A Retrospective Analysis of Maxillofacial Trauma in Shiraz, Iran: a 6-Year Study of 768 Patients (2004-2010)

Arabion HR.*, Tabrizi R.*, Aliabadi E.*, Gholami M.*, Zarei K.*

* Dept. of Maxillofacial Surgery, School of Dentistry, Shiraz University of Medical Science, Shiraz, Iran
* Dept. of Maxillofacial Surgery, Hamedan University of Medical Science, Hamedan, Iran.
* Postgraduate student Dept. of Maxillofacial Surgery, Shiraz University of Medical Science, Shiraz, Iran.

ABSTRACT

Statement of Problem: Information about the etiology and incidence of maxillofacial trauma is important for prevention and appropriate treatments of such injuries.

Purpose: The purpose of this retrospective study was to conduct an analysis of maxillofacial injuries transferred and/or referred to the department of maxillofacial Surgery at Chamran emergency hospital, Shiraz, over a 6-year period with special reference to age, gender, occupation, date, type, site, etiology and clinical management.

Materials and Method: The data for this study were collected and reviewed retrospectively from the records and radiographs of 768 patients who were treated for maxillofacial trauma in the department of maxillofacial surgery at the Shiraz Chamran Emergency Hospital, Iran, between 2004 and 2010.

Results: A total of 730 of the subjects were the patients with fractures of the facial skeleton. The mean age was 26.6± 12.6 years, ranging from 2 to 81 years. Traffic accident was the most frequent etiological factor of maxillofacial fractures irrespective of gender (69.9% for men and 54.2% for women), whereas the second most frequent cause of injuries was falling down (9.8% for men and 21.5% for women). The other etiologies were assaults (5.2%), sport related injuries (1.3%) and firearm injuries (1%). Regarding the head injuries in patients with maxillofacial fractures, brain contusion was seen in 227(29.6%) patients and 13.5% of patients had lacerations in the facial soft tissue. The monthly distribution peaked in October, with 81 cases (10.5%), which would be for the reason that schools open in this month. The next highest incidence was in December, with 80 cases (10.4%), probably because of the changing weather's effect on road traffic.

Conclusion: Isolated mandibular fracture due to the road traffic accident was the most common type of maxillofacial injuries in the city of Shiraz.
A Retrospective Analysis of Maxillofacial Trauma in Shiraz, Iran: a 6-Year Study of 768 Patients (2004-2010) Arabion HR., et al.

Figure 1 The diagram shows the age distribution of patients and it helps recommend other ways in which injuries to the face can be averted [3]. The purpose of this retrospective study was to analyze the maxillofacial injuries transferred and/or referred to the department of maxillofacial surgery at the Chamran emergency hospital, Shiraz, over a 6-year period, with special reference to the age, gender, occupation, date, type, site, etiology and clinical management.

Materials and Method
The data for this study were collected and reviewed retrospectively from the records and radiographs of 768 patients who were treated for maxillofacial trauma in the department of maxillofacial surgery in Shiraz Chamran emergency hospital, Iran, between 2004 and 2010. The first year postgraduate students were responsible for data collection from the patients. The source of data was the patient radiographs and the performed clinical examination. The classification of fractures was done based on the Fonseca definition as follows [4]:

1. Midline: fractures between central incisors
2. Para-symphysis: fractures occurring within the area of the symphysis.
3. Symphysis: bounded by vertical lines distal to the canine teeth.
4. Body from the distal symphysis to a line coinciding with the alveolar border of the masseter muscle.
5. Angle: triangular region bounded by the anterior border of masseter to the postero-superior attachment of the masseter muscle.
6. Ramus: bounded by superior aspect of the angle to two lines forming an apex at the sigmoid notch.
7. Condylar process: area of the condylar process superior to the ramus region.
8. Coronoid process: include the coronoid process of the mandible superior to the ramus region.
9. Alveolar process: the region that would normally contain teeth.

The data recorded included name, age, gender, date, occupation, consciousness, cause of injury, site, type of operation(s) and head trauma.

