



# Zygomatic Fractures: A 10-Year Retrospective Epidemiological Study

Hassan Mohajerani,<sup>1</sup> Nima Sadeghi,<sup>2,\*</sup> Taraneh Montazemi,<sup>3</sup> and Afsaneh Montazemi<sup>4</sup>

<sup>1</sup>Associate Professor, Department of Oral and Maxillofacial Surgery, Dental School, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>2</sup>Post Graduate Student, Department of Oral and Maxillofacial Surgery, Dental School, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>3</sup>Dentist, Department of Oral and Maxillofacial Surgery, Dental School, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>4</sup>ENT Resident of Iran University, Rasoul Hospital, Tehran, Iran

\*Corresponding author: Nima Sadeghi, Department of Oral and Maxillofacial Surgery, Dental School, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Tel: +98-9121276135, Fax: +98-2126109848, E-mail: dr.nsadeghi@yahoo.com

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## Abstract

**Background:** Zygomatic fractures are among the most common maxillofacial injuries.

**Objectives:** This study aimed to assess the incidence and causes of zygomatic fractures in patients referring to Tehran Taleghani hospital during a 10-year period.

**Methods:** This descriptive, retrospective, cross-sectional study was conducted on 294 records of patients (248 males and 46 females) with zygomatic fractures selected via census in Tehran Taleghani hospital from 2003 to 2013. Age, gender, cause of fracture, type of treatment modality, and post-operative complications were extracted and reported by using descriptive statistics. Data were analyzed using chi square and Fisher's exact tests.

**Results:** Most patients were aged 20 - 30 years (n = 121, 42.1%). Car accident (n = 97, 33%), motorcycle accident (n = 89, 30.3%), and fall from height (n = 44, 15.1%) were the most common causes of fractures. The most common associated fracture was mandibular fracture (n = 104, 35.4%). The most common type of zygomatic fracture was zygomaticomaxillary complex (ZMC) fractures (87.3%) treated by open reduction with internal fixation (84.8%). Paresthesia or hypoesthesia of the infraorbital nerve (n = 177, 64.6%) was the most common complication. Periorbital ecchymosis (n = 159, 58%) was the most common ocular complication. Epistaxis (P = 0.01), paresthesia and hypoesthesia of infraorbital nerve (P = 0.016), enophthalmos (P = 0.014), step formation at the inferior orbital rim (P < 0.001), periorbital ecchymosis (P < 0.001), and subconjunctival hemorrhage (P = 0.006) had a higher frequency in ZMC compared to non-ZMC fractures.

**Conclusions:** Zygomatic fractures comprised 22.8% of all maxillofacial injuries and they occurred mainly due to traffic accidents with a higher prevalence in males aged 20 - 30 years. They were mostly treated by open reduction with internal fixation.

**Keywords:** Zygomatic Fractures, Maxillofacial Injuries, Prevalence

## 1. Background

Zygomatic bone has an important position in the facial skeleton and plays a fundamental role in facial beauty. It forms part of the floor and lateral wall of the orbit, the prominence of the cheek (malar eminence), and the zygomatic arch that plays a major role in facial morphology.

Facial trauma often results in soft tissue injury and dental and facial skeletal fractures particularly mandibular fracture. Fractures of the mandible mostly involve the condyles, coronoid process, ramus, the angle of the mandible, body of the mandible, symphysis and parasymphysis. Severe trauma may result in multiple fractures of the mandible with more than one fracture line (1, 2). Facial fractures mostly occur due to traffic accidents, fights, fall from height, and work and sport accidents.

Zygomatic fractures are important due to their

anatomical position as well as their relation to the orbit and the mandible. In some cases of zygomatic fracture, due to the relation to the mandible, the coronoid processes cannot easily move posteriorly and thus, the mouth cannot be opened. Considering the anatomy of the zygomatic bone, loads applied to it are transferred to the adjacent bones (which are often weak) via its four processes that results in their fracture. Ocular complications may also occur due to zygomatic fractures. Due to the relation of zygomatic bone to the orbit, zygomatico-orbital fractures may cause laceration of the external ocular muscles, resulting in diplopia (3).

Facial fractures, particularly zygomatic fractures, are often associated with edema and ecchymosis around the orbit as well as in the subconjunctival area. Disregarding these symptoms may lead to delayed diagnosis and treatment and consequent development of complications such

as diplopia, limitations in mandibular movements, and compromised esthetics (4-6).

