Mandibular Fractures Pattern in the Tunisian Center

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Abstract

Background: The mandible is currently the most frequently fractured bone of the viscerocranium. This study aimed to determine the patterns associated with mandibular fractures in the Tunisian center and to distinguish the different imaging modalities used for the diagnosis.

Methods: For the current study, patients diagnosed for a mandibular fracture at the University Hospital of Mahdia, in the period from the 1st January 2005 to 31st December 2016 were available. Data were collected from the clinical observation charts.

Results: The average age was 29.2 years. Patients aged 20 years to 29 years sustained the most mandibular fractures. The overall distribution (male to female) ratio was 7.13 years. A Road traffic accident was the most common mechanism of injury. The chart review identified 292 patients with 414 mandibular fractures, 178 patients had unilateral mandibular fractures. The orthopantomogram was the most frequent imaging modality used to establish the diagnosis. The most common fracture site was the angle. Condylar fractures were predominant in children. Of all patients, 16.4% had an associated extra facial injury and 18.5% had other facial injuries concomitant.

Conclusion: In all facial traumas, mandibular fracture must be excluded due to the high incidence. Diagnostic imaging allows the fracture to be classified, which therefore decides treatment options in order to prevent functional and aesthetic sequel.

Keywords: Mandibular fracture; Epidemiology; Etiology; Imaging

Introduction

The facial area is one of the most frequently injured areas of the body, and the mandible is one of the most common maxillofacial bones fractured. The mandibular fractures may affect function as well as esthetic appearance. Hence, they must be diagnosed and managed appropriately.

A clearer understanding of the epidemiological patterns of these fractures and their mechanism will assist providers of health care as they plan the treatment of maxillofacial injuries. Such epidemiological information can also be used to guide the future funding of public health programmers geared towards prevention of such injuries.

The aim of this study is to analyze the mandibular fracture in the Tunisian center and to identify the epidemiological, etiologies and the clinical features of theses fractures.

Patients and Methods

A retrospective study was undertaken of 292 patients with fractured mandibles presenting to the University Hospital Taher Sfar of Mahdia from the 1st January 2005 to the 31st December 2015. Patients with alveolodental fractures were excluded from this study.

Data for each patient were obtained from the oral and maxillofacial surgery department, surgical and medical record books in a standardized and systematic pattern. Factors considered were: age, gender, medical history, date of trauma, etiology of the accident, time between trauma and diagnosis, associated injuries, clinical aspects, and radiological findings including site, type, number and displacement. The data was analyzed by standard statistical methods using SPSS (22.0).

All finding are anonymous. The current research since it is a retrospective study was granted an exemption by our local institutional review board.

Results

Age and sex distribution

The ages of all patients ranged from 2 to 72 years. The mean age was 29.2 years. The patients were
categorized into 7 age groups: 0 to 9, 10 to 19, 20 to 21, 30 to 39, 40 to 41, 50 to 59, and ≥ 60 years. There were 24 children (aged less than 15 years) (8.2%), 262 adults (89.7%) and 6 patients aged more than 60 years (2.05%). There were more patients in the age group 20 years to 29 years (39.7%) and the most frequent age was 25 years (Figure 1).

There were 256 boys and men (87.7%). The male to female ratio was 7.13:1.

Etiology
Road Traffic Accidents (RTA) was the leading cause (45.89%), followed by assaults (30.82%), falls (16.43%) and sports (3.42%). Work-related injuries and epileptic seizures accounted for only 3.41% of all cases.

Date between trauma and medical appointment
The total number of mandibular fractures was 414, with an average of 1.41 fractures per mandible.

Majority of patients (178 patients, 60.95%) had unilateral type of mandibular fractures followed by 98 patients (33.56%) with bi-lateral fractures (Table 2).

The angle was the most commonly involved area in single fractures (31.46%), followed by the parasymphysis (23.59%).

Among bifocal fractures, the most frequent combination of anatomical sites of fractures was the angle and the parasymphysis (26.53%) followed by the symphysis and the angle (22.44%).

Among multiple fractures, the most frequent combination was the symphysis with the two condyles. Symphysis and parasymphysis fractures frequently occurred in patients who sustained bilateral and multiple fractures (81.8%), followed by angle and condylar fractures (54.5% and 40%).