Results
During the 6 years of study, 768 patients were hospitalized and treated. There were 660 males (86%) and 107 females (14%), with a male to female ratio of 6.1:1. A total of 730 of subjects were patients with fractures of the facial skeleton. The mean age was 26.6±12.6 years, ranging from 2 to 81 years. The patients’ age distribution is shown in Figure 1.

The causes of injuries are listed in Figure 2. Traffic accident was the most frequent etiological factor in maxillofacial fractures regardless of gender (69.9% for men and 54.2% for women), whereas the second most frequent cause of injuries was falling down (9.8% for men and 21.5% for women). The other etiologies maintained a similar hierarchy, including: assault (5.2%), sports related injuries (1.3%) and firearm injuries (1%).

According to the investigation of socioeconomic activity, 56.5% of the patients had professional job skill (56.2% for men and 0.3% for women), and 17.6% of them were students (Table 1).

| Occupation     | Male (%) | Female (%) | Total (%) |
|----------------|---------|------------|-----------|
| Self employment| 388(50.5)| 0(0)       | 388(50.5) |
| Employee       | 44(5.7) | 2(0.3)     | 46(6)     |
| Housekeeping   | 0(0)    | 80(10.4)   | 80(10.4)  |
| Student        | 123(16) | 12(1.6)    | 135(17.6) |
| Other          | 106(13.8)| 13(1.7)    | 119(15.5) |

In this study, 730 patients suffered from 1118
Figure 2 The causes of injuries in the traumatic patients

Facial fractures, of which the most common was mandibular fracture with a prevalence of (448, 58.4%) followed by zygomatic complex fracture (185, 24.1%), orbital fracture (116, 15.1%) and maxillary Lefort fracture (95, 12.4%).

The most common mandibular fracture site was the body (31.5%); followed by the condyle (19.3%), the angle (16.9%), the parasympphyseal regions (16.1%), the symphysis area (10.2%), the coronoid process (4.3%) and the ramus (1.6%). The fracture sites are presented in Table 2.

Table 2 Site distribution of maxillofacial fractures

| Region          | Anatomic site            | Number of patients | Percent |
|-----------------|--------------------------|--------------------|---------|
| Upper third     | Frontal sinus fracture   | 6                  | 0.8     |
|                 | Nasoethmoideal fracture  | 26                 | 3.4     |
| Middle third    | Nasal fracture           | 85                 | 11.1    |
|                 | Zygomaticomaxillary      | 185                | 24.1    |
|                 | fracture                 |                    |         |
|                 | Zygomatic arch fracture  | 4                  | 0.5     |
|                 | Orbital fracture         | 116                | 15.1    |
|                 | Maxillary fracture       | 95                 | 12.4    |
|                 | Lefort I                 | 46                 | 6       |
|                 | Lefort II                | 33                 | 4.3     |
|                 | Lefort III               | 16                 | 2.1     |
| Lower third     | Isolated mandibular      |                     |         |
|                 | fracture                 |                    |         |
|                 | Condyle                  | 49                 | 6.4     |
|                 | Coronoid                 | 11                 | 1.4     |
|                 | Ramus                    | 4                  | 0.5     |
|                 | Angle                    | 43                 | 5.6     |
|                 | Body                     | 80                 | 10.5    |
|                 | Para-symphysis           | 41                 | 5.3     |
|                 | Sympysis                 | 26                 | 3.4     |
|                 | Multiple mandibular      | 194                | 25.3    |
|                 | fracture                 |                    |         |
| Other           | Dentoalveolar fracture   | 57                 | 7.4     |

The data regarding head injuries in patients with maxillofacial fractures demonstrated that brain contusion was seen in 227 (29.6%) patients and 13.5% of patients had lacerations in the facial soft tissue. The monthly distribution peaked in October, with 81 cases (10.5%), which seems to have been due to the schools’ opening or the changing weather’s effect on road traffic (Table 3). 696 patients (90.6%) were treated as inpatients with a mean period of hospitalization of 6.5 days, opening.

