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Original Article

# Epidemiologic patterns of maxillofacial fractures: A 5-year study in one of the referral hospitals of Iran

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**Abstract**

**Introduction:** Maxillofacial trauma resulting in fractures are among the most common reasons for referral to the ER. Epidemiological fracture patterns are widely dependent on cultural, environmental, and socio-economic parameters. This study aimed to assess the epidemiology and prominent patterns of maxillofacial injuries and fractures in Iran.

**Methods**: This cross-sectional study was conducted at a trauma research center. In this study, medical records of patients with maxillofacial fractures from 2010 to 2015 were reviewed. Factors such as age, gender, GCS at admission, hospital stay, fracture cause, site of fractured bones, ocular injuries, brain injuries, trigeminal involvement, facial nerve involvement, soft tissue injuries, and upper face fractures were evaluated. Treatments rendered were also reviewed. Data analysis was performed using SPSS version 22.

**Results:** 283 patients with a mean age of 32.48 years and a male-to-female ratio of 4:1 was seen. The most common age group was the third decade of life (38.2%). The most common causes of fracture were MVA (66.4%), falls (13.1%), and assault (9.2%). The most common fractured bones were: mandible (42.04%), orbit (39.57%), and maxilla (37.1%). The most common treatment was open reduction (94%) and internal fixation with miniplates (49.5%). The hospital stay duration was 3.4 days (average).

**Conclusion:** In this study males in the third decade of life were the most prone to facial fractures. Associated injuries were common and must not be neglected on physical examination. The profession, culture, and social differences in the society are influential in facial fractures and thus the pattern will differ in different nations.

**Keywords:** Trauma, Maxillofacial Fracture, Mandibular Fractures.

## Introduction

Different populations, varying lifestyles, and cultures are influential in sustaining maxillofacial trauma and fractures and are among the causes of presentation to emergency departments in recent decades [1,2]. Anatomical complexities and vicinity to the main components of various systems of the body necessitate vigilant and thorough examination and evaluation of maxillofacial fractures [3,4]. Misdiagnosis or neglect in the management of injuries can lead to catastrophic outcomes. Besides the face, the brain, cervical spine, and eyes are at danger in these fractures; physiologic concerns for airway control and respiration, cosmetic problems, and psychological impacts are also severe issues to be considered by healthcare providers. In addition to medical aspects, high direct and indirect economic costs of maxillofacial fractures impose a significant financial burden on patients and health service systems of countries around the world. Thus, timely diagnosis of maxillofacial fractures is essential to prevent these consequences [5]. For a timely diagnosis and appropriate management, having a vision of the epidemiology of these fractures is necessary for physicians along with policymakers.

While the causes of maxillofacial injuries can be summarized as motor vehicle accidents, falls, sports, occupational injuries, violence/assaults, there is a vast variation around the causes in different countries, cultures, environments, and age groups [6,7]. For instance, in developing countries with high populations and low incomes, motorcycles are more frequently used, and traffic rules are not strictly obeyed, while in developed countries, high-quality vehicles are more frequently used, and driving guidelines are more precisely respected. These differences are reflected in different rates of maxillofacial injuries due to traffic accidents and injury patterns.

Iran, as a semi-developed country, experiences a high load of maxillofacial traumas annually. Although, there is limited data on epidemiology, etiology, treatment plans, and complications of maxillofacial fractures in this country. Several regional studies in Iran have been conducted on this issue. It seems that more studies are needed for a comprehensive understanding of trends in sustained fractures. The study aimed to assess the causes, treatment plans, and complications of maxillofacial fractures in trauma patients admitted to a referral hospital in Tehran for 5-year.