Distribution regarding age and fracture site:
The 268 adults of our study presented with 382 fractures. Of these fractures, the angle region predominated with 29.31%, followed by the parasymphysis (19.89%), the symphysis (18.32%), the condyle (17.8%), the body (11.51%) the ramus (1.57%) and the coronoid (1.57%).

Condylar fractures were predominant in children (50%), followed by parasymphyseal fractures (25%), the symphysis fractures (23.59%), the angle (6.25%) and the ramus (6.25%).

Distribution regarding fracture displacement:
Displaced fractures were predominant (78.26%).

Distribution regarding site and etiology:
Among the mandibular angle fractures, RTA and interpersonal conflicts were the major causes (43.85% and 38.59%). Condylar fractures were commonly associated to RTA and falls (62.28% and 16.66%) (Table 3).

Distribution regarding associated injuries:
In 54 cases (18.49%), mandibular fracture was associated with mid-facial fractures, and the remaining 238 patients (81.5%) sustained only mandibular trauma. Several maxillofacial fractures were associated; Lefort (22.61%), dentoalveolar (21.42%), zygomatic (14.28%), maxillary (13.09%), nasal (11.9%), orbital (9.52%) and skull base injuries (7.14%).

In addition, extra facial injuries accounted for 16.43% of all cases (Brain injuries: 46.42%, lower extremity injuries: 32.14%, chest injuries: 17.85%, abdominal injuries: 3.57%).

Discussion
Epidemiology
The sheer pace of modern life with high-speed travel as well as an increasingly violent and intolerant society has made facial trauma...
a form of social disease from which no one is immune. Mandible fracture if remains undiagnosed or inappropriately treated may lead to severe consequences on the cosmetic, functional and psychological aspects of the patients. The epidemiology of these fractures is highly variable with time among several countries. The mechanism of injury is also inconsistent in the literature. Etiology of fracture is multifactorial and based variably on socio-economic status, culture, technology, demography, local behavior and law [1].

**Incidence**

Among maxillofacial trauma, mandibular fractures constitute a major portion because of its prominence, unique mobility, and location. They are the first or the second most common facial bone fractures their incidence ranges from 15.5% and 67% of all facial fractures [1-3].

**Age and sex**

The results of our investigation are largely in agreement with those of previous reports, particularly with regard to age and sex. The highest incidence of mandibular fractures in this study was in the age group 20 years to 29 years [4,5].

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Number</th>
<th>Site</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral</td>
<td>178</td>
<td>Angle</td>
<td>56</td>
<td>31%, 46%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parasympysis</td>
<td>42</td>
<td>23%, 59%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Body</td>
<td>28</td>
<td>15%, 73%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Condyle</td>
<td>30</td>
<td>16%, 85%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Symphysis</td>
<td>18</td>
<td>10%, 11%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ramus</td>
<td>2</td>
<td>1%, 12%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coronoid</td>
<td>2</td>
<td>1%, 12%</td>
</tr>
<tr>
<td>Bilateral</td>
<td>98</td>
<td>Unsymmetrical fractures</td>
<td>Parasympysis+Angle</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Symphysis+angle</td>
<td>22</td>
<td>22%, 44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Symphysis+condyle</td>
<td>18</td>
<td>18%, 36%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parasympysis+condyle</td>
<td>8</td>
<td>8%, 16%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parasympysis+Body</td>
<td>4</td>
<td>4%, 0.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Angle+Body</td>
<td>4</td>
<td>4%, 0.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Body+condyle</td>
<td>4</td>
<td>4%, 0.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parasympysis+Ramus</td>
<td>2</td>
<td>2%, 0.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Angle+Ramus</td>
<td>2</td>
<td>2%, 0.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Symmetrical fractures</td>
<td>Two parasympysis</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Two condyles</td>
<td>4</td>
</tr>
<tr>
<td>Multiple</td>
<td>12</td>
<td>Symphysis+ Two condyles</td>
<td>4</td>
<td>33%, 33%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parasympysis+ angle+Two condyles</td>
<td>2</td>
<td>16%, 66%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Angle+ condyle+ coronoid</td>
<td>2</td>
<td>16%, 66%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Symphysis+ angle+condyle</td>
<td>2</td>
<td>16%, 66%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Symphysis+ Ramus+ coronoid</td>
<td>2</td>
<td>16%, 66%</td>
</tr>
<tr>
<td>Commiunitd</td>
<td>4</td>
<td>Body</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>292</td>
<td></td>
<td>292</td>
<td>100%</td>
</tr>
</tbody>
</table>

The explanation may be that this age group takes part in dangerous exercises and sports, drive motor vehicles carelessly, and are most likely to be involved in violence. It emphasizes that safe traffic behaviors should be encouraged in adolescents and young adults.

