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The Egyptian Journal of Otolaryngology (2022) 38:168
https://doi.org/10.1186/s43163-022-00354-3

The Egyptian Journal of Otolaryngology

ORIGINAL ARTICLE Open Access

Pediatric versus adult maxillofacial fractures

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Abstract

Objective: To study, compare, and analyze the differences and the detailed features of the maxillofacial fractures in adults versus children.

Patients and methods: This prospective comparative study was conducted on patients who had traumatic maxillofacial fractures. Patients were categorized into 2 groups: the pediatric group and the adult group. History taking including the type of trauma, examination, computed tomography (CT) maxillofacial, fracture management, and outcome evaluation was done for all patients.

Results: Within included 82 patients (42 adults, 40 children), males were the most affected in adult and pediatric groups and the most affected age was between 19 and 27 years (29.2%). Motor vehicle accident (MVA) was the most common cause in both the adult group (66.66%) and the pediatric group (60%). But fall represents a significant cause in children (17.5%) with a significant difference between the two groups ($p = 0.038$). The mandibular fracture was the most common fracture in pediatric (65%) and adult (38.1%) groups with a significant difference between both groups regarding different sites of trauma ($p = 0.017$). Surgical intervention was performed in 80% of pediatric patients and 92.23% with a significant difference ($p = 0.035$).

Conclusion: MVA is the main etiology of maxillofacial fractures in children and adults, but fall is an important cause of pediatric trauma. Pediatric maxillofacial fractures below school age are a rare event with increasing incidence with age. Mandibular fractures are the most common site in the adult and pediatric populations. Most cases of maxillofacial fractures are surgically treated with OR/IF with good results but conservative management is used more in pediatric than adult fractures.

Keywords: Maxillofacial fracture, Pediatric, Adult, Trauma, OR/IF, Mandible

Background

Because the face is the most prominent human body part, maxillofacial insults are common in traumatized patients. The existence of vital organs such as eyes, sinuses, and ears and the potentiality for airway blockage mandate thorough recognition of the maxillofacial injuries [1, 2].

Children differ from adults in their anatomic and physiologic makeup and hence demand a different guideline set. Because the facial skeleton would be in the growing period, great care should be taken to early management. Factors like the greater flexibility of bones, underdeveloped sinuses, un-erupted teeth, the presence of a protective fat pad, and less engagement in a high-velocity motor vehicle accident (MVA) make children less prone to injury [2, 3]. There are numerous challenges during handling pediatric fractures such as developing bones, dental eruptions, roots of deciduous, and difficulties in the application of the rigid maxillomandibular fixation (MMF) [4]. Hence, pediatric maxillofacial fractures pose a special challenge to maxillofacial surgeons. There is also the appearance of new effective trends in maxillofacial fracture repair [5] and new maxillofacial classifications [6] that need to be compared between children and adults. Therefore, detailed knowledge regarding

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the difference between pediatric and adult maxillofacial trauma and fractures is extremely important.

So, the aim of the current study was to compare between pediatric and adult maxillofacial fractures including the prevalence, epidemiology, site, pattern, treatment, and outcome.

Methods

The current prospective study took place in the otorhinolaryngology, head and neck surgery department on patients who had traumatic maxillofacial fractures of various types in the period from February 2017 to July 2020. Neglected fractures, infected fractures, and pathological fracture patients who refused to share in the study were excluded. Informed written consents were obtained from the patients or their parents (if patients< 18 years old) and approval from the Zagazig University review board (IRB) was taken.

Patients were categorized into 2 groups: the pediatric group, including patients less than 18 years old, and the adult group, including patients ≥ 18 years old. Assessment of the patients includes history taking including the type of trauma; examination; computed tomography (CT) maxillofacial; axial, coronal, and 3D; type of management; and outcome. The data was collected, recorded, tabulated, and analyzed. Then, we compared between pediatric and adult maxillofacial fractures including the prevalence, epidemiology, site, pattern, treatment, and outcome.

Surgical intervention was open reduction and internal fixation (OR/IF). When there are mandibular fractures other than condylar and/or subcondylar fracture, manual MMF was used intraoperatively with an immediate mandibular release [7, 8], while in the presence of condylar and/or subcondylar fracture, rigid MMF was used during OR/IF that was released 2 to 4 weeks postoperative [7, 8].