The next highest incidence was in December, with 80 cases (10.4%), probably because ranging from 1 to 41 days. Patients considered “untreated” accounted for 72 cases (9.4%), including refusal of treatment, death, and institution transfers. The surgical treatment details of 696 patients are shown in Table 4.

Patients were under routine followed-up for up to 1 month after treatment in cases of simple reduction and fixation surgery. Additional follow-up was considered if any complications were encountered in the patients. Of the 768 patients included in this study, 103 (13.4%) showed some degree of postoperative malocclusion that was managed with elastic therapy. Ankylosis was developed in 27 patients (3.5%) and was managed with physiotherapy.

Discussion

Trauma is the leading cause of death in the first 40 years of life. Traumatic injury could be considered as an etiology of productivity loss, causing more loss of working years than heart disease and cancer combined. Fractures of the facial skeleton are a common part of the multiple traumas resulting from the motor vehicle crashes and industrial accidents, as well as the sports and assaults [4]. In most developed countries, violence has replaced vehicle collisions as the main cause of maxillofacial trauma; while, in many developing countries, road traffic...
accidents (RTAs) remain the main cause [5], 50-70% of people who survive the traffic accidents had facial trauma [6].

The etiology of facial trauma reported in this study is similar to that reported in other studies conducted in the Middle East and Africa [1, 7-11] in which RTAs were the main cause of maxillofacial fractures. The present study is also consistent with other studies from other parts of the world [12-17]. On the other hand, assault-related maxillofacial injuries were reported to be more common in developed countries [3-2, 18-21]. In our study, assault-related maxillofacial fractures constituted only 5.2% of cases. It seems that increased use of protective measures such as seat belts, airbags, motorcycle helmets and strictly enforced speed limits in developed countries has been credited with a reduction in the incidence of maxillofacial trauma due to RTAs [22].

The subjects, eligible for inclusion in the study, had a maxillofacial fracture and were referred to the Chamran hospital emergency department. The subjects were excluded from the study if their records were not completed.

Facial fractures were distributed in a fairly normal curve by age with a peak incidence occurring between ages 20 and 30. Also, children under 12 involved in 5-10% of all facial fractures. Most facial traumas in children involved the lacerations and soft tissue injuries. The reasons for the lower incidence of facial fractures in children can be concluded as the face is smaller in relation to the rest of the head, there is a lower proportion of cortical bone to cancellous bone in the children's faces, poorly developed sinuses make the bones stronger and fat pads provide protection for the facial bones [23]. As in this study, a high male-to-female ratio among maxillofacial injury victims has been widely reported [12, 1, 24, 14-15]. This is attributed to the fact that men are more involved in outdoor activities and more frequently exposed to violent interactions. Furthermore, male vehicle drivers outnumber female drivers. This ratio seems to be lower in developed countries because of the greater socioeconomic outdoor activity of women [25-26].

In this study, the isolated mandibular fracture was the most common type of maxillofacial fracture. This is consistent with findings in some other studies [7, 1, 13, 27-30, 14, 18, 31], but different from the studies that reported higher rates of zygomatic [20], nasal [32-33] or midface [34-35] bone fractures. One reason for this difference could be that most of nasal fractures are usually referred to the Namazi hospital where the ENT department is located. Moreover, the cause of trauma in our study was found to be the road traffic accident but in other studies was assault, which often leads to nasal and midface fractures. In our study, the most common site of mandibular fracture was condyle, followed by angle, which is in agreement with some studies [7, 13, 24, 31] but not other researches, in which the angle [36-37], condyle [15], or para-symphysis [38] was the most common site of fracture. The second most common site of mandibular fracture was condyle, followed by angle, parasymphysis, symphysis, coronoid process and ramus.

The definition of the fractures is done based on the place of the fractures, so the absence of an acceptable universal classification of fractures can lead to different result in different studies, therefore, there is a necessity for making a universal classification of facial fractures.

The head and brain injuries are commonly associated with facial trauma, particularly the upper face. The brain injury occurs in 15-48% of people with maxillofacial trauma [39]. Thaller SR reported a 55% incidence of concomitant facial fracture and brain injury [40]. In the current study, brain contusion was found in 29.6% of cases.

