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CLINICAL PAPER

# Epidemiological Study of the Socioeconomic Impact of Mandible Fractures in a Spanish Tertiary Hospital: Review of the Literature

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**Abstract**

*Introduction* Mandibles fractures are one of the most frequent pathologies treated in an Oral and Maxillofacial Department and represent a serious public health problem.

*Materials and Methods* We present a retrospective study of patients treated for mandible fractures by the Oral and Maxillofacial Surgery Department in a Spanish tertiary hospital during 2010–2012.

*Results* One hundred and thirty-nine patients with 201 mandible fracture sites were assisted in our department; 15% were female and 85% were male, with a male-to-female ratio of 5.5:1. The observed mean age was 35 years with a range between 15 and 89 years. The most frequent etiology of fractures was the assault (43%) followed by falls (32%). The most common fracture site was the mandibular angle (35%), followed by the parasymphysis (30%). Concerning combined fractures (60%), the most repeated association was the angle and the parasymphysis. The principal imaging test for diagnosis was the orthopantomography. The intermaxillary fixation was performed in the 25% of cases, and the rest of mandible fractures were fixed by osteosynthesis. The surgical treatment had an average of 4.2 days after the trauma, and the mean time of hospitalization was 6.5 days.

*Conclusion* The principal aim of the treatment of mandible fractures is to restore the function of the patient occlusion. A malocclusion after surgery may decrease the patient quality of life, so a correct fracture reduction could shrink health spending. After the result shown in the present study, the social education should be improved in the developed countries with the objective of decline in the amount of aggressiveness.

**Keywords** Oral surgery · Mandible fractures · Maxillofacial trauma

## Introduction

Fractures of the facial bones are one of the most frequent pathologies treated in an Oral and Maxillofacial Department. Among them, the mandible is one of the most affected bones, accounting for 15.5% to 59% of all the facial fractures according to several studies [1, 2]. That represents a serious public health problem which becomes a socioeconomic problem too.

The epidemiology is widely variable among different countries, lifestyle and socioeconomic differences [3, 4]. The epidemiological study of the mandible fractures acquires importance due to both therapeutic and resource management. That is why the establishment of some preventive measures such as health education could be the key to avoid some facial fractures [4].

Analysis of the epidemiology of mandibular fractures reveals the etiology, sex and age, oral health, time between injury and treatment, types and the most common site of fractures, complications and long-term follow-up [5]. As

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we know, the incidence of mandible fractures varies depending on the different countries [3, 4, 6–21].

The principal causes of mandible fractures are road traffic accidents, assaults, casual falls, pathological fractures and sports injuries [22]. We can notice that in some studies the road traffic accidents are the primary cause of facial fractures which usually correspond to developing countries [15, 22]. However, interpersonal violence has become increasingly important as an etiological factor [18]. Nowadays, a decrease in the mandible fractures caused by traffic accidents due to the toughening of legislation and safety improvements like the airbag has been observed [23, 24].

The principal aim of the surgical treatment is first of all restoring mandibular function. Otherwise, malocclusion can cause important morbidity. On the other hand, the esthetic aspect is also essential for preserving quality of life.

The present study tries to know the epidemiological analysis of the surgical mandible fractures in a tertiary hospital of Spain to implement new preventive measures in our society.

## Materials and Methods

We present a retrospective study of patients treated for mandible fractures by the Oral and Maxillofacial Surgery Department at the Miguel Servet University Hospital (Spain) during the years 2010–2012. Only mandible fractures treated under general anesthesia or local and sedation anesthesia were included in the present study. Pediatric mandible fractures (age $< 14$ years), non-surgical mandible fractures and patients with incomplete medical records were excluded.

We collected the following data: age, sex, origin, etiology, date of fracture, imaging test, subtype of fracture, date of surgery, surgical technique, date of discharge and postoperative complications. The type of fixation system was also recorded.

Non-displaced subcondyle and condyle fractures were treated by intermaxillary fixation. Just one preformed plate was used by angle fractures, and two miniplates were placed in the symphysis and parasymphysis. The follow-up was 12 months.

The following causes of injury were considered: road traffic accident, assault, falls, sport injuries, pathological fractures and others. The different subtypes of mandible fracture were classified in: symphysis, parasymphysis, angle, subcondyle and condyle. Chi cuadrado was used to show statistical differences between qualitative data.

All analyses were performed using IBM SPSS Statistics for Mac, version 20.0. This study respects the principles of the Declaration of Helsinki.

## Results

Between January 1, 2010, to December 31, 2012, 139 patients with 201 mandible fracture sites were assisted in our Maxillofacial Department in a tertiary hospital of Spain. Of the 139 patients included in the study, 21 (15%) were female and 118 (85%) were male, with a male-to-female ratio of 5.5:1.

