (13)	0	1 (1)	2 (20)	82 (79)
Maxilla	195 (36)	101 (52)	94 (48)	0	30 (15)	76 (39)	89 (46)
Mandible	380 (71)	276 (75)	104 (63)	68 (17)	85 (22)	120 (32)	107 (28)
Dentoalveolar	256 (50)	192 (75)	64 (25)	25 (10)	38 (11)	89 (35)	104 (41)

Table 3
Number of patients/month. Data are number of patients.

Month	No.
January	25
February	39
March	25
April	34
May	26
June	70
July	81
August	77
September	35
October	27
November	31
December	65

population. Akhter et al reported a similar study that reported 141 patients in two hospitals in Lahore from September 2003 to December 2005,[5] and Khan et al presented 191 children with facial fractures in a two-year study conducted at a tertiary care hospital in Multan.[2] The reason for the larger number of patients in our study is that the Mayo Hospital is the largest tertiary care centre and caters for more than 100,0000 patients/year with a 40-bed, fully-functional, maxillofacial surgical department, which is the largest of its kind in Pakistan.[9]

Our patients' ages ranged from 2-16 years (mean (SD) 9 (4) years). Kim et al in 2012 analysed the results of 741 children with ages that ranged from 0-18 years, mean (SD) 13 (4) years, with the 13 -15 year age group (36%) being the most often involved.[8] Khan et al reported facial fractures in patients ranging from 1-12 years of age (mean (SD) age 7 (4) years), and oddly, reported that 46% of their affected patients were less than 4 years old, which is an unusual age for facial trauma as at this age most children are supervised by their parents, and is in complete contrast to findings of other such studies (including ours).[2,4,8] The highest number of the patients presenting with PFF in our study (39%) were in the 12-16 years age group, followed by the 8-12 years age group (35%), which is consistent with the findings of several other studies.[3,4,8] The higher incidence of fractures among this age group can be attributed to lifestyle changes developed by children after 12 years of age, which results from increasing participation in social activities or contact sports, together with a higher incidence of assaults and interpersonal violence, and a general reduction in parental supervision.[8,10]

In agreement with several recent studies, we found a male predominance, as boys are more likely to sustain facial fractures because they participate in more physical activities than girls.[2,4,5,8]

The most common cause of trauma was a fall (39%), followed by road traffic crash (31%), while there were 25% of sports-related injuries. Our findings differed from those of previous studies on the subject, which reported that interpersonal violence and road traffic crashes were the most common aetiological factor.[8,11,12]

The patients' characteristics, aetiology, presentation, and monthly distribution of facial fractures differ among countries, and such differences are influenced by social, educational, and cultural factors.[8]

We found that the mandible was the most commonly-fractured bone as 71% of children had mandibular fractures. A total of 50% had dentoalveolar trauma, making it the second most common cause. These finding are comparable with several other studies on the subject – for example, Khan et al reported 30% of patients with mandibular fractures and 20% with dentoalveolar fractures among their sample.[2] Akhter et al reported 50% dentoalveolar fractures and 45% mandibular fractures among their sample.[4] Kim et al in 2012 reported nasal bone fractures to be the most common among all fractures of the facial bones, accounting for 69%.[8] This was in complete contrast to our findings, and those of several other such studies from across the world.[2–5,13] The reason for this contrast is that the most common cause of injury cited among Korean children was violence. Nasal bones are the least resistant in the facial skeleton, and the relative prominence and delicacy of the nose makes it most likely to be injured in older children, particularly during fist-fights.[1,13] Our results showed that the mandible was the most commonly-fractured bone, as it is the most vulnerable part of the body of a falling child.[7]

We found that the monthly distribution of facial fractures in children peaked during summer and winter vacations, while the fewest were recorded during January (n = 25), March (n = 25), May (n = 26), and October (n = 27). Our findings were in complete contrast with the results of previous studies that reported a drop in the number of facial fractures during the summer and winter vacations among Korean

children.[8],[13],[14] This variation could be attributed to the schedule of exams in the months of January, March, May, and October in our population, when school children have the fewest outdoor activities. The peaks in the incidence of facial fractures are recorded during the summer and winter vacations, because there is increased recreational activity among school-going children. A slightly higher peak was recorded during February (n = 39), which coincided with spring festivals when children participate in kite-flying at roof tops of small multistory houses. This finding is particularly relevant considering the recent decision of the government to lift the 12-year ban on flying kites.[15] The festival was previously banned by the Supreme Court of Pakistan in 2005, following reports of 19 deaths and numerous injuries caused during the kite-flying festival.[16] To the best of our knowledge maxillofacial trauma among children associated with kite-flying is under-reported as most of the patients who present with facial injuries during this season attribute them to causes such as falls, traffic crashes, and interpersonal violence.[5,17]