The prevalence and position of zygomatic and facial fractures depend on the community in which the study is performed (7). Zygomatic fractures rank second after nasal fractures among the mid-face fractures (8-10). Although previous studies have reported different incidence rates for zygomatic fractures, a study on the adult population demonstrated that approximately 17% of facial traumas involved zygomatic fractures (11). Most previous studies have reported higher prevalence of zygomatic fractures in males and in the second and third decades of life (4:1 male/female ratio) (12). Long-term studies are required to collect demographic information and find out the epidemiological patterns of maxillofacial fractures in every community. Collecting data regarding the incidence of trauma and its complications will result in accurate planning and following strategies to prevent it and promote general health. By knowing the causes and frequency of maxillofacial traumas, they can be more easily prevented and the burden on the health care system due to these traumas will be diminished. Epidemiological studies on these fractures and their causes allow designing and implementing preventive strategies (13).

Taleghani hospital is a major trauma center in Iran and a referral center for maxillofacial traumas. Despite numerous studies on mandibular fractures, studies on zygomatic fractures are scarce. Thus, the aim of the current study was to assess the frequency and causes of zygomatic fractures in patients referring to the maxillofacial department of Taleghani hospital in Tehran during 2003 - 2013.

## 2. Methods

This descriptive, retrospective, epidemiological study was conducted on medical records of patients referring to the maxillofacial department of Taleghani hospital in Tehran during 2003 - 2013 due to zygomatic fractures.

The inclusion criteria were all admissions to the maxillofacial department of Taleghani hospital during the mentioned period. Patient files were chosen using census ( $n = 294$ ). Patient records were retrieved from the archives of the hospital and data were extracted from the files and recorded in a predesigned questionnaire. The reliability and validity of the questionnaire had been previously confirmed. A questionnaire was filled out for each patient file. Patient files with incomplete data or those irrelevant to the study objective were excluded. Sex, level of education, occupation and age of patients, cause of fracture, time of fracture, soft tissue trauma, involved area (s), fractures associated with zygomatic fracture, ocular complications,

other complications, underlying systemic conditions, surgical intervention, and post-operative complications were extracted from patient files and recorded.

Data were analyzed using SPSS version 18.0. The frequency of each variable such as age, sex, cause of accident, type of treatment, etc. in patients with zygomatic fractures was calculated and reported. The difference between males and females in terms of the cause of fracture and difference in prevalence of complications in different types of fractures (ZMC or non-ZMC fractures) were statistically analyzed using chi square and Fisher's exact tests. Type one error was considered as 0.05 and  $P < 0.05$  was considered statistically significant.

## 3. Results

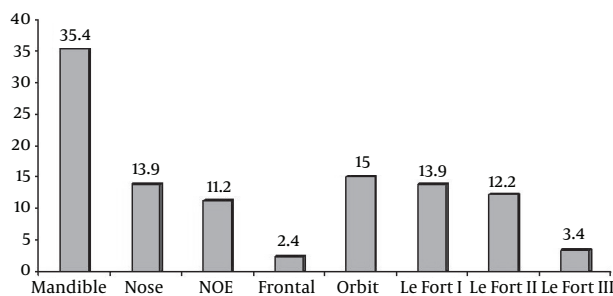
Of 1,288 patients with maxillofacial fractures due to trauma who referred to the maxillofacial department of Taleghani hospital during 2003 - 2013, 294 patients had 315 zygomatic fractures comprising 22.8% of all maxillofacial fractures. 20 patients only had complete information regarding age, sex, time of accident, site and side of fracture, and type of treatment in their medical file. Of all patients, 248 (84.4%) were male and 46 (15.6%) were female with a male/female ratio of 5.4/1.

In terms of age group, 47 (16%) were between 10 and 20, 121 (41.2%) were between 20 and 30, 62 (21.1%) were between 30 and 40, 40 (13.6%) were between 40 and 50, 15 (5.1%) were between 50 and 60, 8 (2.7%) were between 60 and 70, and 1 (0.3%) was between 70 and 80 years old. The minimum age was 10 and the maximum age was 74 years.