Pediatric and elderly mandibular fractures are rare [6]. The prevalence of pediatric facial fractures is lowest in infants and increases progressively with increasing age. Only 0.87% to 1.0% of facial fractures occur in children younger than five years, whereas 1.0% to 14.7% occurs in patients older than 16 years. Two peaks have been observed in the frequency of such fractures: The first, at the age of six to seven years, is associated with the beginning of school attendance. The second, at 12 to 14 years, is related to increased physical activity and participation in sports during puberty and adolescence [7].

Sex ratio varies with geographic region, socioeconomic status, and culture, but the male predominance is commonly reported [8].

The present study showed this male predominance (87.7%) with a sex distribution (male to female) ratio of 7.13:1, in accordance with previously large-scale studies [4]. This is mainly due to more
Table 3: Location distribution and mechanism of injury.

<table>
<thead>
<tr>
<th></th>
<th>RTA (%)</th>
<th>Assaults (%)</th>
<th>Falls (%)</th>
<th>Sports (%)</th>
<th>Work injury (%)</th>
<th>Epileptic seizure (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symphysis</td>
<td>45%, 9%</td>
<td>35%, 1%</td>
<td>8%, 1%</td>
<td>2%, 7%</td>
<td>5%, 4%</td>
<td>2%, 7%</td>
<td>17%, 87%</td>
</tr>
<tr>
<td>Parasymphysis</td>
<td>57%, 1%</td>
<td>26%, 19%</td>
<td>14%, 28%</td>
<td>4%, 76%</td>
<td>0%</td>
<td>0%</td>
<td>20%, 28%</td>
</tr>
<tr>
<td>Body</td>
<td>31%, 8%</td>
<td>31%, 81%</td>
<td>22%, 72%</td>
<td>4%, 54%</td>
<td>9%, 0.9%</td>
<td>0%</td>
<td>10%, 62%</td>
</tr>
<tr>
<td>Angle</td>
<td>43%, 8%</td>
<td>38%, 59%</td>
<td>15%, 78%</td>
<td>0%</td>
<td>21%, 75%</td>
<td>0%</td>
<td>27%, 53%</td>
</tr>
<tr>
<td>Ramus</td>
<td>75%</td>
<td>25%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>1%, 93%</td>
</tr>
<tr>
<td>Condyle</td>
<td>62%, 2%</td>
<td>14%, 28%</td>
<td>16%, 66%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>44%, 76%</td>
</tr>
<tr>
<td>Coronoid</td>
<td>66%, 6%</td>
<td>33%, 33%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>1%, 44%</td>
</tr>
<tr>
<td>Total</td>
<td>50%, 7%</td>
<td>29%, 46%</td>
<td>14%, 49%</td>
<td>81%, 93%</td>
<td>81%, 93%</td>
<td>61%, 44%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Involvement in outdoor activities, alcohol abuse during driving and increased urban violence.

**Etiologies**

The etiology and incidence of mandibular fractures vary with the different geographic regions, socioeconomic status, cultures and traffic rules. Many authors have reported road crashes as a major cause of mandibular fractures in developing countries, whereas others have reported assaults as the main cause in developed countries [1].

In the current study, road traffic accidents were the leading mechanism of injury (45.89%), followed by assaults. Other causes of mandibular fractures were relatively minor. This is consistent with the findings of many other studies in Arabic and developing countries [4,8,9]. It may be explained by the increasing number of vehicles, high speed driving, less use of seat belts and helmets, absence of airbags in most of the vehicles, alcohol abuse during driving and the deleterious condition of roads.

Thus, the concerned authorities should focus on traffic regulations and public transportation system reforms.

In developed countries sport accidents are the most common cause where traffic laws are more widely respected [1,10].

Etiologies are also variable regarding age and gender. In fact, if RTA and violence are the leading etiologic factors in adults, falls are the most common factor in childhood accounting for 46.1%, which is in agreement with Atilgan et al. [11] and Andrade et al. [12]. Whereas, Glazer et al. [7], Van et al. [13] and Rémi et al. [14], found that RTA is the leading etiology in children accounting respectively for 60%, 57% and 61%.

