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Incidence and pattern of maxillofacial fractures in children and adolescents: A 10 years retrospective cohort study

Hai-Hua Zhou [a,b], David Ongodia [a,b], Qi Liu [a,b], Rong-Tao Yang [a,b], Zu-Bing Li [a,b,*]

[a] The State Key Laboratory Breeding Base of Basic Science of Stomatology (Hubei-MOST) & Key Laboratory of Oral Biomedicine Ministry of Education, School & Hospital of Stomatology, Wuhan University, Wuhan, Hubei, People's Republic of China
[b] Department of Oral and Maxillofacial Surgery, College and Hospital of Stomatology, Wuhan University, Wuhan, Hubei, People's Republic of China

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ABSTRACT

Objective: The purpose of this study was to evaluate and compare the demographic characteristics of maxillofacial fractures between children and adolescents.
Methods: The sample was composed of all children (less than 12 years) and adolescents (between 13 and 18 years old) who presented with maxillofacial fractures during a 10-year period (2000–2009). The age, gender, time of injury, mechanism of trauma, location and pattern of fracture, associated injuries, and treatment methods were recorded and analyzed. Data analysis included Chi-Square test, Fisher exact test. p less than 0.05 was considered significant.
Results: Seventy-nine children (male-to-female ratio, 1.63:1) and 113 adolescents (male-to-female ratio, 3.52:1) sustained 389 maxillofacial fractures. Children were more involved in falls compared to adolescents (44.3% versus 23.9%, $p = 0.003$), while adolescents sustained more assault-related injuries (13.3% versus 2.5%, $p = 0.010$) and motorcycle accidents (22.1% versus 8.9%, $p = 0.015$) compared to children. Children suffered mandibular fractures proportionally higher than adolescents (93.1% versus 64.5%, $p < 0.001$). Adolescents sustained mid-facial fractures more frequently than children (35.5% versus 6.9%, $p < 0.001$). Severe facial fractures occurred more in adolescents compared to children (35.4% versus 14.1%, $p = 0.001$). Open reduction was done more in adolescents than in children (92.3% versus 74.6%, $p < 0.001$).
Conclusions: The incidence and pattern of maxillofacial fractures in children were remarkably different from that in adolescents. Preventive measures and treatment plan should be designed with differences between the two groups in mind.

1. Introduction

Pediatric maxillofacial trauma differs from that in adults, because of the facial growth. The high ratio of crania-to-body and crania-to-face, the incomplete pneumatization of the facial sinuses, un-erupted teeth in maxillary arch and resiliency of the skeleton and sutures, are all responsible for the less frequency of facial fractures; especially the mid-facial area [1–10]. More force is needed to produce a pediatric facial fracture [1,11]. Under these circumstances, children who sustain maxillofacial fractures are more likely to also sustain cranio-cerebral injury and soft tissue or general organ trauma [11–14].

After puberty (adolescence period), majority of the facial sinuses or frontal sinuses attain full size, and most of the permanent teeth will have erupted thus leading to a reduced resiliency of bone [1,2,4,12]. In addition, the less supervision by parents and boisterous behavior by the adolescents [5,7,15], predisposes them to maxillofacial fractures [16–18]. The fracture pattern thereafter is similar to that in adults [5,9]. The eruption of wisdom teeth in the mandible at about 18 to 24 years of age (after adolescence), has highly been associated with increasing risk of mandibular angle fractures, while simultaneously reducing the risk of condylar fractures [19,20].

There is also lack of a common agreement on the precise meaning of the term "adolescent"; Rocchi et al. [18] thought that adolescence can be defined as the period of transition from a child to the social status of an adult.

Facial fractures in children are usually treated by non-surgical approach in the form of maxillo-mandibular fixation (MMF) [7]. However, primary and early mixed dentition has numerous anatomic challenges associated with MMF procedures [2,21,22].

* Corresponding author at: Department of Oral and Maxillofacial Surgery, College and Hospital of Stomatology, Wuhan University, 237 Luoyu Road, Wuhan 430079, People's Republic of China. Tel.: +86 27 87686215; fax: +86 27 87873260.
E-mail address: lizubing0827@163.com (Z.-B. Li).

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The traditional MMF technique is difficult in children, because of the short crowns and resorbed roots in primary teeth, the presence of partially erupted permanent teeth [7]. However, the treatment of facial fractures in adolescents is still controversial.

Based on the above background, we assumed that the incidence, pattern and treatment of facial fractures in children were different from that in adolescents. To address this problem, we did a retrospective cohort study, with the aim of establishing the distinction in facial trauma between children and adolescents. This will give a valuable insight into preventive and treatment interventions.

2. Patients and methods

The Institutional Review Board of Wuhan University approved the protocol, survey and consent forms. Records of 79 children (less than 12 years) and 113 adolescents (between 13 and 18 years old) were retrieved for the period January 2000 to December 2009. Data about age, gender, date of injury, mechanism of trauma, location and pattern of fracture, associated injuries, and treatment methods were recorded and analyzed.

Causes of injury were classified into seven categories: assault-related injuries, bicycle-related accidents, motor vehicle accidents, motorcycle accidents, falls, sports-related accidents, and others.