## Methods

This cross-sectional study was conducted at a trauma research center. This study was approved by the Research Ethics Committee (approval ID: IR.BMSU.REC.1399.189). In this study, medical records of patients with maxillofacial fractures from 2010 to 2015 were assessed. Patients with incomplete record, facial congenital deformity, genetic diseases, facial pathological lesions leading to fractures, and positive history of maxillofacial fracture were excluded from the analysis. A questionnaire form based on the necessary parameters was designed to be filled out with the data of the records. Demographic data, including gender and age at the time of injury, were recorded. The length of hospital stays and GCS at presentation were also retrieved. Causes of fractures were recorded as MVA, fight, falling, gunshot, sports events, and explosives. Fracture regions were assessed as frontal, orbital, nasal, maxillary, zygomatic, and mandibular. Le Fort classification was also evaluated. Ocular injury, brain injury, trigeminal nerve, and facial nerve involvement were other parameters assessed in our study. The presence of soft tissue injuries was recorded as oral or lip laceration, eyelid laceration, septal hematoma, tongue laceration, and ear. Finally, treatment plans were reviewed.

The SPSS (version 22.0, IBM, Chicago, USA) was used for data analysis. For descriptive analysis, frequency and percentage or mean and standard deviation were reported, whenever necessary. To analyze the association of parameters, the student t-test and Pearson's chi-square test were used based on the type of parameters. ANOVA test was applied for comparing variables in more than two groups based on the cause, age groups, and location of the fracture. The statistical significance threshold was considered as 0.05 for p-value.

## Results

In the present study, 283 patients with maxillofacial fractures with a mean age of 32.48± 14.98 years, and a male-to-female ratio of 4.43:1 were reviewed. Baseline and demographic characteristics of patients are presented in Table 1.

Causes of fractures were demonstrated as vehicle motor accidents (188 patients, 66.4%), falls (37 patients, 13.1%), assaults (26 patients, 9.2%), sports (8 patients, 2.8%), gunshots (7 patients, 2.5%) and explosions (5 patients, 1.8%). Fracture cause was unknown in 12 patients (4.2%).

The most common fracture site was the mandible (42.04%), followed by orbit (39.57%) and maxilla (37.1%). The details of fracture locations are summarized in Table 2.

Soft tissue injuries (14.3%) are the most common associated injuries. Ocular injuries (10.6%) rank second among accompanying injuries. Complete details of these injuries are presented in Table 3. Three main treatments were miniplates (49.5%), open nasal reduction (10.2%), and closed nasal reduction (6.4%). Details of the frequency of treatments are shown in Table 4.

The mean age of patients was significantly different between males and females (p=0.031). Fracture causes were not different between genders (p=0.498), mandibular fracture frequency was significantly different between males and females (p=0.033), and no

significant difference was observed in associated injuries according to gender. The details of these comparisons are shown in Table 5.

Table 1. Baseline and demographic characteristics of patients.

| **Parameter** | **Mean±SD/Number (%)** |
|---|---|
| Age (years) | 32.48±14.98 |
| **Gender** | |
| Male | 231 (81.6%) |
| Female | 52 (18.4%) |
| **Age group** | |
| 0-10 years | 1 (0.4%) |
| 10-20 years | 61 (21.6%) |
| 20-30 years | 108 (38.2%) |
| 30-40 years | 34 (12%) |
| 40-50 years | 42 (14.8%) |
| 50-60 years | 19 (6.7%) |
| 60-70 years | 10 (3.5%) |
| 70-80 years | 8 (2.8%) |
| **GCS on admission** | |
| 15 | 279 (98.6%) |
| 14 | 2 (0.7%) |
| 11 | 1 (0.4%) |
| 6 | 1 (0.4%) |
| **Hospital stay duration (days)** | 3.44 ± 3.30 |

Table 2. Distribution of fractures in maxillofacial traumas.