Road traffic crashes (31%) were the second most common cause of facial fractures in the present study. Motorcycles are an important and common means of transportation and make up about two-thirds of the country's registered vehicles.[18] Road crashes in Pakistan are the second leading cause of disability, and motorcyclists (particularly pillion passengers) are the most vulnerable road users as they have poor safety records when compared with those of other road users.[19] The use of motorcycles by children (as drivers or pillion passengers) is common in developing countries such as Pakistan, and is considered to be the main cause of their mortality and morbidity. Children as young as 2-3 days old in developing countries are highly exposed to motorcycles even as pillion passengers. In most developing countries, infants are often carried on motorcycles, by the driver or another passenger. Some who are about a year old sit in front of the driver, but some sit or stand between the driver and the passenger. This makes them highly vulnerable to injuries during accidents as almost all child motorcycle passengers do not have helmets.[20] Bhatti et al in 2018 reported that the number of riders who wore helmets was below average in those aged < 18 years (1%). They reported that helmet-wearing was comparatively less common by pillion riders, women, and children.[21] Helmet use significantly decreases the risk of head and facial injuries.[22]

In the light of these figures, we highlight the following recommendation based on the World Health Organization Report on Child Development and Motorcycle Safety (2015),[20] and propose that it should be implemented by the government to reduce the burden of disease and injury in our country.

- Infants, toddlers, and children under 6 years must not be allowed on motorcycles.
- Children under 15 years must not be allowed to drive a motorcycle.
- Children must wear crash helmets when being carried on a motorcycle.
- A child pillion passenger must wear his or her own standardised crash helmet, which fits the head, face, the whole lower jaw, and particularly the chin.
- New driving education and skill development training programmes should be designed to increase knowledge in safe driving, hazard perception, and management of specific age groups (young drivers such as 13 to 15 years, and 16 to 18 years).

Special attention to the morphological and physiological factors that are specific to a growing child is needed for proper management of facial fractures, as specialised care is required to evaluate and treat these injuries properly.[6] In Pakistan many tertiary care hospitals lack an operational oral and maxillofacial surgery department to provide emergency care.[7] These fractures are difficult to diagnose and evaluation, and history taking from an agitated child is problematic. It is also difficult to obtain plain radiographs of good quality as multiple anatomical structures overlap in a growing skull.[23] The treatment and management of these fractures require multiple hospital admissions and costly equipment (including titanium or absorbable plating systems) the cost of which increases with the number of plates and screws being used in each individual case.[24]

Not all patients are able to afford such expensive equipment and may opt for conservative and compromised options. Most of these patients are uneducated, lack self-awareness, have little if any money, and limited access to concerned professional health workers and trained specialists. This may lead to mismanagement, which can translate into late complications including facial deformity as a result of aberrant growth and ankylosis of the temporomandibular joint.[7,25]

Conclusion

The results of this study will help to identify the current magnitude of the problem in relation to the sociodemographic characteristics of our population. Appropriate preventive measures including continuation and reimplementation of the ban on roof-top kite flying, construction of protective railings on the roofs of small multistory houses, and encouragement of kite flying in public parks are recommended. Parents are also advised to provide protection to their children while driving a motor vehicle by always keeping them in the rear-seats strapped comfortably in seatbelts, child-seats, and helmets when on motorbikes or bicycles. All children should be supervised by their parents or guardians particularly during their vacations when there is increased recreational activity and higher risk of, and greater exposure to, trauma. To reduce the burden of disease and injury among children, governments should play a stronger role in preventing facial fractures in children. Promotion of unhealthy types of behaviour or lifestyle among children and adolescents by the media should be

discouraged and prohibited. There is a need to establish an oral and maxillofacial surgery department in all tertiary care hospitals across the country to provide correct and timely treatment for such patients.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients' permission

This study was conducted at Oral and Maxillofacial Surgery Department, King Edward Medical University/Mayo Hospital, Lahore, with the approval of the ethics committee. Informed consent was obtained from the patients or guardians.

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