The observed mean age was 35 years with a range between 15 to 89 years. Attending to the origin, the most patients treated in our hospital came from our city, Zaragoza, with a total of 77 patients (55%); the rest of the patients came from surrounding areas.

The most frequent etiology of fractures was the assault with 60 patients (43%) followed by falls with 45 patients (32%), road traffic accidents (14%), sports (10%) and pathologic fractures (1%). Concerning the group of the patients with sport injuries, cycling was the most frequent causative factor in 5% of the patients followed by football (4%) and skiing (1%).

Significative differences in etiology were showed between males and females patients. The most common causes of mandible fractures in males was assaults and in females was casual falls, 79% and 72%, respectively ($p < 0.05$).

The most common fracture site was the mandibular angle (35%), followed by the parasymphysis (30%), subcondyle fracture (30%) and symphysis (5%) (Fig. 1). Concerning combined fractures (60%), the most repeated association was the angle and the parasymphysis.

The most frequent presenting sings and symptoms were pain, malocclusion, limitation of mouth opening and tooth

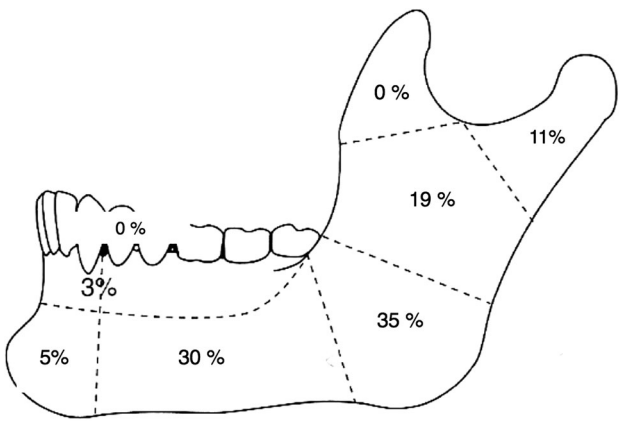


**Fig. 1** Mandible fractures sites

mobility. The principal imaging test for diagnosis was the orthopantomography which was used in the 94% of the cases; computed tomography (CT) was needed in 21% of cases.

The intermaxillary fixation was performed in the 25% of cases (non-displaced subcondyle and/or intracapsular condyle fracture). The remaining mandible fractures were fixed by osteosynthesis with one preformed plate in the angle and two plates in the symphysis and parasymphysis. All fractures were treated by intraoral approach except one condyle fracture in which the preauricular approach was used.

Most patients received their first surgical treatment an average of 4.2 days after the trauma because mandible fractures were operated scheduled in our hospital. The mean time between surgery and hospital discharge was 1.2 days; so the mean time of hospitalization was 6.5 days. Unlike other fractures, it was shown there is no relation between operation in the first 72 h and the complication rates [25]. The months where we operated more mandible fractures are shown in Fig. 2.

## Discussion

The National Health Service data from 2015 show that Spain spends 65 billion of euros per year on the health care, meaning 1.412 euro per person. The increase in the spending is between 7 and 11% in the last 20 years [26]. Most mandible fractures need surgery which increase the hospital cost.

Moreover, the epidemiological analysis of mandible fractures helps us to know whether there are more or less accidents than years before, the severity of them and the social behavior [7]. The knowledge of the etiology can improve the prevention and consequently lessen the health spending.

The epidemiology of mandibular fractures has changed dramatically with the advent of lower speed limits, new safety belt, air bag and helmet laws; however, the literature has shown an increased urban violence [27], especially in the developing countries.

According to the gender, we mainly found that men are significantly more affected than women with a proportion of 5.5:1. It has been shown in the literature, but there are no many studies with such results [4] (Table 1). The significant difference between males and females is due to the males much more involved in the interpersonal violence [28]. In fact, in our study there is no female-related assault.

The mean age of the patients included in our study is 35 years, which is similar to the literature reviewed. Maxillofacial and mandible fractures occur most frequently in people aged 20–30 years [18] (Table 1).

In relation to the etiology of mandible fractures, interpersonal violence is the most common cause for mandibular fractures in North American countries [29], North European countries [29], Australia [30] and New Zealand [31]; as we see in the present study. This situation could be related to the substance abuse, immigration and tourism given that almost the half of our patients were from other countries. In less developed countries, motor vehicle accidents are the most common cause for mandibular fractures [32, 33]. However, in the highest socioeconomic standard country in the world, Switzerland, the main cause of mandible fractures is the traffic accident followed closely by sports accident [34]. As outlined in the bibliography, the etiology of craniomaxillofacial injuries is multifactorial, mostly depending on socioeconomic, demographic, cultural, technological and environmental factors.