| **Location** | **Number (%)** | **Location** | **Number (%)** |
|---|---|---|---|
| **Mandibular fracture** | 119 (42.04%) | Frontal fracture | 19 (6.7%) |
| *Body* | 28 (9.9%) | Orbital fracture | 112 (39.57%) |
| *Condyle* | 16 (5.7%) | *Roof* | 17 (6 %) |
| *Angle* | 15 (5.3%) | *Floor* | 28 (9.9%) |
| *Ramus* | 2 (0.7%) | *Lateral wall* | 1 (0.4%) |
| *Symphysis* | 12 (4.2%) | *Medial wall* | 2 (0.7%) |
| *Parasymphysis* | 1 (0.4%) | *complex* | 65 (23%) |
| *complex* | 45 (15.9%) | Nasal fracture | 100 (35.4%) |
| **Maxillary fracture** | 105 (37.1%) | *Single nasal fracture* | 84 (29.7%) |
| **Zygomatic fracture** | 90 (31.8%) | *Nasal + septal fracture* | 16 (5.7%) |

Table 3- Associated injuries in maxillofacial fractures.

| Injury | Number (%) | Injury | Number (%) |
|---|---|---|---|
| **Ocular injury** | 30 (10.6%) | **Facial nerve involvement** | 2 (0.7%) |
| **Brain injury** | 5 (1.76%) | **Soft tissue injury** | 40 (14.13%) |
| *Epidural hematoma* | 1 (0.4%) | *Oral/lip laceration* | 30 (10.6%) |
| *CSF leak* | 2 (0.7%) | *Eyelid laceration* | 6 (2.1%) |
| *Epidural hematoma + intracranial bleeding* | 2 (0.7%) | *Septal hematoma* | 1 (0.4%) |
| **Trigeminal nerve involvement** | 21 (7.42%) | *Tongue laceration* | 2 (0.7%) |
| *Supraorbital* | 4 (1.4%) | *Lip and ear laceration* | 1 (0.4%) |
| *Infraorbital* | 13 (4.6%) | **Upper limb fracture** | 4 (1.4%) |
| *Infraalveolar* | 3 (1.1%) | **Open fracture** | 12 (4.2%) |
| *Infraorbital + zygomaticofacial* | 1 (0.4%) | | |

Table 4. Treatments in maxillofacial fractures.

| **Treatment** | **Number (%)** | **Treatment** | **Number (%)** |
|---|---|---|---|
| Miniplates | 140 (49.5%) | Miniplate + wire | 2 (0.7%) |
| Open nasal reduction | 29 (10.2%) | Miniplate + titanium mesh | 2 (0.7%) |
| Closed nasal reduction | 18 (6.4%) | Miniplate + medpor prosthesis | 7 (2.5%) |
| Medpor prosthesis | 4 (1.4%) | Miniplate + archbar | 32 (11.3%) |
| Archbar + wire IMF | 10 (1.4%) | Miniplate + IMF screw | 28 (9.9%) |
| IMF screw | 9 (3.2%) | Medpor prosthesis + IMF screw | 1 (0.4%) |

Table 5. Study parameters based on patients' gender

| Parameter | Males | Females | p-value | Parameter | Males | Females | p-value |
|---|---|---|---|---|---|---|---|
| **Age (years)** | 31.57±15.16 | 36.51±13.60 | 0.031 | **Fracture locations** | | | |
| **Fracture causes** | | | | *Frontal* | 17 (7.4%) | 2 (3.8%) | 0.360 |
| *Unknown* | 10 (4.3%) | 2 (3.8%) | 0.498 | *Orbital* | 86 (37.2%) | 26 (50%) | 0.089 |
| *MVA* | 150 (64.9%) | 38 (73.1%) | | *Nasal* | 78 (33.8%) | 22 (42.3%) | 0.244 |
| *Assault* | 22 (9.5%) | 4 (7.7%) | | *Maxillary* | 83 (35.9%) | 22 (42.3%) | 0.390 |
| *Fall* | 29 (12.6%) | 8 (15.4%) | | *Zygomatic* | 68 (29.4%) | 22 (42.3%) | 0.072 |
| *Gunshot* | 7 (3%) | 0 (0%) | | *Mandibular* | 104 (45%) | 15 (28.8%) | 0.033 |
| *Sports accident* | 8 (3.5%) | 0 (0%) | | **Hospital stay duration** | 3.43±3.17 | 3.50±3.85 | 0.895 |
| *Explosive* | 5 (2.2%) | 0 (0%) | | | | | |