Follow-up for all patients was conducted weekly for a month then at 3 months, 6 months, and 1 year postoperatively assessing the healing, functional results, and complication.

Statistics evaluation was done by SPSS 17 statistics software for Windows (SPSS Inc, Chicago, IL). $p < 0.05$ was set as the significance level.

Result

From 174 patients who presented to the Otolaryngology and Emergency departments, 82 patients met the inclusion and exclusion criteria and accepted to share their data. Pediatric patients (< 18 years old) were 40 (47.5%) patients and adult patients (> 18 years old) were 42 (52.5%) patients.

Patients below 10 years were 12 (14.6%), patients between 10 and 17 years were 28 (34.1%), patients between 19 and 27 years were 24 (29.2%), patients between 27 and 60 years were 18 (21.9%), and no patients were above 60 years. There was no affected patient below 6 years (school age), and patients below 10 years were the least affected subdivision (14.6%). Males were the most affected in adult and pediatric groups. In adults, males were 42 (100%) and in the pediatric group, males were 38 (95%), while only two females were affected in the pediatric group and there was no detected female case in the adult group ($p = 0.142$). So, both groups were matched as regards gender distribution.

Motor vehicle accident (MVA) was the most common cause of maxillofacial fractures in both adult group 28 (66.66%) and pediatric group 24 (60%). But violence increased in adults more than the pediatric group as it was in adult group 12 (28.57%) and pediatric group 8 (20%), while fall in the pediatric group is one of the important causes of maxillofacial fractures in pediatric group 7 (17.5%) with a significant difference between the two groups regarding the cause of trauma ($p = 0.038$).

The mandibular fracture was the most common fracture in pediatric and adult groups: in the pediatric group, it was 26 (65%) while in the adult group it was 16 (38.1%). The zygomaticomaxillary complex (ZMC) fracture was less common in the pediatric group 11 (27.5%) while in the adult group, it was 14 (33.3%). The frontal bone fracture was the least common in the pediatric group 3 (7.5%) while in the adult group it was 12 (28.6%). There was a significant difference between the pediatric and adult groups regarding different sites of trauma ($p = 0.017$) (Table 1, Fig. 1).

A single fracture was detected in 34 (81%) of adult patients and in 34 (85%) of pediatric patients, while multiple fractures were detected in 8 (19%) of adult patients and 6 (15%) of pediatric patients without significant difference between the two groups ($p = 0.62638$).

As regards associated fractures other than the maxillofacial fractures, in the pediatric group, there were 2 (5%) patients with a humerus fracture, 2 (5%) patients with a coronoid fracture, 2 (5%) patients with a tibial fracture, and 4 (10%) patients with an ulnar fracture. In the adult group, there were 2 (4.8%) patients with a tibial fracture and 4 (9.5%) with an ulnar fracture without a significant difference (p=0.36).

In the pediatric group, 8 (20%) of patients need conservative measures while in the adult group, only 2 patients (4.76%) need conservative measures. In the pediatric group, surgical intervention was performed for 32 (80%) of the patients while in the adult group, 40 (95.23%) of patients had surgical intervention with a significant difference ($p = 0.035$) (Table 1, Fig. 1).

The reported complication in the pediatric group was 2 patients who had an unsatisfactory scar, while no

Table 1 Comparison between pediatric and adult groups

Variables		Pediatric patients	Adult patients	*p* value
Gender	**Males**	38 (95%)	42 (100%)	0.142 NS (X^2=2.153)
	Females	2 (5%)	0 (0%)	
Age	**Range (years)**	6–17	19–60	
Types of fractures	**Mandibular**	26 (65%)	16 (38.1%)	0.017 S (X^2= 8.097)
	ZMC	11 (27.5%)	14 (33.3%)	
	Frontal	3 (7.5%)	12 (28.6%)	
Multiplicity of the fracture	**Single**	34 (85%)	34 (81%)	0.62638 NS (X^2= 0.237)
	Multiple	6 (15%)	8 (19%)	
Causes of trauma	**Motor vehicle accidents**	24 (60%)	28 (66.7%)	0.038 S (X^2= 8.397)
	Violence	8 (20%)	12 (28.6%)	
	Sports	1 (2.5%)	2 (4.7%)	
	Falls	7 (17.5%)	0	
Associated fractures	**Humerus fracture**	2 (5%)	0	0.36 NS (X^2= 3.2)
	Coronoid fracture	2 (5%)	0	
	Tibial fracture	2 (5%)	2	
	Ulnar fracture	4 (10%)	4	
	Total	10 (25%)	6 (14.3%)	
Management	**Conservative**	8 (20%)	2 (4.76%)	0.035 S (X^2= 4.443)
	Surgical	32 (80%)	40 (95.23%)	

X^2 chi-square test, *NS* non-significant

complications were reported in the adult group without a significant difference between both groups ($p = 0.152$). No other complications were detected such as dental malocclusion, infected wound, malar asymmetry, enophthalmos, or bone depression.