Tatsumi et al. [15] concluded that elderly patients are predominantly affected secondary to falls.

**Clinical features**

**Date between injury and medical appointment:** In this study, we found that patients presented between 0 and 24 days after trauma to the emergency, with 80.8% of all cases presented in the first 24 h.

Rocton et al., [10], revealed a mean period of 30 h, whereas for Tatsumi et al. [15], the mean period was 2.8 days. This difference may be explained by the accessibility to the emergency centers and means of transport [15].

**Clinical examination**

**General examination:** The most frequent associated injury in the current study was contusion, followed by abrasion and laceration. This result is similar to those mentioned by many authors (Adewole et al., Batista et al., Kapoor et al., Daniel et al., Le et al., Saddki et al., Shepherd et al.), but in contradiction with those others such Kraft et al., Okoje et al., Nonato et al., Hashim et al., and Hitosugi et al. who indicated laceration as the associated injury with the highest incidence [16]. The predominance of contusions in this study emphasizes the reduced severity of the traumas included in the study [16].

**Dental trauma:** The dental schema, very often neglected, must be carefully established for medico-legal purposes. Many other studies indicate dental injuries to be most frequently associated with mandibular fractures, unlike soft tissue injuries [16]. The data obtained in this study show a relatively low incidence of dental injuries (34.93%). This is probably due to the fact that some of the patients included in the study were partially or totally edentulous when the trauma occurred. The most frequent dental injury was crown fracture, followed by dental avulsion, which is in accordance with the results published by some authors [16]. In contrast, other authors report dental avulsion (Batista et al., Kapoor et al., Ravindran et al., Zhou et al.,) or dental dislocation (Marchiori et al., Roccia et al.) to be the most frequent post-traumatic dental injury [16].

**Imaging:** Although mandibular fractures are relatively easy to diagnose in comparison with other facial fractures such as those of the mid-face, selection of the appropriate radiographic examination for detection of mandibular fractures appears to differ.

It is important for a fracture to be identified quickly as there can be detrimental outcomes to the patient if missed; this includes malunion, nonunion and delayed union of the fracture.

**Conventional radiographs:** Panoramic radiographs provide a generally good view of the entire mandible. In most cases, it should suffice, only in rare instances where there is extreme displacement of the fracture segments and for complex fractures, CT is indicated. An instance of such a condition is a higher condylar fracture [17]. In the current study, panorex was performed in 84.9% of all cases.

Reverse Towne’s radiograph allows substantial detail of the condyles and is excellent for detailing any medial or lateral displacement, with little overlapping of the mastoid bone, for many authors, this incidence is mandatory to visualize the condylar region [18].

**CT imaging:** Computed tomography is the most sensitive and specific of the imaging techniques. In fact, Da Costa e Silva, concluded that this technique is excellent for showing intracapsular condyle and that the 3 dimensional views are mandatory in cases of condylar fractures [18].

In the current study, the CT was performed in only 24.65% of all cases. This is explained by the mainly disadvantage of this examination which is the cost.
Many other researchers have shown that panoramic radiography is similar to computed tomography in its diagnostic accuracy for mandible fractures and both are more accurate than plain film radiograph. The indications to use CT for mandible fracture vary by region, but it does not seem to add to diagnosis or treatment planning except for comminuted or avulsive type fractures, although, there is better clinician agreement on the location and absence of fractures with CT compared to panoramic radiography [19].

**Classification**

**Fractures distribution depending on site:** The anatomic distribution and incidence of mandibular fracture are widely variable. Using the Dingman and Natvig classification, many authors reported symphysis as the most frequently affected site whereas, others reported this to be mandibular body, angle and condyle [20]. In this study, of the 414 total fracture lines, 27.53% were located in the angle area, and 20.28 % in the parasymphysis region.

Many authors such Iida et al. [21], Rajkumar et al. [22] and Fuselier et al. [23], reported that the angle region is the frequently affected site probably due to the presence of an un-erupted third molar.

In accordance with many previous studies, the majority of our patients had single fracture site (60.95%) [10].

