**Epidemiologic Analysis and Evaluation of Complications in 1266 Cases with Maxillofacial Trauma**

Cenk Demirdover, Alper Geyik, Hasip Samil Yazgan, Fatih Alp Ozturk, Suleyman Cakmak, Haluk Vayvada, Adnan Menderes, Mustafa Yilmaz

Department of Plastic, Reconstructive, Aesthetic and Hand Surgery, Faculty of Medicine, Dokuz Eylul University, Izmir, Turkey

**Abstract**

**Introduction**: Patients with maxillofacial trauma represent a major group of patients in plastic surgery practice. These traumas are often caused by in-car and noncar road accidents and can result in permanent damages. This study aims at providing an epidemiologic analysis of such cases together with their diagnostic procedures, treatment methods, and postoperative complications. **Materials and Methods**: A total of 1266 maxillofacial trauma cases that were operated on between 2003 and 2017 were studied, and analyzed for fractured bones, etiology, diagnosis and treatment principles, and complications. **Results**: The major etiologic factor causing maxillofacial trauma in our study is noncar road accidents (25.5%). Mandible fractures were seen to be the most common type of bone fracture (52.2%). Together with physical examination, computerized tomography and orthopantomography are the diagnostic procedures we effectively use in our clinic. Rigid and semi-rigid fixation with plate and screws are the most frequently used treatment methods, and complication rates are seen to be lower (by 6.6%) than those reported in the literature. **Conclusion**: Careful and meticulous processes, as well as effective follow-up of the patient are required to achieve optimal esthetic and functional results in maxillofacial trauma cases. Such approach can help to reduce the possibility of complications and allow for their early identification, hence early intervention.

**Keywords**: Complications, maxillofacial fractures, rigid internal fixation

**Introduction**

Many studies conducted in various countries report different incidences for maxillofacial trauma, these cases nevertheless represent a major group among the emergency cases in plastic surgery practice after hand injuries.[1] These traumas can vary etiologically based on age and gender; most often, however, they are caused by road accidents involving both in-car and noncar road accidents. Its etiology varies widely based on geographical region, cultural status, and lifestyle differences, as well as on socioeconomic status.[2,3] The treatment of maxillofacial traumas involves facial bone fractures in the head and neck region, dentoalveolar trauma, and soft-tissue damage.[4] Because these traumas often accompany multiple traumas such as traumas of the head, the spine, and the lower or upper extremities, increased morbidity and longer treatment times are seen in this patient group. Epidemiologic studies have an important part in the prevention of this process.[5] The gold standard imaging modalities for diagnosis are computerized tomography and orthopantomography. The rigid fixation technique using plates as developed by Michelet and modified by Champy et al. is the most widely used repair approach in treatment.[6]

The purpose of this study is to present the occurrence mechanism of maxillofacial traumas, the most affected bone structures, distribution of these variables by patient’s age, treatment methods used, and the resulting complications in comparison to the reports in the literature.

**Materials and Methods**

In this study, data of 1266 patients who had either directly applied or were referred by the ER to our clinic between the years of 2003 and 2017 were retrospectively analyzed. All age groups were included in the study, the fractures were diagnosed by Champy et al. is the most widely used repair approach in treatment.[6] The purpose of this study is to present the occurrence mechanism of maxillofacial traumas, the most affected bone structures, distribution of these variables by patient’s age, treatment methods used, and the resulting complications in comparison to the reports in the literature.

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**Address for correspondence:** Dr. Alper Geyik, Department of Plastic, Reconstructive, Aesthetic and Hand Surgery, Dokuz Eylül University, Faculty of Medicine, Inciralti, Izmir, 35340, Turkey.
E-mail: alp_er027@hotmail.com

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through physical and radiological examinations and classified according to the AO-CMF criteria. The specialized study group AO evaluates cranio-maxillofacial fractures in three levels based on anatomic complexity and pattern. The data distribution of our study relate to the first two levels of this classification. These two levels involve the fractured areas in the face and the distribution of anatomic localizations of fractured facial bones. Accordingly, mandibular fractures (dentoalveolar, symphysis-parasymphysis, corpus, angulus-ramus, coronoid, and condylar processes); maxillary fractures (alveolar, Le Fort Types I, II, III); nasal fractures, nasoorbital fractures, orbital fractures (floor, medial, roof, and lateral walls); zygoma fractures (zygomatic complex and arch); and frontal sinuses fractures were reviewed. The patient’s data were retrieved from our clinic database by retrospective screening of records from the mentioned period. Distribution of fractures was examined by years. Means of occurrence were identified as in-car or noncar accidents, falling, assault, firearms injury, and other causes. Surgical treatments were identified by patient’s age, localization, pattern, stability, and etiology of fracture; and postoperative complications were evaluated.