In the past 20 years, changes in maxillofacial

| Table 3 Monthly distribution of maxillofacial trauma patients |
|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
|                | January | February | March | April | May | June | July | August | September | October | November | December |
| Number          | 48      | 56       | 35    | 62    | 67  | 76   | 62   | 65     | 71         | 81      | 65        | 80         |
| Percent         | 6.3     | 7.3      | 4.6   | 8.1   | 8.7 | 9.9  | 8.1  | 8.5    | 9.2        | 10.5    | 8.5       | 10.4       |

Table 4 Surgical treatment modalities according to the site of maxillofacial fractures (Fx) (percent)

|                | Mandibular Fx | Maxillary Fx | ZMC Fx | Zygomatic Arch Fx | Nasal Fx | Frontal Fx | Orbital Fx | NOE Fx | Dentoalveolar Fx | Total |
|----------------|---------------|--------------|--------|--------------------|----------|------------|------------|--------|-----------------|-------|
| Open reduction | 69.9          | 75.8         | 83.2   | 0                  | 0        | 50         | 87.9       | 84.6   | 61.4            | 68.8  |
| Close reduction| 25            | 13.7         | 3.2    | 100                | 88.2     | 16.7       | 0.9        | 3.8    | 35.1            | 21.9  |
| No treatment   | 5.4           | 10.5         | 13.5   | 0                  | 11.8     | 33.3       | 11.2       | 11.5   | 3.5             | 9.4   |
trauma management have been strongly influenced by innovations in materials and technology [41-42], since some issues such as early recovery, segment stability and patient comfort have been considered paramount in the treatment of maxillofacial fractures [43]. The treatment of facial fractures varies from surgeon to surgeon and it also depends on the available instruments. The reports from the United Arab Emirates [44] and Nigeria [45] stated that open reduction and rigid internal fixation of the facial fractures have not become popular in most developing countries, mainly because of the cost issue [46]. In a study performed in Iran between 1987 and 2001, Ansari reported a marked predilection for “simple techniques” and most patients (70.8%) were treated by applying closed procedures [12]. Since 2004 in Iran, all costs of the management of trauma patients were covered by the government and the trend changed toward the use of internal rigid fixation. Our study showed that 68.8% of patients were treated by miniplates’ osteosynthesis; only 21.9% of them were managed by closed techniques, confirming the effect of cost on the treatment planning.

Conclusion
Isolated mandibular fracture due to road traffic accident was the most common type of maxillofacial injuries in the city of Shiraz. These findings should also alert the authorities, particularly the government to the need for the provision of good roads, enforcement of existing traffic laws and general improvement of the socioeconomic condition of the community.

Conflict of Interest
The authors of this manuscript certify that they have no financial or other competing interest regarding this research.