Discussion

Traumatic maxillofacial fractures appear to be less frequent and different in the pediatric than in the adult population, because of multiple elements such as the difference in the constitution of bones, more tissue elasticity, incomplete ossification in children (Chocron et al., 2019), small-sized bones, developing paranasal sinuses, the existence of growth centers, faster healing period, and possible presence of developing teeth germs [9].

Few studies compare between the maxillofacial fractures in adult and pediatric patients and most of these studies are retrospective [3, 10–12] and some lack the management of those patients [3, 12].

So, we studied the comparison between adult versus pediatric maxillofacial fractures in a prospective study including the management data.

In the current study, below school age (6 years), no maxillofacial fracture patients were detected. In accordance, it is estimated that < 1% of the maxillofacial trauma occur in children < 5 years old [2]. In addition, in the present study, no maxillofacial fracture was reported in patients above 60 years. This could be attributed to the limited mobility of children below skull age and patients above 60 years)retirement age) that limits their trauma.

As previously reported in the literature [1, 2, 4], in the current study, males were the main gender affected by maxillofacial fractures with high percent (95% in children and 100% in adults).

The mandibular fracture was the most commonly reported fracture in both adults and children, but there was a significantly highest incidence of mandibular fractures that occurred in children (65%) versus 38% in adults. The mandibular fracture was also the most common in agreement with most previous studies [9, 11, 13–15].

The cause of trauma was significantly different between adult and pediatric. In spite of that MVA is the most common cause of trauma in both adults and children, fall was the cause in 17.5% of the pediatric group and was not reported as a cause in the adult group (Table 1). Near results were also detected by Atilgan et al. [16] and Arvind et al. [13], while Jung et al. [17] and Bharadwaj [18] found that fall was the most common cause.

These etiological pattern changes differ from region to region and may be due to socioeconomic problems, social habits, the stresses of residing in large or crowded cities, etc. But the results here reflect the important extra care of preventing and care of risk of fall in children.

Surgical treatment was the main used treatment in both groups, and this may be attributed that this