There was no significant correlation between Age and fracture causes (p=0.894). Patients with nasal fractures were significantly younger than patients with other fractures (p=0.034). Other associated injuries did not show significant differences between ages. Hospital stay length was significantly longer in the fifth decade of life (p=0.004). The significant relationship between age and treatments was not detected (p=0.339).

In the majority of fracture locations, MVA was significantly the most common cause for fracture (p<0.05) except for frontal and mandibular fractures that did not show any significant difference between causes of fracture (p-values of 0.391 and 0.422, respectively). MVA was also significantly associated with ocular injury and open fracture (p-values=0.000), but no correlation was found between fracture causes and brain injury, trigeminal or facial nerve involvement, soft tissue injury and upper limb fracture (p-values of 0.860, 0.985, 0.301, 0.671 and 0.915 respectively). Hospital stay length was significantly longer in fractures due to gunshots (5.71±3.40 days, p=0.010).

Treatment plans differed significantly between various fracture causes as in MVA, 59.4% were treated with miniplates while this rate in assault and falls were 42.3% and 32.4%, respectively. On the other hand, 9.5% patients in the MVA group underwent open or closed nasal reduction. The frequency of this treatment in the assault group of patients (30.7%) and falls (24.3%) were higher compared to MVA (p=0.002).

## Discussion

Maxillofacial traumas as a common cause of presentation to ERcan occur in all ages and genders due to a various of fracture causes. Although, certain epidemiologic patterns for these fractures vary in different regions of the world that reflect the cultural and socioeconomic background. In this study, we aimed to evaluate these patterns in Iran. 283 patients were evaluated in our study during a 5-years with a mean age of 32.48 years in the 20-30 age group (38.2%), being the most common involved age range. The male-to-female ratio was also calculated as 4.43:1. Two studies by Samierad et al. [8,9] in different parts of Iran reported that males comprise 80.3% and 76.3% of patients with maxillofacial fractures, and 20-30 years' age group included 40% of the study populations. A study by Kalantar Motamedi et al. [10] revealed a rate of 84% for males and 40% for 21-30 years old patients. A study by Zhou et al. [11] showed an increase of M/F ratio from 3.35:1 to 3.63:1 in 2000-2004 and 2005-2009 period. Almost all other studies have reported similar findings except a study by Boonkasem et al. [12] in Thailand which reported no significant difference between rates of maxillofacial fractures between the second, third, fourth, and fifth decades of life. In our study mean age of females and males was significantly different (31.57 years versus 36.5 years, p=0.031). Mandibular fracture

frequency was considerably different between males and females (45% versus 28.8%). The nasal fracture occurred in significantly lower ages compared to other fractures. Hospital stay length was significantly longer in the fifth life decade (5.52 days).