References
[1] Bataineh AB. Etiology and incidence of maxillofacial fractures in the north of Jordan. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998; 86: 31-35.
[2] Dimitroulis G, Eyre J. A 7-year review of maxillofacial trauma in a central London hospital. Br Dent J 1991; 170: 300-302.
[3] Telfer MR, Jones GM, Shepherd JP. Trends in the aetiology of maxillofacial fractures in the United Kingdom (1977-1987). Br J Oral Maxillofac Surg 1991; 29: 250-255.
[4] Fonseca RJ. Mandibular fractures. Oral and Maxillofacial Trauma. 3th ed., Elsevier Sanders: USA; 2005. p. 486-487.
[5] Girotto JA, MacKenzie E, Fowler C, Redett R, Robertson B, Manson PN. Long-term physical impairment and functional outcomes after complex facial fractures. Plast Reconstr Surg 2001; 108: 312-327.
[6] Adeyemo WL, Ladeinde AL, Ogunlewe MO, James O. Trends and characteristics of oral and maxillofacial injuries in Nigeria: a review of the literature. Head Face Med 2005; 1: 7.
[7] Bailey BI, Johnson JT, Newlands SD, et al. Head & Neck Surgery: Otolaryngology. 4th ed., Hagerstown, MD: Lippincott Williams & Wilkins; 2005. p. 935-936.
[8] Khan AA. A retrospective study of injuries to the maxillofacial skeleton in Harare, Zimbabwe. Br J Oral Maxillofac Surg 1988; 26: 435-439.
[9] Khalil AF, Shaladi OA. Fractures of the facial bones in the eastern region of Libya. Br J Oral Surg 1981; 19: 300-304.
[10] Lawoyin DO, Lawoyin JO, Lawoyin TO. Fractures of the facial skeleton in Tabuk North West Armed Forces Hospital: a five year review. Afr J Med Sci 1996; 25: 385-387.
[11] Oikarinen K, Schutz P, Thalib L, Sándor GK, Clokie C, Meisami T, Safar S, et al. Differences in the etiology of mandibular fractures in Kuwait, Canada, and Finland. Dent Traumatol 2004; 20: 241-245.
[12] Ansari MH. Maxillofacial fractures in Hamedan province, Iran: a retrospective study (1987-2001). J Craniomaxillofac Surg 2004; 32: 28-34.
[13] Fasola AO, Nyako EA, Obiechina AE, Arotiba JT. Trends in the characteristics of maxillofacial fractures in Nigeria. J Oral Maxillofac Surg 2003; 61: 1140-1143.
[14] Abiose BO. Maxillofacial skeleton injuries in the western states of Nigeria. Br J Oral Maxillofac Surg 1986; 24: 31-39.
[15] Hussain SS, Ahmad M, Khan MI, Anwar M, Amin M, Ajmal S, et al. Maxillofacial trauma: current practice in management at Pakistan Institute of Medical Sciences. J Ayub Med Coll Abbottabad 2003; 15: 8-11.
[16] Iida S, Kogo M, Sugiura T, Mima T, Matsuya T. Retrospective analysis of 1502 patients with facial fractures. Int J Oral Maxillofac Surg 2001; 30: 286-290.
[17] Shapiro AJ, Johnson RM, Miller SF, McCarthy MC.
Facial fractures in a level I trauma centre: the importance of protective devices and alcohol abuse. Injury 2001; 32: 353-356.

[18] Erol B, Tanrikulu R, Görgün B. Maxillofacial fractures. Analysis of demographic distribution and treatment in 2901 patients (25-year experience). J Craniomaxillofac Surg 2004; 32: 308-313.

[19] Ström C, Nordenram A, Fischer K. Jaw fractures in the County of Kopparberg and Stockholm 1979-1988. A retrospective comparative study of frequency and cause with special reference to assault. Swed Dent J 1991; 15: 285-289.

[20] al-Qurainy IA, Stassen LF, Dutton GN, Moos KF, el-Attar A. The characteristics of midfacial fractures and the association with ocular injury: a prospective study. Br J Oral Maxillofac Surg 1991; 29: 291-301.

[21] Scherer M, Sullivan WG, Smith DJ Jr, Phillips LG, Robinson MC. An analysis of 1,423 facial fractures in 788 patients at an urban trauma center. J Trauma 1989; 29: 388-390.

[22] Asadi SG, Asadi Z. Sites of the mandible prone to trauma: a two year retrospective study. Int Dent J 1996; 46: 171–173.

[23] Moore EE, Feliciano DV, Mattox KL. Trauma. 5th ed., McGraw-Hill Professional: New York; 2003. p. 149-165.

[24] Fleisher GR, Ludwig S, Henretig FM. Textbook of Pediatric Emergency Medicine. Hagerstown, MD: Lippincott: Williams & Wilkins; 2006. p. 1475–177.

[25] Oji C. Jaw fractures in Enugu, Nigeria, 1985-95. Br J Oral Maxillofac Surg 1999; 37: 106-109.

[26] Meyer U, Benthaus S, Du Chesne A, Wannhof H, Zöllner B, Joos U. Examining patients with facial skull fractures from an etiological and legal perspective. Mund Kiefer Gesichtschir 1999; 3: 152-157.

