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Maxillofacial Fracture Types and their Management in 3- to 18-year-old Individuals Referred to Shariati Hospital, Tehran, Iran

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A B S T R A C T

Objectives: This study was performed to find the most common types of maxillofacial fractures and their management in 3 to 18-year-old individuals referred to the Department of Oral and Maxillofacial Surgery at Shariati Hospital in Tehran, during a 9-year period.

Materials and Methods: This retrospective study evaluated the records of 319 patients with maxillofacial fractures between 2012-2020, ranging in age from 3 to 18 years. Data regarding the etiology and location of the fracture, age, gender, and treatment approach were retrieved from the archival records and analyzed.

Results: A total of 319 patients were included in the study, out of which, 255 (79.9%) were males and 64 (20.1%) were females. Motor-vehicle accidents were the most common cause of trauma (N=124, 38.9%). We recorded 605 fractures and among them, the parasymphysis (N=131, 21.6%) was the most common site of isolated fractures. Type of treatment varied depending on the fracture type and degree of displacement of the broken segments. It consisted of open reduction and internal fixation, and closed reduction procedures, which included the use of arch bars, ivy loops, lingual splints, and circummandibular wirings.

Conclusion: Analysis of the results revealed that the severity of injury increased with age. Older individuals had higher a number of fracture sites and experienced greater displacement of the broken segments.

Keywords: Maxillofacial Injuries; Mandibular Fracture; Maxillary Fracture; Athletic Injuries

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INTRODUCTION

The head and the face are respectively the first and fourth most common sites of trauma in humans; however, the face is known to suffer the highest rate of injuries. In 2016, the rate of morbidity and mortality due to head and face trauma in children was reportedly 3.74% and 3.07%, respectively [1-3]. Although the majority of head and face injuries in children are incidental, some cases of child abuse have also been reported causing fracture in these areas, accounting for 2.3% of all morbidities and mortalities in children due to head and face trauma [4,5].

Head and face trauma in children often leads to soft tissue and dentoalveolar injuries. Head and neck fractures are less frequent in children than adults [2]. Although only 15% of all facial fractures occur in children, their occurrence often leads to mortality or disabilities that impair the routine daily activities and impose high costs on the family and the community [6,7].

Despite the higher frequency of facial trauma

in children compared with adults, a smaller percentage of this age group suffer from facial fractures, which can be due to incomplete mineralization of the facial skeleton, greater buccal fat volume, and less pneumatization of the sinus in children. Due to the abovementioned factors, the facial skeleton in children absorbs the energy of impact without causing fracture. In case of fracture, it would be commonly in the form of greenstick fracture [8].

Head and face fractures in children can be divided into different groups depending on the age and developmental stage of the child, and the fracture pattern. In the age range of 0 to 18 years, males are more commonly affected by facial fractures compared to females, and the frequency of fracture goes up with increasing age [6]. Children between the ages of 0 to 5 years have the lowest rate of facial fractures, probably because they are supervised most of the time. Fractures in this age group often occur in the process of routine daily activities. On the other hand, children between 6 to 11 years have the second rank in terms of frequency of facial fractures; fractures in this age group mainly occur due to motor-vehicle accidents, playing, and cycling. Facial fractures more commonly occur in teenagers (12 to 18 years of age). In this age range, teenagers become more self-sufficient and start driving and take part in team sports. Fractures in this age group often occur as the result of violence in sport activities [9].

Facial trauma and fractures in developing children can have adverse long-term consequences in children and their families. Thus, correct diagnosis and early treatment are of utmost importance. Ignoring facial fractures in developing children can cause facial asymmetry [10]. Due to the relatively low prevalence of facial fractures in children, literature is not rich in this respect, and further studies are required for more accurate classification of such injuries, finding techniques to improve the long-term treatment outcome, and establishing preventive safety measures in this regard.

Shariati Hospital is one of the largest hospitals located in downtown Tehran, Iran. Its Oral and Maxillofacial Surgery Department is among the most equipped departments in the country. Patients of different age groups suffering from maxillofacial injuries are referred to this hospital. In this study, we aimed to investigate maxillofacial fractures, and their causes and treatments in children and teenagers.

MATERIALS AND METHODS

This retrospective study evaluated 319 records of patients with maxillofacial fractures treated in Shariati Hospital between 2012 and 2020. The inclusion criteria consisted of an age range between 3 to 18 years along with a history of maxillofacial trauma and subsequent fracture as the chief complaint. The patients were divided into three age groups of 3 to 7, 8 to 12, and 13 to 18 years. This study only assessed fractures, and individuals with soft tissue injuries were excluded. In patients with maxillary fractures, only the nasal, zygomatic arch, and the zygomaticomaxillary complex (ZMC) fractures were evaluated. Patients with skull fractures, dentoalveolar fractures, and facial burns were excluded. Age, gender, cause of fracture, site of fracture, and type of treatment were extracted from patient records and analyzed.

The study protocol was approved by the ethics committee of Tehran University of Medical Sciences (IR.TUMS.SENTISTRY.REC.1398.132).

RESULTS

A total of 605 fractures were recorded in 319 patients evaluated in the present study.