In terms of causes of fracture, car accident had the highest frequency ( $n = 97$ , 33%), followed by motorcycle accident ( $n = 89$ , 30.3%), fall from height ( $n = 44$ , 15%), fight ( $n = 19$ , 6.5%), work accident ( $n = 19$ , 6.5%), and sport accident ( $n = 6$ , 2%). Cause of fracture was unknown in 20 subjects (6.8%).

Figure 1 shows the association of zygomatic fractures with other fractures. Zygomatic fractures were most commonly associated with mandibular fracture ( $n = 104$ , 35.4%) and least commonly accompanied by frontal bone fracture (7, 2.4%). In total, 112 patients (38%) only had zygomatic fracture and the rest had multiple (ZMC) fractures. In 53 patients (19.3%), dentoalveolar traumas were also noted. Of 274 patient files with information regarding the underlying systemic conditions, 50 (18.2%) had a systemic disease.

Table 1 shows the frequency distribution of patients with zygomatic complex fractures based on the presence of accompanying mandibular fracture at the same side or the opposite side. Zygomatic arch fractures were reported in 26 (8.2%) and ZMC fractures were reported in 275 cases



**Figure 1.** Frequency Distribution of Fractures Associated with Zygomatic Fractures (2003 - 2013, Taleghani Hospital)

(87.3%). Site and side of zygomatic fractures in patients are summarized in [Table 2](#).

Treatment of zygomatic arch fractures ( $n = 25$ ) was closed reduction in 17 (68%), open reduction with internal fixation in 4 (16%), and open reduction without fixation in 3 (12%) patients. Follow-up had been done in one patient.

Of 263 surgical procedures performed for ZMC fractures, 223 (84.8%) were open reduction with internal fixation, 20 (7.6%) were open reduction without fixation, and 12 (4.6%) were closed reduction. 8 cases had been followed up (3%).

Post-operative complications were seen in 4.4% of the patients including removal of plate due to pain, hypersensitivity reactions or plate exposure in 4, infection in 3, unesthetic outcome, facial asymmetry, and cheek deformity in 2, enophthalmos in 2, and diplopia, vertical dystopia, scar and epistaxis in 1 case.

Symptoms of zygomatic fracture are shown in [Table 3](#). Paresthesia or hypoesthesia of the infraorbital nerve was the most common ( $n = 177$ , 64.6%) and emphysema was the least common symptom ( $n = 9$ , 3.3%).

[Table 4](#) presents ocular complications due to zygomatic fracture with periorbital ecchymosis as the most common ocular symptom.

Soft tissue traumas had been reported in 274 patients; 48.2% of the patients had experienced traumatic soft tissue injury at one site. There were 37 cases of abrasion (13.5%), 3 cases of contusion (1.1%), 30 cases of intraoral laceration (10.9%), 94 cases of extraoral laceration (34.3%), and 19 cases of mucosal ecchymosis (6.9%).

Isolated zygomatic arch fractures were due to fight in 4 (21%), sport trauma in one (16.7%), work accident in 2 (10.5%), motorcycle accident in 8 (8.9%), car accident in 7 (7.2%), and fall from height in 3 (6.8%) patients. Chi square test revealed a significant difference in causes of zygomatic fracture between males and females ( $P < 0.001$ ).

[Table 5](#) summarizes the frequency distribution of com-

plications in two groups of ZMC and non-ZMC fractures. Paresthesia or hyperesthesia of the infraorbital nerve was the most common symptom in patients with ZMC fractures while in patients without ZMC fractures, the most common symptom was jaw opening limitation.

#### 4. Discussion

In our study, 22.8% of the fractures treated in the Oral and maxillofacial department of Taleghani hospital during 2003 - 2013 were zygomatic fractures. In another study conducted in a university hospital in Osaka, Japan, during a 15-year period, the prevalence of zygomatic fractures was reported to be 15.9% (14). Motamedi in his 5-year study in a trauma center in Tehran evaluated maxillofacial fractures in 237 patients and reported a prevalence rate of 13.5% for zygomatic fractures and 24% for zygomatico-orbital fractures (15). Our obtained value was higher than that of Motamedi et al., which may be due to different evaluation periods (5 years versus 10 years), different medical centers evaluated, and different sample sizes. Alternatively, this can simply show an increase in trauma cases attributed to many factors such as population growth and higher use of motor vehicles. Future multi-center studies are required to elucidate further this topic. Van den Bergh et al. evaluated the etiology and incidence of maxillofacial fractures during a 10-year period in Amsterdam and reported that zygomatic and mandibular fractures accounted for 80% of fractures in males and females (16). In our study, ZMC fractures had the highest frequency, which is in accordance with the findings of Ungari et al. (17). Moreover, in studies by Abdullah et al., (18) and Septa (19), ZMC fractures had the highest frequency among the mid-face fractures.