[27] Gassner R, Tuli T, Hächtl O, Rudisch A, Ulmer H. Cranio-maxillofacial trauma: a 10 year review of 9,543 cases with 21,067 injuries. J Craniomaxillofac Surg 2003; 31: 51-61.

[28] Zachariaides N, Papavassiliou D. The pattern and aetiology of maxillofacial injuries in Greece. A retrospective study of 25 years and a comparison with other countries. J Craniomaxillofac Surg 1990; 18: 251-254.

[29] Perkins CS, Layton SA. The aetiology of maxillofacial injuries and the seat belt law. Br J Oral Maxillofac Surg 1988; 26: 353-363.

[30] Dimitroulis G, Eyre J. A 7-year review of maxillofacial trauma in a central London hospital. Br Dent J 1991; 170: 300-302.

[31] Motamed MH. An assessment of maxillofacial fractures: a 5-year study of 237 patients. J Oral Maxillofac Surg 2003; 61: 61-64.

[32] Maladière E, Bado F, Meningaud JP, Guilbert F, Bertrand JC. Aetiology and incidence of facial fractures sustained during sports: a prospective study of 140 patients. Int J Oral Maxillofac Surg 2001; 30: 291-295.

[33] Muraoka M, Nakai Y. Twenty years of statistics and observation of facial bone fracture. Acta Otolaryngol Suppl 1998; 538: 261-265.

[34] Le BT, Dierks EJ, Ueeck BA, Homer LD, Potter BF. Maxillofacial injuries associated with domestic violence. J Oral Maxillofac Surg 2001; 59: 1277-1283.

[35] Gray E, Dierks E, Homer L, Smith F, Potter B. Survey of trauma patients requiring maxillofacial intervention, ages 56 to 91 years, with length of stay analysis. J Oral Maxillofac Surg 2002; 60: 1114-1125.

[36] Gassner R, Ulmer H, Tuli T, Emsenhof R. Incidence of oral and maxillofacial skiing injuries due to different injury mechanisms. J Oral Maxillofac Surg 1999; 57: 1068-1073.

[37] Bamjee Y, Lownie JF, Cleaton-Jones PE, Lownie MA. Maxillofacial injuries in a group of South Africans under 18 years of age. Br J Oral Maxillofac Surg 1996; 34: 298-302.

[38] Ogundare BO, Bonnick A, Bayley N. Pattern of mandibular fractures in an urban major trauma center. J Oral Maxillofac Surg 2003; 61: 713-718.

[39] King RE, Scianna JM, Petruzzelli GJ. Mandible fracture patterns: a suburban trauma center experience. Am J Otolaryngol 2004; 25: 301-307.

[40] Thaller SR. Facial trauma. 2th ed., New York: Marcel Dekker; 2004. p. 11, 23.

[41] Davidoff G, Jakubowski M, Thomas D, Alpert M. The spectrum of closed-head injuries in facial trauma victims: incidence and impact. Ann Emerg Med 1988; 17: 6-9.

[42] Adebayo ET, Ajike OS, Adekeye EO. Analysis of the pattern of maxillofacial fractures in Kaduna, Nigeria. Br J Oral Maxillofac Surg 2003; 41: 396-400.

[43] Laskin DM, Best AM. Current trends in the treatment of maxillofacial injuries in the United States. J Oral Maxillofac Surg 2000; 58: 207-215.

[44] Al Ahmed HE, Jabar MA, Abu Fanas SH, Karas M. The
pattern of maxillofacial fractures in Sharjah, United Arab Emirates: a review of 230 cases. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2004; 98: 166-170.

[45] Adebayo ET, Ajike OS, Adekeye EO. Analysis of the pattern of maxillofacial fractures in Kaduna, Nigeria. Br J Oral Maxillofac Surg 2003; 41: 396-400.

[46] Qudah MA, Bataineh AB. A retrospective study of selected oral and maxillofacial fractures in a group of Jordanian children. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002; 94: 310-314.