Age and gender:

In the current study, the mean age of patients was 14.4 years. Only 20% of maxillofacial fractures had occurred in children younger than 7 years. Individuals between 8-12 years and 13-18 years had the highest rate of fractures. Of all, 255 (79.9%) of the affected patients were males and 64 (20.1%) were females. When considering all age groups, males had a higher frequency of fractures (Table 1).

Table 1. Gender distribution among 3 to 18-year-old patients with maxillofacial fractures refereed to Shariati Hospital, Tehran, Iran

Age (y)	Male	Female	Total
3-7	12 (60%)	8 (40%)	20
8-12	35 (70%)	15 (30%)	50
13-18	208 (83.5%)	41 (16.5%)	249
Total	255	64	319

Etiology:

Motor-vehicle accidents were the most common cause of fractures (38.9%) followed by falls from height (32.9%). These two causes accounted for approximately 72% of all fractures. Other causes included impact injury (19.7%) and street fights (8.5%). With an increase in age, the etiology of fractures shifted to motor-vehicle accidents and street fights.

Falls from height were the most common cause of fracture in the age group of 3 to 7 years (65%) and 8 to 12 years (54%). Road accidents were the most common cause of fracture in 13- to 18-year-olds (42.6%).

Fracture types:

Fracture of the parasymphysis had the highest frequency (N=131, 21.6%) followed by the body of mandible (N=125, 20.6%), subcondylar region (N=99, 16.3%), angle of mandible (N=93, 15.3%), ZMC (N=62, 10.2%), condylar head (N=37, 6.1%), nasal bone (N=24, 3.9%), mandibular ramus (N=19, 3.1%), ZMC arch (N=8, 1.3%), and the coronoid process (N=7, 1.1%). The most common site of fracture was the subcondylar region (60%) in patients between 3-7 years, and the parasymphysis in patients between 8-12 years (42%), and 13-18 years (41.4%).

Management of fractures:

In our study population, the frequency of open reduction surgery was 71% in the parasymphysis, 71.2% in the body of the mandible, 9.1% in the subcondylar region, 78.5% in the angle of mandible, 96.8% in the ZMC, 12.5% in the nasal area, 36.8% in the mandibular ramus, and 12.5% in the ZMC arch.

Closed reduction and using an arch bar had a frequency of 18.3% in the parasymphysis, 16.8% in the body of mandible, 68.7% in the subcondylar region, 20.4% in the angle of mandible, 70.3% in the condylar head, and 63.2% in the mandibular ramus.

The frequency of closed reduction with lingual splint was 7.6% in the parasymphysis and 9.6% in the body of mandible.

The frequency of closed reduction with ivy loop was 0.8% in the parasymphysis, 17.2% in the subcondylar region, 1.1% in the angle of mandible, and 8.1% in the condylar head. The circummandibular wiring had a frequency of 1.5% in the parasymphysis and 2.4% in the body of mandible.

Closed reduction with external splint was used for the management of nasal bone fractures in the majority of patients (87.5%); open reduction was performed for 12.5% of patients due to the severity of injury.

Closed reduction was performed for 62.5% of patients with ZMC arch fracture.

No treatment was performed for 0.8% of the parasymphyseal, 5.1% of subcondylar, 3.2% of ZMC, 21.6% of condylar head, 25% of ZMC arch, and 100% of coronoid fractures.

DISCUSSION

The present study assessed the frequency of different types of maxillofacial fractures in 3 to 18-year-olds and their management. We did not evaluate dentoalveolar fractures because the aim was to assess the management of maxillofacial bone fractures. The main finding of the current investigation was the correlation of aging with the pattern of change in type of fractures and the shift in their management from closed reduction to open reduction and placement of non-resorbable plates.

The prevalence and etiology of fractures varied among the 319 patients and 605 fractures evaluated in this study. The mean number of fractures was 1.89 in each patient, which was almost similar to the value reported by Ellis et al [11]. They reported 3462 fractures in 2137 patients, with averagely 1.6 fractures per patient. Amarista Rojas et al. [12] reported averagely 1.56 fractures per patient.

The majority of the fractures in our sample was seen in males (79.9%), which was in agreement with the results of previous

studies on this topic [11-15]. The overall male to female ratio was 3.98 in our study, which was in agreement with the available literature on this respect [11,16,17].

We found that the majority of fractures were due to motor-vehicle accidents. The same was reported by Holland et al [18]. Falls from height were the second most common cause of maxillofacial fractures in the present study and were the main cause of maxillofacial fractures in children in a study conducted in Switzerland [19]. Li and Li [20] in a study in China attributed the low prevalence of maxillofacial fractures in infants to the one-child policy implemented in China, such that parents take better care of their only child compared with families with higher number of children. Another study conducted in South China reported that cycling accidents were the main cause of maxillofacial fractures in children [21]. A study conducted in South Africa stated that violence and street fights were the main causes of fractures [22]. These findings indicate that the causes of fractures are variable in different parts of the world, depending on the lifestyle and socio-economic status of the people. Despite this controversy, higher rate of fractures in males, increase in prevalence of fractures in children with increasing age, and higher frequency of mandibular fractures, have been acknowledged in previous studies as well [19-22].