Maxillofacial fracture causes were variously based on different environmental, cultural, and socioeconomic parameters. The most common fracture causes in our study were MVA (66.4%), fall (13.1%), and assault (9.2%), respectively. This order of causes is frequently seen in other studies with some variations in different regions of the world. The superiority of MVA is due to the shift from non-urban and non-industrial societies to urban and industrial developments that lead to higher traffic accidents. Developing countries are at much higher risks than developed countries. A study by the European Maxillofacial Trauma Project reported that only 11% of maxillofacial traumas result from MVA in Europe [13], while this rate in many other parts of the world is significantly high. Abosadegh et al [4] revealed an 83.1% rate for MVA in fractures. Kalantar Motamedi et al [10] reported that the majority of maxillofacial fractures were due to MVAs of cars and motorcycles. Arabion et al [14] reported that MVA (69.9% males, 54.2% females), fall (9.8% males, 21.5% females), and assault (5.2%) were the most common causes of fracture. Although MVA ranks first in the majority of studies, there are reports which reveal opposite results. Yoffe et al [15] reported that falls (35%) constitute the largest proportion of causes for fractures followed by MVA (29%) and assault (18%). In this study, a rise in admissions due to falls and assaults, as well as the decline in hospitalizations due to MVA during 1996-2005 compared to 1985-1995 were reported. On the contrary, Zhou et al. [11] reported that MVA has increased from 49.3% to 54.6% and assault has decreased from 16.8% to 12.4% during 2000-2004 and 2005-2009. Rashid et al. [16] also reported that assaults (77%) were the most common cause of fracture in males while falls (46%) were the most common cause for females. In our study, MVA was significantly the most common cause of fracture except for frontal and mandibular fractures in which MVA could not reach a significant difference. The hospital stay duration was significantly longer due to gunshots compared to other causes (5.71 days, p=0.010) which can be attributed to probable higher severity and associated concomitant injuries.

The most common fractures in our study were mandibular fractures (42.04%) with the mandibular body being the most frequently fractured site of the mandible, followed by orbital (39.57%), maxillary (37.1%), and nasal (35.4%) fractures. Kalantar Motamedi et al. have reported 65% mandibular fractures, 19% maxillary fractures, and 36% zygomatic fractures. Another study by Kalantar Motamedi et al. [10] mentioned mandibular condyle as the most common site for maxillofacial fracture. Hoppe et al. [17] also reported mandibular (29%), orbital (26.5%), and nasal (14.4%) fractures as the most common locations for fracture. Zhou et al [11] reported a decrease from 59.6% to 55.3% in mandibular fractures from 2005 to 2009 while midface fractures grew from 40.4% to 44.7% during that period.

In our study, 14.3% of patients experienced concomitant soft tissue injuries with oral/lip lacerations were the most common ones (10.6%). The ocular injury was also presented in 10.6% of cases. Trigeminal nerve involvement (7.42%) was significantly more common than facial nerve involvement (0.7%). Upper limb fractures were seen in 1.4% of cases. In comparison to other studies, the rates of our study were remarkably lower which was probably due to deficits in the registry of associated injuries in our patients. Manodh et al. [18] have reported that soft tissue injury occurred most commonly in MVA, and the upper limb was the most common site for soft tissue injury. Wusiman et al. [19] have reported that upper limb injury (27.5%) was the most common associated injury followed by brain injury (24.5%) and ocular injury (21.4%). The most common involved nerve in that study was the facial nerve (62.9%). Mijiti et al.[20] reported that associated injuries were present in 48.3% of cases, and intracranial injuries were found in 37% of patients.

In the present study, 49.5% of patients were treated with miniplates. The open and closed nasal reduction was performed in 10.2% and 6.4% of cases. In the majority of studies in the literature, open reduction and internal fixation (ORIF) was the most common treatment plan. Udeabor et al. [21] reported that ORIF was used in 40.4% of patients while this rate in the research of Mijiti [20] was as high as 62.4%.

The main limitation of our study was the lack of data on overall traumas for the comparison of maxillofacial fractures to other parts of the body.

## Conclusion

In maxillofacial fractures, males in the third decade of life were the most prone to facial fractures. Associated injuries were common and must not be neglected on physical examination. The profession, culture, and social differences are influential in facial fractures and vary in different nations. MVA is the central cause, and the mandible has a high risk for fracture.

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## Conflict of Interest Disclosures

The authors declare that they have no conflicts of interest.

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None

## Authors' Contributions

All authors contributed equally in the study.

## Ethical Statement

This study was approved by the Research Ethics Committee of Baqiyatallah university of medical sciences (approval ID: IR.BMSU.REC.1399.189).

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