Mandibular fractures were classified as: condylar, symphysis, body, angle, ramus, coronoid, and alveolar fractures. Mid-facial fractures included zygomatic complex fracture (ZCF), zygomatic arch, Le Fort I/II/III, sagittal, nasal-orbital-ethmoid (NOE), ethmoid, maxilla, palate and alveolar fractures; Upper third facial fractures (fracture of frontal bone). The associated fractures were classified as skull, thoracic cervical, vertebra, pelvis, extremity, and abdominal injuries.

Treatment methods were recorded as closed treatment, open reduction and mixed treatment.

Statistical analysis was performed with SPSS software (version 16.0; SPSS, Chicago, IL). The continuous variables were reported as the mean $\pm$ SD and were assessed by t-test. The Chi-Square test was used to analyze and compare the categoric variables. The Fisher exact was carried out when any cell of the 2×2 table less than 5. Probabilities of p less than 0.05 were considered significantly different.

3. Results

Table 1 shows the distribution of children or adolescents according to season. Both children and adolescents suffered most maxillofacial injuries during summer and autumn.

Table 2 shows the gender distribution; statistical analysis revealed that male adolescents were more frequently injured compared to male children (77.9% versus 62.0%, $p = 0.017$), while female children were more frequently injured compared to female adolescents (38.0% versus 22.1%, $p = 0.017$). The male: female ratio was 1.63:1 in children, while the ratio increased to 3.52:1 in adolescents.

Table 3 shows the distribution of trauma mechanism in children and adolescents. Children were more involved in falls compared to adolescents (44.3% versus 23.9%, $p = 0.003$), while adolescents were more involved in assault-related injuries (13.3% versus 2.5%, $p = 0.010$) and motorcycle accidents (22.1% versus 8.9%, $p = 0.015$). Road traffic accidents was the most frequent etiology for both children (37 of 79, 46.8%) and adolescents (61 of 113, 54.0%).

Table 4 shows that more than half of mandibular fractures involved the condyle in both children (55.4%) and adolescents (53.3%). Statistical comparison indicated there was no proportional difference in the type of mandibular fractures between children and adolescents.

Table 5 shows the distribution of facial (mid- and upper third-face) and associated fractures between children and adolescents. It is worth noting that only 9 mid-face fractures occurred in children. For adolescents, ZCF and zygomatic arch fractures accounted for most of the facial fractures (39.1%), followed by maxillary (25.0%), and orbital fractures (21.7%). As far as associated general injuries were concerned, skull fractures accounted for 33.3% in children and 31.6% in adolescents.

A notable finding was that majority of the fractures (93.1%) in children were of the mandible, as compared to 6.9% mid-facial fractures; meanwhile, 35.5% mid-facial fractures were sustained by adolescents. Statistical analysis revealed a significant difference in the distribution of mid-facial fractures between children and adolescents ($p < 0.001$, Table 6).

Table 7 shows the severity of the fractures; data analysis revealed that single fractures occurred more frequently in children compared to adolescents ($p = 0.021$). Severe fractures were more in adolescents compared to children ($p = 0.001$).

Most of the fractures were managed surgically both in children (74.6%) and adolescents (92.3%). However, closed treatment was performed more frequently in children compared to adolescents ($p < 0.001$), while open reduction was performed more in adolescents than in children ($p < 0.001$) (Table 8).

The average number of maxillofacial fractures in children or adolescents was analyzed and compared, statistical analysis revealed a significant difference between them (children, 1.63 ± 0.72; adolescents, 2.29 ± 1.31, $p < 0.001$), adolescents patients sustained the serious injuries more frequently than children patients.

4. Discussion

According to previous study [23], the mandible and maxilla differ from the trunk bones who most susceptible to osteoporotic

Table 1
Distribution of patients by season.

Season	Children	Adolescents	Total	p value
Spring	20 (25.3%)	18 (15.9%)	38 (19.8%)	0.108
Summer	23 (29.1%)	35 (31.0%)	58 (30.2%)	0.782
Autumn	22 (27.8%)	37 (32.7%)	59 (30.7%)	0.469
Winter	14 (17.7%)	23 (20.4%)	37 (19.3%)	0.649
Total	79 (100.0%)	113 (100.0%)	192 (100.0%)	

Table 2
Gender distribution and ratio.

Gender	Children	Adolescents	Total	p value
Male	49 (62.0%)	88 (77.9%)	137 (71.4%)	0.017
Female	30 (38.0%)	25 (22.1%)	55 (28.6%)	0.017
Total	79 (100.0%)	113 (100.0%)	192 (100.0%)	
Male:female ratio	1.63:1	3.52:1	2.49:1	

Table 3
Etiology of the fractures.

Etiology	Children	Adolescents	Total	p value
Assault	2 (2.5%)	15 (13.3%)	17 (8.9%)	0.010
Bicycle	12 (15.2%)	12 (10.6%)	24 (12.5%)	0.346
Motor vehicle	18 (22.8%)	24 (21.2%)	42 (21.9%)	0.799
Motorcycle	7 (8.9%)	25 (22.1%)	32 (16.7%)	0.015
Falls	35 (44.3%)	27 (23.9%)	62 (32.3%)	0.003
Sports	–	5 (4.4%)	5 (2.6%)	0.079
Others	5 (6.3%)	5 (4.4%)	10 (5.2%)	0.743
Total	79 (100.0%)	113 (100.0%)	192 (100.0%)	