The anatomic distribution of mandible fractures is widely variable and sometimes depends on the mechanism. In our study, the angle is the most frequently isolated mandible fracture reported in others studies [21, 35, 36]. However, other studies have shown the most frequently

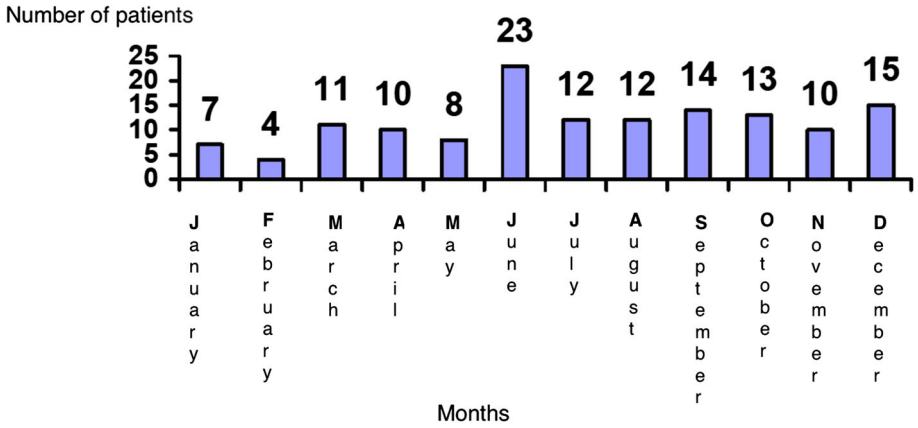


**Fig. 2** Mandible fracture surgeries per month

**Table 1** Epidemiological characteristics of literature revised

| Study | Location | Country | Ratio male/female | Mean age | Location | Principal etiology |
|---|---|---|---|---|---|---|
| Zandy et al. [51] | Maxillofacial fractures | Iran | 3.3:1 | 24 | Nasal bone | Traffic accidents |
| Gassner et al. [10] | Maxillofacial trauma | Austria | 2:1 | 35 | Dentoalveolar fracture | Activity of daily |
| Gandhi et al. [32] | Maxillofacial trauma | India | 6.6:1 | 31.8 | Symphysis | Traffic accidents |
| Brasileiro et al. [12] | Maxillofacial trauma | Brasil | 4:1 | 28 | Mandible | Traffic accidents |
| Lee et al. [52] | Maxillofacial trauma | Korea | 3.2:1 | 31 | Nasal bone | Violence |
| Simsek et al. [53] | Mandible fractures | United States | 5.5:1 | 30.4 | Angle | Violence |
| Simsek et al. [53] | Mandible fractures | Turkey | 3.2:1 | 30.6 | Body | Traffic accidents |
| Laski et al. [11] | Maxillofacial trauma | USA | 2.5:1 | 30.5 | Mandible | Violence |
| Gutta et al. [39] | Mandible fractures | United States | 7.4:1 | 35 | 1. Angle<br>2. Condyle | Violence |
| Zix et al. [34] | Mandible fractures | Switzerland | 2.7:1 | 37 | 1. Condyle<br>2. Symphysis | Traffic accidents |
| Depprich et al. [29] | Mandible fractures | USA | 2.3:1 | 33 | 1. Condyle<br>2. Angle | Violence |
| Oikarien et al. [41] | Mandible fractures | Kuwait | 6.45:1 | 26 | 1. Body<br>2. Angle | Violence |
| Oikarien et al. [41] | Mandible fractures | Canada | 5:1 | 31 | 1. Condyle<br>2. Angle | Violence |
| Oikarien et al. [41] | Mandible fractures | Finland | 2.6:1 | 30 | 1. Condyle<br>2. Body | Violence |
| De matos et al. [2] | Mandible fractures | Brasil | 4:1 | 28 | 1. Condyle<br>2. Body | Traffic accidents |
| Our study | Mandible fracture | Spain | 5.5:1 | 35 | 1. Angle<br>2. Parasymphysis | Violence |

affected site is the symphysis and parasymphysis like in the study of Patrocinio [5] and Abosadegh [37] from Malaysia. It is noteworthy that the main cause of mandible fractures in our region is the violence, and it is known that assault is a significant predictor for isolated mandible fracture [38], just like occurred in our study or in others' studies in the developed countries [39–41].

Patrocinio et al. [5] studied 93 patients with mandibular fractures whose main signs and symptoms were pain, swelling, hematoma, dental malocclusion, facial contour deficit, cracking and mobility of bone fragments. In the present study, the main symptom was the pain (92%) followed by the malocclusion (69%); we have barely seen hematoma and facial contour distortion.