Taleghani hospital is a major maxillofacial trauma center in Tehran, providing service to a large number of patients with maxillofacial injuries. Thus, the results of studies conducted in this center are somehow generalizable to the entire population of Tehran. Based on the current study results, car accident was the main cause of zygomatic fractures (33%) followed by motorcycle accident (30.3%), fall from height (15%), work accident (6.5%), and sport accident (2%). ((21%) and sport accidents (16.7%) were also the main causes of zygomatic arch fractures. Causes of zygomatic fractures were significantly different among males and females. Punjabi et al., in their study in Karachi, Pakistan, reported the main causes of zygomatic fractures to be traffic accidents (50%), fight (23.17%), and fall from height (20.73%) (20). Ungari et al., in their study on 642 patients treated in a university hospital in Rome, Italy, reported the main causes of zygomatic fractures to be traffic accidents (26%), fight (20%), fall from height (19%), and sport accidents (10%). The main causes of zygomatic arch

**Table 1.** Frequency Distribution of Patients with Zygomatic Complex Fractures Based on the Presence of Accompanying Mandibular Fracture at the Same Side or the Opposite Side<sup>a</sup>

| Other Fractures                         | Zygomatic Fracture |           |               |                       |                      |           |         |
|---|--------------------|-----------|---------------|-----------------------|----------------------|-----------|---------|
|   | Condyle            | Coronoid  | Parasymphysis | Angle of the mandible | Body of the mandible | Symphysis | Ramus   |
| Zygomatic fracture at the same side     | 33 (31.7)          | 23 (22.1) | 21 (20.2)     | 15 (14.4)             | 15 (14.4)            | 3 (2.9)   | 3 (2.9) |
| Zygomatic fracture at the opposite side | 22 (21.1)          | -         | 7 (6.7)       | 2 (1.9)               | 10 (9.6)             | -         | -       |

<sup>a</sup>Values are expressed as No. (%).**Table 2.** Frequency Distribution of Site and Side of Zygomatic Fracture in Study Patients (2003 - 2013, Taleghani Hospital)

| Site of Zygomatic Fracture | Number | Percentage |
|----------------------------|--------|------------|
| Left ZMC                   | 143    | 45.3       |
| Right ZMC                  | 104    | 33         |
| Bilateral ZMCs             | 14     | 8.8        |
| Left zygomatic arch        | 13     | 4.1        |
| Right zygomatic arch       | 11     | 3.4        |
| Bilateral zygomatic arches | 1      | 0.6        |
| Zygomatic arch + ZFS       | 4      | 1.2        |
| Zygomatic arch + buttress  | 3      | 0.9        |
| ZFS + buttress             | 4      | 1.2        |
| ZFS                        | 3      | 0.9        |

Abbreviation: ZFS, The Zygomaticofrontal Suture.

**Table 3.** Frequency Distribution of Complications of Zygomatic Fractures in Study Patients (2003 - 2013, Taleghani Hospital)

| Zygomatic Fracture Complications                      | Frequency | Percentage (Not Including the lost Data) |
|---|-----------|--|
| Paresthesia or hypoesthesia of the infraorbital nerve | 177       | 64.6                                     |
| Step formation at the inferior orbital rim            | 163       | 59.5                                     |
| Mouth opening limitation                              | 144       | 52.6                                     |
| Obstructed sinus cavity                               | 91        | 33.2                                     |
| Cheek depression                                      | 90        | 32.8                                     |
| Off occlusion   | 90        | 32.8                                     |
| Epistaxis   | 44        | 16.1                                     |
| Step at the ZFS                                       | 33        | 12                                       |
| Emphysema   | 9         | 3.3                                      |

Abbreviation: ZFS, The Zygomaticofrontal Suture.