Results

Of the 1266 patients included in the study, 895 are male (70.7%) and 371 are female (29.3%); male-to-female ratio is 2.4. Mean age was 32.16 ± 15.44, ranging from 1 to 86. Of the total patients treated between the years of 2003 and 2017, the number of patients treated in 2002–2003 was 42. The highest number of patients (205 patients) was observed in 2014–2015 [Figure 1]. A review of the distribution by months over the years showed that the highest number of patients were treated in the May–August period. The most common etiologic cause was noncar road accidents (324 patients, 25.5%). Of these 324 patients, 241 had motorcycle accidents and 303 had presented to the clinic with injuries from in-car accidents. Etiological factors were identified as falling in 223 patients (17.6%), blunt trauma in 206 patients (16.2%), assault in 155 patients (12.2%), and other causes (e.g., tooth extraction and odontogenic cyst) in 35 patients (2.7%), maxillofacial fractures associated with firearms injuries were identified in 20 patients (1.5%).

According to the national records from the years 2007–2016, the number of road traffic accidents – the top etiological factor identified in our study – was highest in 2015 with 1.313.359 road traffic accidents in which 304.421 were injured. Interestingly, the number of maxillofacial surgeries performed were also highest in the same year.

Distribution of bone fractures by structures was 661 mandibular fractures (52.2%), 408 zygoma fractures (32.2%), 217 maxillary fractures (17.1%), 107 orbital fractures (8.4%), 50 nasal fractures (3.9%), 38 frontal sinus fractures (3%), 36 panfacial fractures (2.8%), and 33 nasoorbitoethmoid fractures (2.6%). Given this data, considering panfacial and nasoorbitoethmoid fractures as one group, 1550 different types of fractures were treated in 1266 patients.

Distribution of mandibular fractures by localization was 334 (50.5%) in the symphysis-parasymphysis region, 183 (27.6%) in the angulus-ramus region, 126 (19%) in the corpus, 109 (16.4%) in the condylar region, 26 (3.9%) in the dentoalveolar area, and 12 (1.8%) in the coronoid region [Table 1]. A total of 325 of the zygoma fractures were zygoma complex fractures (79.6%), and 83 were isolated zygoma arch fractures (20.4%). Of the 107 orbital fractures, 62 patients (57.9%) had fractures in the orbital floor. Eight hundred and eighteen patients had a single bone fracture. Cases of 448 patients involved multiple bones. Average time to surgery after trauma was 13.7 days. The earliest surgical procedure was performed on the same day and the latest on the 362nd day of the trauma. Some pre- and post-operative computed tomography scans are shown in Figures 2-8.

The most commonly applied surgical treatment was seen to be open reduction and internal fixation. In cases with mandibular fractures, fracture site, pattern, presence of a single fracture or multiple fractures, and intrinsic stability were assessed, after which rigid fixation (load bearing) techniques with 2.4-mm diameter miniplates and screws, or functional stable fixation (semirigid fixation) techniques with plates suitable to 2.0-mm diameter screws were used together, also with intermaxillary fixation (arch bar or screw) depending on the localization of the fracture. Closed reduction was the most commonly used treatment method in cases with nasal fractures and isolated zygomatic arch fractures. Soft-tissue reconstruction was performed in cases which soft-tissue damage accompanied fractures. In one case, facial nerve reconstruction was performed due to accompanying damage. In cases with orbital floor fractures bone reduction was

<table>
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<tr>
<th>Etiology</th>
<th>Symphysis-parasymphysis</th>
<th>Corpus</th>
<th>Angulus-ramus</th>
<th>Condyle</th>
<th>Coronoid</th>
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<td>30</td>
<td>51</td>
<td>25</td>
<td>2</td>
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<tr>
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<td>35</td>
<td>63</td>
<td>38</td>
<td>5</td>
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<tr>
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<td>51</td>
<td>13</td>
<td>28</td>
<td>16</td>
<td>2</td>
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<td>15</td>
<td>23</td>
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<td>-</td>
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<tr>
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<td>5</td>
<td>5</td>
<td>2</td>
<td>2</td>
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</table>

Table 1: Analysis of etiological factors by parts of the mandible
performed by inserting a foley catheter into the maxillary sinus. In pediatric patients with large defects, cartilage grafting was used, and in adult patients, porous polyethylene and titanium mesh plates were used for the reconstruction of the orbital floor.

Early or late postoperative complications developed in 84 of the patients (6.6%) included in the study [Figure 9].
Postoperative findings in 83 patients, particularly pain during mastication that did not regress for 6 months; plate exposition; plate infection; malocclusion; malunion/nonunion; enophthalmos; and postoperative ectropion/scleral show which was not identified in the preoperative physical examination, and temporomandibular joint ankylosis that developed after condyle fracture in one patient were accepted as postoperative complications.

**DISCUSSION**

The frequency of maxillofacial trauma incidences is seen to increase in the recent years, and in turn leading to significant increases in health expenditures. Many studies are reported in the literature on the etiology of maxillofacial traumas. Results of these studies indicate road traffic accidents as the most common causes in these types of traumas. Likewise, in our study, noncar road accidents were identified to be the top cause with 324 patients and a ratio of 25.5%. In some developed countries, however, these ratios are seen to vary, and maxillofacial traumas caused by road traffic accidents are seen to be less common.