In the current investigation, the mandible was the most common site of fracture. The same was reported by Ashrafullah et al, [23] in India and Imahara et al, [7] in the United States. We observed that the parasymphysis was the most common site of fracture in the mandible. Fractures of the condylar head and subcondylar area have been reported under the category of condylar fractures in the majority of previous studies. The condyles would rank first in terms of the most common site of fractures in the mandible if we merged the fractures of condylar head and subcondylar region under one category of condylar fractures. However, we reported the condylar head and subcondylar fractures separately in this study; thus, we found parasymphysis to be the most common site of fracture in our study. Fragility of the mandible can be due to the presence of teeth and tooth buds in empty bone spaces, lower thickness of the mandibular bone, and presence of curvatures in the mandible [23].

The treatment goals of maxillofacial fractures in children are the same as those in adults; however, their management may be different. Age-related developmental stage of the child and stage of development of dentition are the most important concerns in treatment planning and selection of the best treatment approach for children. Surgical access and dissection of the periosteum can adversely affect the osteogenic potential of bone, and delay the healing process. Thus, conservative approaches should always be the first choice [24].

Younger patients have a faster healing rate. Therefore, in non-displaced fractures, or cases with small displacement, healing often occurs with no delay. Consequently, the patient may require no treatment, or might need closed reduction [24, 25]. The duration of fixation of the mandible in children should be shorter than that in adults (2 weeks versus 4-6 weeks) [26]. Surgical procedures should be performed conservatively and with minimal manipulation, and should be modified according to the developmental stage of bone and teeth [24]. Due to the high prevalence of comminuted and severe fractures in this population, they often require open reduction and internal fixation [27]. In general, the need for surgical management increases with age [25]. This finding was also confirmed in our study.

Based on our results, the majority of facial fractures in children younger than 10 years were managed by closed reduction. One fundamental concept in management of facial fractures is that dental occlusion can serve as a guide for reduction procedures. Thus, intermaxillary/maxillomandibular fixation is an important part of treatment of facial fractures [28]. The first step in management of any jaw fracture is to use arch bar or ivy loop, aiming to reinstate the normal occlusion of patient and symmetry and natural form of the face, and perform intermaxillary/maxillomandibular fixation. The old justification in favor of closed

reduction for comminuted fractures is that open reduction and internal fixation would be highly difficult. The fracture segments should be carefully reduced and the plate should be precisely adapted to the area. According to Schilli [29], this is a tiresome process and requires high precision.

The rigid fixation technique is known to significantly decrease treatment time. This makes selection of the preferable treatment technique somewhat difficult. The open reduction technique to reduce fractures is associated with decreased blood supply to the area. Many previous studies have opted for the closed reduction technique due to decreased blood supply and subsequently higher risk of infection and inappropriate healing of the fracture in the open reduction technique [30]. Some studies conducted in 2008 [7], 2015 [31], and 2019 [32] reported surgical management of fractures in 25.1%, 31.95 and 22.4% of the patients. This rate was 57.7% in the current investigation. At present, open reduction and fixation with resorbable plates is being increasingly performed in children. These biodegradable plates can provide adequate strength and stability to maintain the broken pieces together, and do not require a secondary surgery for their removal since they are resorbable [33]. However, use of this technology is limited to some certain cases in hospitals affiliated to Tehran University of Medical Sciences due to financial considerations.

In the present study, 335 fractures were surgically treated. Surgical treatment of fractures was due to the severity of injury in the majority of the cases (57.7%). A high percentage of surgically treated patients were ≥12 years, and had higher level of dental and skeletal development, which may explain the high percentage of surgical procedures in them. The risk of adverse effects of surgery on facial growth is not high in this age group; the risk is even lower in candidates for open reduction surgery. On the other hand, patients with minor fractures or small displacements were probably treated with conservative approaches at the dental clinic and were not referred to the hospital; resultantly, they were not included in our study population.

With increased age, a significant increase is noted in the need for surgical management of fractures. Different surgeons may opt for different approaches for management of similar cases. In the maxillofacial departments of hospitals affiliated to Tehran University of Medical Sciences, fracture cases with no or insignificant displacement do not undergo surgical treatment; they are prescribed a soft diet and are followed. However, the need for surgical management is obvious in most cases referred to hospitals.

High prevalence of fractures due to motor-vehicle accidents in Iran can be a result of traffic violations such as refusal to wear a seatbelt, not using a helmet by cyclists, and priority violations. Imposing heavier penalties for traffic violations may decrease the rate of motor-vehicle accidents and consequently the rate of associated injuries.

One of the strengths of the current investigation is its high sample size compared to other studies conducted in Iran. It is also important to examine the fractures separately in anatomical areas and the treatments performed. Difficulties in accessing the information recorded in the files and not reviewing the treatment results are among the weaknesses of our study.

CONCLUSION

We conclude that the rate of fractures in older people is higher and their treatment can be more difficult due to larger displacements.

CONFLICT OF INTEREST STATEMENT

None declared.

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