**Table 4.** Frequency Distribution of Ocular Complications in Patients with Zygomatic Fractures (2003 - 2013, Taleghani Hospital)

| Ocular Complications                            | Frequency | Percentage (Not Including the lost Data) |
|---|-----------|--|
| Periorbital ecchymosis                          | 159       | 58                                       |
| Subconjunctival hemorrhage                      | 143       | 52.2                                     |
| Enophthalmos                                    | 54        | 19.7                                     |
| Diplopia  | 34        | 12.4                                     |
| Blurred vision                                  | 21        | 7.7                                      |
| Asymmetric pupils and abnormal pupillary reflex | 8         | 2.9                                      |

(21.5%), sport accidents (15.8%), and fall from height (14%) (17). Traffic accidents and fight have been mentioned as the most common causes of zygomatic fractures in several other studies, as well (16, 21). Lee and Antoun in 2009 stated that fight was the most common cause and alcohol consumption was the most common contributing factor to zygomatic fractures (22).

Developed countries have significantly lower prevalence of traffic accidents by implementation of rigid traffic laws. As a result, in developed communities, fight is the most common cause of zygomatic fractures while in developing countries, like Iran, traffic accidents usually rank first among the causes of maxillofacial injuries particularly zygomatic fractures.

Based on our study results, of patients with zygomatic fractures, 84.4% were male and 15.6% were female. All previous studies on this topic have reported higher frequency of zygomatic fractures in males. Cheema reported that out of zygomatic fractures, 88.04% occurred in males and 11.96% in females (21). These rates were 88.4% and 11.6%, respectively, in the study by Ungari et al. (17). Septa et al. reported that 76% of mid-facial fractures occurred in males (19). Such higher prevalence in males is due to their greater presence in the community, higher frequency of male drivers, and their greater participation in sport activities.

fracture in their study were fight (29.1%), traffic accidents

**Table 5.** Frequency Distribution of Complications in Patients with Zygomatic Fractures in Two Groups of ZMC and Non-ZMC Fractures (2003 - 2013, Taleghani Hospital)<sup>a</sup>

| Complications   | Presence of ZMC Fracture (N = 243) | Absence of ZMC Fracture (N = 31) | Total | P Value |
|---|------------------------------------|----------------------------------|-------|---------|
| Cheek depression                                      | 80 (32.9)                          | 10 (32.3)                        | 90    | 0.941   |
| Step at the ZFS                                       | 31 (12.8)                          | 2 (6.5)                          | 33    | 0.395   |
| Epistaxis   | 44 (18.1)                          | 0                                | 44    | 0.01    |
| Paresthesia or hypoesthesia of the infraorbital nerve | 163 (67.1)                         | 14 (45.2)                        | 177   | 0.016   |
| Emphysema   | 9 (3.7)                            | 0                                | 9     | 0.604   |
| Enophthalmos  | 53 (21.8)                          | 1 (3.2)                          | 54    | 0.014   |
| Step formation at the inferior orbital rim            | 157 (64.6)                         | 6 (19.4)                         | 163   | 0.001   |
| Sinus obstruction                                     | 85 (35)                            | 6 (19.4)                         | 91    | 0.082   |
| Periorbital ecchymosis                                | 151 (62.1)                         | 8 (25.8)                         | 159   | 0.001   |
| Subconjunctival hemorrhage                            | 134 (55.1)                         | 9 (29)                           | 143   | 0.006   |
| Diplopia  | 32 (13.2)                          | 2 (6.5)                          | 34    | 0.393   |
| Blurred vision  | 19 (7.8)                           | 2 (6.5)                          | 21    | 1       |
| Mouth opening limitation                              | 126 (51.9)                         | 18 (58.1)                        | 144   | 0.514   |
| Off occlusion   | 83 (34.2)                          | 7 (22.6)                         | 90    | 0.196   |
| Asymmetric pupils and abnormal pupillary reflex       | 8 (3.3)                            | 0                                | 8     | 0.603   |

Abbreviation: ZFS, The Zygomaticofrontal Suture.

<sup>a</sup>Values are expressed as No. (%).

ities. In addition, use of alcohol and illicit drugs is often more common among men. All these factors contribute to the higher risk of zygomatic fractures in men (17).

In our study, 41.2% of patients with zygomatic fractures were in the age range of 20 - 30 years, which is in accordance with previous studies. Ungari et al. reported that most patients with zygomatic fractures were in the age range of 21 - 30 years (31.9%) (17). In a study by Rajput and Bariar, most patients (32.3%) were in their third decade of life (23). Similar results were reported by van den Bergh et al. (16). Traffic accidents, street fights, and sport injuries mainly occur in the second and third decades of life (17).