In Turkey, patient numbers and health expenditures can be reduced by means of effective measures against road traffic accidents. Further epidemiological studies can contribute to raising public awareness about these types of traumas and their precautions.

Our study showed a higher ratio of maxillofacial trauma incidences among men than women. This finding is consistent with the results of many studies reported in the literature. That men have more active social roles, higher rates of business ownership, tend to drive more often, and to act more violently contribute to this result.

With regards to the mean age, maxillofacial trauma incidences tend to increase among young- and middle-aged individuals, yet etiological factors vary among the age groups. While fractures mostly occur during daily activities and playing in pediatric ages; road traffic accidents are more frequent among middle-aged individuals, albeit this can vary depending on the socioeconomic level of countries; and falling has a major role among the elderly.

Six hundred and sixty-one (52.2%) of the 1266 patients included in the study were identified to have mandibular fractures. This ratio is found to be comparable, although higher, to those reported by similar studies. Furthermore, there are studies that indicate nasal bones as the most commonly (40%) fractured structure in maxillofacial traumas. Such fractures can be seen as both isolated and together with other fractures. While conservative approach is used for the follow-up of some isolated nasal fracture patients, others are treated in the ER by plastic surgeons or otorhinolaryngologists with basic equipment. These are deemed to be the reasons why the nasal fracture ratio in our retrospective study was found lower than those reported in the literature.

With regards to the directions of the mandibular force vectors, fractures in the symphysis-parasymphysis and angulus-ramus groups were seen to be rather accompanied by condyle fractures in our study. Therefore, when considering imaging techniques in these types of injuries, each segment should be examined individually. Apart from road traffic accidents being the major cause of such fractures, assaults, and blunt traumas are significant causes in mid-face fractures.
Surgeries of these patients can be delayed since maxillofacial traumas are often accompanied by comorbidities. That patients are often referred to our clinics after being treated in the ERs of external health institutions or fractures are identified in the late stage only after patients experience increased complaints, contribute to higher complication rates, and as well complicate the reconstruction procedure itself.

Complications were encountered in only 84 (6.6%) of the 1266 patients that were operated on for their fractures. The complication rates in our study are found to be considerably low compared to those reported in the literature.[21] The most common complications in our study were malocclusion (25%) and plate exposition (24%). Malocclusion and malunion (7%) develop as a result of insufficient reduction and fixation. Intermaxillary fixation plays an important role in remedying these types of complications. Risks for these types of complications are higher in patients whose system cannot adapt to intermaxillary fixation. Delays in treatment related to other factors can also increase infection and nonunion risks.[22] Subciliary incision is the approach used in our clinic in cases with fractures of the orbital floor, the zygoma, and the maxilla. Retraction of the lower eyelid can occur as a result of the incision technique. Composite soft-tissue defects can develop in addition to multiple bone fractures, especially in cases that occur secondary to firearms injuries. To close these defects, lacerations were primarily sutured, and partial flaps were approximated to the defect, and after debridement of suitable areas skin grafts, local and regional flaps (mucosal flap, forehead flap, etc.), and free flaps (free fibula, free parascapular flap, etc.), were used. In 2 cases with additional bone defects, iliac bone graft was used along with rigid fixation. Complications developed in 5 (25%) out of 20 patients that underwent bone reconstruction for firearms injury. Three of these complications were plate infection and were necrotic bone and plate exposition. Compared to the other etiological causes, plate infection and plate exposition were encountered in more in firearms injury cases. This may be because these types of wounds are often contaminated, and treatment is often delayed because of other fatal traumas, and soft tissue is insufficient.

Champy’s open reduction and titanium alloy plate-screw systems and internal fixation techniques are the most commonly used treatment methods. Load-bearing and load-sharing osteosynthesis techniques were also used depending on the evaluated condition of the fracture. Given that fixation techniques of the past that used wires are today replaced by titanium or degradable plates and screws, it is possible that bone adhesives will replace today’s techniques as technology advances. Such advanced techniques would eliminate unfavorable outcomes such as plate exposition or infection that account for 39.2% of the complications encountered in our study.

**Conclusion**

Maxillofacial fractures are frequently encountered traumas. Optimal functional and esthetic outcomes should be considered since they involve the face region. The essential approach in such cases is to manage the treatment once life-threatening conditions are eliminated, and the patient is stabilized. More satisfactory results can be achieved with the recently developed plate-screw systems, biomaterials, and techniques. Notwithstanding the advancements, depending on the mode of the maxillofacial trauma, permanent functional damages can occur in seeing, mastication, or speaking. Since the major cause of these types of traumas, i.e., road traffic accidents, can be prevented or mitigated, measures to be taken to that end seems to be the most reasonable approach both for enhancing life quality and preventing labor losses and for minimizing health expenditures.

We believe that using the best suitable surgical approach as determined by experienced teams, meticulous performance of the surgery, early intervention, using the appropriate plate-screw systems, careful postoperative follow-up of the patient, as well as developing fully-equipped and expert multidisciplinary centers will serve to minimize complication rates.

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**Conflicts of interest**

There are no conflicts of interest.

**References**

Demirdover, et al.: Maxillofacial trauma