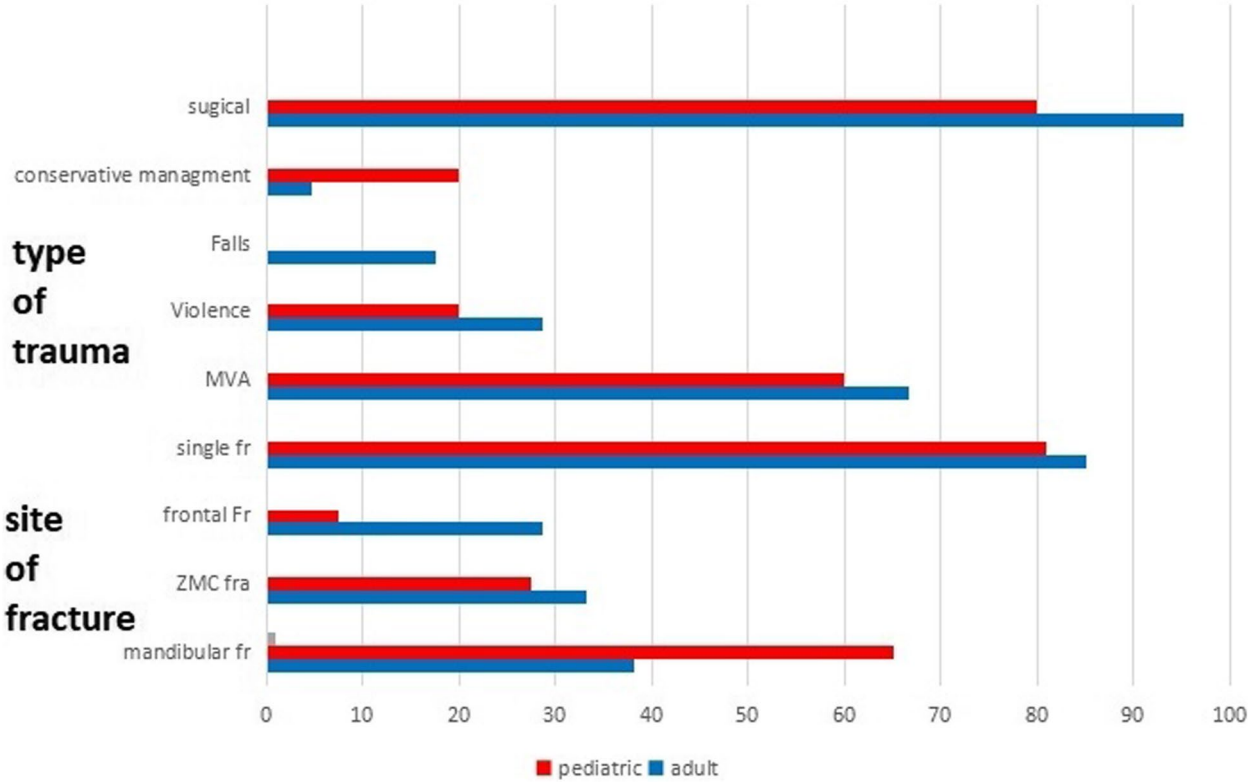

Fig. 1 The chart showed the difference between adult and pediatric maxillofacial fractures

research was done in a tertiary hospital and so many cases were treated conservatively at the primary and secondary care hospitals and health facilities. On the other hand, maxillofacial fractures were treated conservatively more in children (20%) than in adults (4.76%). Near results were reported by Iatrou et al. [12] reported.

In the present study, OR/IF was the main operative intervention. Similarly, Daniels et al. [10] documented that OR/IF was the main treatment modality in 69.2% of patients.

We agree with Bansal et al. [19] that in pediatric patients, although closed treatment could be preferred, as it preserves the soft tissue and periosteum, displaced fractures especially with co-existing condylar fractures should be treated by OR/IF.

The basic principle of fracture treatment is reduction, fixation, immobilization, prevention of infection, and rehabilitation, with the least disability and smallest risk for the patient [3, 4]. Thus, whenever there is a displaced fracture, today, OR/IF is the standard management [4, 7].

Conclusion

Pediatric maxillofacial fractures became common nowadays in comparison to adults. Even though MVA is the main etiology in children and adults, fall is an important cause of trauma in children. Pediatric maxillofacial fractures below school age are a rare event with increasing incidence with age. Mandibular fractures are the most common site in the adult and pediatric populations. ZMC is the second common site in the pediatric group while in adults ZMC and frontal fractures are similar. Most cases of maxillofacial fractures are surgically treated with OR/IF with good results but the pediatric group shows more incidence of conservative management than adults.

Abbreviations

CT: Computed tomography; MMF: Maxillomandibular fixation; OR/IF: Open reduction and internal fixation; MVA: Motor vehicle accident.

Acknowledgements

None.

Authors' contributions
MWE suggested and developed the research idea; reviewed the literature; did the surgery, interpretation, and analysis of the collected data; tabulated the data; wrote the manuscript; assisted in preparing the tables; and approved the submitted version. EE modified the research idea, interpretation, and analysis of the collected data; assisted in writing methods and revising the written manuscript; prepared the tables; and approved the submitted version. AW reviewed the written manuscript, assisted in preparing tables, revised the manuscript critically for important intellectual content, and approved the submitted version. AME reviewed the literature, prepared the patient for surgery, followed up the patient, collected patient data, assisted in preparing the tables, and approved the submitted version. MAE assisted in surgery, data analysis, and interpretation; reviewed the written manuscript; assisted in preparing tables; revised the manuscript critically for important intellectual content; and approved the submitted version. All authors have read and approved the final manuscript.

Funding
The authors declare no financial support or interest to this study.

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Informed written consents were obtained from the patients or their parents to share in the study after explanation of its purposes. Zagazig University Hospitals IRB approval was obtained.

Consent for publication
The patients included in this research gave written informed consent to publish the data contained within this study. If patients were less than 16 years old, their relative signed the consent.

Competing interests
The authors declare that they have no competing interests.

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Received: 22 October 2022 Accepted: 5 November 2022
Published online: 19 December 2022

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