In our study, zygomatic fractures were most commonly associated with mandibular fractures (35.4%). This finding was similar to the results of Obuekwe et al., reporting a prevalence rate of 21% for zygomatic fractures associated with mandibular fractures (24).

Paresthesia or hypoesthesia of the infraorbital nerve was the most common complication of zygomatic fractures (64.6%) in our study, followed by step formation at the inferior orbital rim (59.5%). Of ocular complications, periorbital ecchymosis was the most common (58%), followed by subconjunctival hemorrhage (52.2%), enophthalmos (19.7%), diplopia (12.4%), and blurred vision (7.7%). In the study by Septa et al., subconjunctival hemorrhage, blurred vision, diplopia, enophthalmos, and blindness occurred in 83.5%, 11.5%, 10.5%, 8.5%, and 3% of patients, respectively (19).

In a study conducted by Obuekwe et al. on 134 patients with zygomatic complex fractures in 2005, subconjunctival hemorrhage (63.4%) was the most common ocular complication (24). Amrith et al. reported the prevalence of diplopia, visual acuity, and traumatic optic neuropathy to be 40%, 23%, and 20%, respectively, in 104 patients with craniofacial trauma and ophthalmic involvement (25). Guly et al. state that risk of eye injuries is seven times higher in individuals with a zygomatic fracture or fracture of the adjacent structures compared to those with facial trauma without a bony fracture (26). Considering the prevalence of ocular complications associated with zygomatic fractures, special attention must be paid to this type of fracture, and in addition to clinical examinations, ocular consultation must be requested for patients prior to surgery. In some cases, an eye surgeon needs to be present in the operating room. Moreover, ophthalmology courses must be held for oral and maxillofacial surgeons to enhance their knowledge in this respect.

Based on the literature, zygomatic fractures are often associated with malar malposition, visual disturbances, enophthalmos, and persistent sensory disturbances of the cheek. Postoperative diplopia and enophthalmos are the most troubling complications (11). Complications such as epistaxis, paresthesia, or hypoesthesia of the infraorbital nerve, enophthalmos, step formation at the inferior orbital rim, periorbital ecchymosis, and subconjuncti-



val hemorrhage were significantly more prevalent in ZMC fractures compared to non-ZMC fractures in our study.

In our study, zygomatic arch fractures were treated with closed reduction in 68% and open reduction with internal fixation in 16% of the cases. Zygomatic complex fractures were treated via open reduction with internal fixation in 84.8%, open reduction without fixation in 7.6%, and closed reduction in 4.6% of the cases. In the study by Hwang and Kim in 2011 on tripod fractures, open reduction with internal fixation was done in 94.5% and closed reduction was performed in 4.6% of the cases. Isolated zygomatic arch fractures were treated via closed reduction in 96.9% and open reduction without fixation in 1% of the cases (27). Adam et al. in 2012 treated isolated zygomatic arch fractures by closed reduction and they used open reduction and internal fixation for comminuted arch fractures and displaced fractures (28). These results are in line with our findings.

Treatment of facial fractures, irrespective of their exact location, must be to restore facial esthetics and function as much as possible and resume normal function of the eyes, nose, mastication, and speech. During the phases of treatment and recovery, complications and adverse effects on patient's nutrition must be minimized as much as possible.

Last but not least, it should be noted that the results of epidemiological studies regarding the prevalence, etiology, clinical manifestations, treatment complications, and characteristics of maxillofacial fractures are related to factors such as geographical location, place of residence, socioeconomic status, cultural conditions and religion, which vary from one country to another (21, 29). A major limitation of this study was that it only evaluated admissions to one hospital. Although the selected hospital was the referral center for maxillofacial traumas in Tehran, future studies covering all hospitals with maxillofacial departments would provide more insight into this topic. Thus, multi-center epidemiological studies on maxillofacial fractures are recommended to find reasons behind the variability in reports from different communities.

#### 4.1. Conclusion

During a 10-year study period, zygomatic fractures comprised 22.8% of all maxillofacial injuries that occurred mainly due to traffic accidents with a higher prevalence in males aged 20 - 30 years. They were mostly treated by open reduction with internal fixation.

#### Footnotes

**Financial Disclosure:** None to declare.

**Conflicts of Interests:** None.

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