Due to the inclusion criteria, the non-surgical mandible fractures, treated with ground, were excluded from our study. Plate osteosynthesis has become popular in the treatment of mandibular fractures and offers some advantages to the surgeons and the patients [42]. Surgeons get a stable reduction which can help to establish occlusion and eliminates the need for intermaxillary fixation. Moreover, we think it is the best option because it allows the immediate recovery of function and shortens period of consolidation favoring a quick osseointegration. We use the intermaxillary fixation with elastics during 20 days for subcondyle barely or non-displaced fracture and for intracapsular condyle fracture with the object of early temporomandibular joint function.

Planning surgical treatment depends on the patient and also on the surgeon; nevertheless, the intraoral approach was the election in our study in the 70% of the patients because it is simple, fast, safe, efficient and esthetic. It allows an opening and anatomic reduction with internal fixation with plates and screws. Horibe et al. [43] showed some complications in the fractures fixed through an extra oral approach that did not observe by the intraoral approach for example. We use an extra oral approach for the patients with displaced subcondyle and condyle fractures and for atrophic mandible fractures.

We usually treated the mandible fractures as a scheduled surgery for the week in which they are admitted to the hospital. Early reduction in mandibular fractures has been associated with diminished rates of complications such as infection [27]. However, these results are controversial as

in some studies, the authors did not observe any correlation between the day of treatment and the complication rates [2]. Our study is similar to the Patrocinio's [5] study where the 73% of the mandibular fractures were treated within the first week unlike the Matos' [2] study where almost half of the patients were treated the same day as the injury.

We have shown an average of 4.2 days between injury and the surgical treatment; similar data were observed by James [27]. In the study of Allareddy et al. [44], the mean length of stay in the hospital was 6.23 days, similar to our results. Domingo et al. [45] showed that duration between injury and surgery did not affect surgical site infection rate. With respect to our study, we have not registered any surgical site infection in spite of not operating the fracture the same day of the injury.

Currently, antibiotic therapy in the treatment of maxillofacial fractures remains controversial. Abubaker AO et al. [46] designed a prospective, randomized, double-blind, placebo-controlled clinical study which evaluated the use of antibiotic prophylaxis in mandibular fractures. These results suggested that the use of postoperative oral antibiotics in uncomplicated fractures had no benefit in reducing the incidence of infections; same results were found by Miles et al. [47]. Similar data were observed by Domingo et al. [45] who concluded that type of antibiotic and duration of postoperative antibiotic administration did not affect the surgical site infection. With regard to antibiotic duration, a retrospective study by Hindawi et al. [48] concluded that varying durations of postoperative antibiotic therapy did not reduce the incidence of surgical site infection. These results make us consider to be stricter in the use of antibiotic in the patients with mandible fractures in our region because of an increase in the bacterial resistances and the hospitalization cost without offering any benefits.

However, in the study of Oruç [49] as in ours, infection was not detected in any of the patients in the follow-up period; they confirm that it may be related to the routine usage of antibiotics in their clinical practice in the postoperative period. As we see, the use of antibiotics is still controversial and we should get a balance between the risk and the benefits of the antibiotic therapy in each patient.

After the surgery, sensory changes are one of the most important problems in our study; the most of the sensory affection was solved in the first year of the surgery in the cases related to dental nerve affection after the trauma. Similar rates of hypoesthesia were observed in other studies [5, 50–53].

Plate and screw removal was performed on four patients in our study because of oral exposition in all of them. We try to analyze these patients and all of them where symphysis or parasymphysis fractures with plates close to the free oral mucosa. Besides the decreased amount of soft tissue over the plate and screws at these areas, we may suggest that easy palpation of these plates can be a possible factor for these subjective symptoms and the posterior oral exposition; it also could be important for the closure of the surgical wound in two planes reinserting the facial musculature.

Our study has some limitations. First of all, it was a retrospective study and the surgery was performed by both, experienced and trainee surgeons. Secondly, the number of the patients included is not high because we included the patients treated by mandible fractures and not other maxillofacial fractures. Thirdly, the follow-up was 12 months in all patients, which means that the complication after a year we barely see them.

## Conclusion

The principal aim of the treatment of mandible fractures is to restore the function of the mandible as soon as possible. A poor outcome in the treatment is related to a decrease in quality of life due to malocclusion, chronic infection, pseudoarthrosis and inability to feed. The complications generated are a correctable expense to the public health system what we should be considered. The social education could be improved in our society with the objective of decrease in the amount of aggressiveness in our region. The assaults were the most common cause of mandible fracture in our study which is associated with isolated mandible fracture. The inferior dental nerve anesthesia was the main complication postoperative although often well tolerated by the patients. The time lapse between injury and surgery did not affect surgical site infection rate, even so we use antibiotic therapy before and after the surgery.

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**Compliance with Ethical Standards**

**Conflict of interest** All authors certify that they have NO affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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