The most frequent combination of fracture lines in the current study is: parasymphysis or symphysis with angle (48.97%), followed by parasymphysis or symphysis with condyle (26.52%). This result correspond to the findings of Eskitascioglu [5], who concluded that fractures of the anterior arch of the mandible are likely to be associated with fractures of the posterior area.

**Distribution depending on age and anatomical location:** Condyle fractures are the most common type of mandibular fractures in children. They account for 28% to 80% of all the mandibular fractures according to different studies, with boys more commonly affected than girls [24]. Symphyseal and parasymphyseal fractures are second in frequency [9,11]. Our sample is small but the results are in accordance with these findings.

The higher incidence of condyle fractures in children is due to the higher proportion of medullary bone with the presence of a single thin layer of the cortex in children [7].

**Fracture distribution by etiology and site:** Regarding the relationship of trauma mechanism and fracture site, our study confirms previous findings of the correlation between etiology and fracture pattern [1,25]. As previously shown, the prevalent fractures resulting from interpersonal violence are in the angle region, and those resulting from motor vehicle collisions are in the parasymphysis and condyle region, which is consistent with our results. The same applies to falls, which are most commonly associated with condyle fractures [1].

In fact, for motorcycle or vehicle accidents, the vector of force is often applied on the mandible in anterior-posterior direction, which initiates the force posterior to the condyles. The results are in accordance with that reported by Morris et al., who indicated that a high-velocity blunt injury like motorcycle collisions would result in a larger number of condyle fractures, while the mandibular angle is the most common fracture site involved in a low-velocity blunt injury like assault or struck injury [25].

**Distribution regarding associated injuries:** The mandible can be seen fractured alone or in combination with fracture of other bones in the maxillofacial region depending on the trauma velocity [25]. In the present study, although the total incidence of associated maxillofacial fractures was lower than that reported in most studies, Lefort fractures were the most common associated injury (6.5%).

Most of the patients in the current study had no comorbidities (81.5%). This result is similar to those published by Chien et al., Natu et al., Businger et al., Thoren et al., and Martins et al. but in contrast to the results of other studies, where the majority of patients diagnosed with mandibular fractures have associated injuries [16].

The explanations of these differences in the literature are purely speculative, depending on the geographic region and etiology, and are inconclusive at present [16].

Of these associated lesions and because of the structure and anatomic proximity of the mandible as well as its direct connection to the skull base, trauma to the mandible is often related to intracranial injury [25].

Therefore, physicians should be aware of this when evaluating patients with mandibular fractures. The protective effect of motorcycle helmets is already well-established in the literature regarding head injury and extensive injury in the face [17,25].

**Distribution regarding dentition:** In the current study, one of the most limitations is the few number of elderly and children. However, the review of the literature reveals that the lack of the teeth causes a loss of the alveolar bone, and this is more important as there is no prosthetic compensation. The mandible is thus weakened by the loss of bone capital, and the absence of teeth amplifies the impact of trauma by lack of bone wedging and thus increases the fracture displacement [17]. Furthermore, this lack of bone wedging makes all the forces oriented towards the condyle and the body.

In children, the study of Thoren et al. [9] has shown that the proportion of condyle fractures, which is the most common fracture, decreases while that of body and angle increases with age [9]. This finding is linked to the three distinct periods of childhood dentition [11].

**Distribution regarding displacement:** Displaced fractures are the most frequent in our study; these results are similar to those reported by other authors [16]. This increased incidence can be explained on the one hand by the fact that most of the traumas causing mandibular fractures have a high kinetic energy and lead to primary displacement, and on the other hand, by the action of important muscle groups on the mandible, which causes significant secondary displacement [16].

Finally, limitations of this study are the retrospective design and the lack of available data regarding conditions, as data were collected from the observations charts, including the circumstances of the mechanism of injury particularly in accidents, motorcycle or vehicle accidents, the speed, the protection methods, the use or not of the seat belt or the helmet, and prior history of facial bone fracture. Additionally, a relatively small population of elderly and young patients makes the interpretation or analysis of these groups of patients less meaningful.

**Conclusion**

From these epidemiological and clinical findings, it is
recommended to systematically examine the mandible and particularly to carefully examine the condyle in front of any facial trauma.

Considering the high incidence of mandibular fractures, the gravity of their functional and aesthetic complications, we insist that:

- For early diagnosis, detailed history collection and careful examination for disturbed dental occlusion, restricted mouth opening and for all maxillofacial or craniofacial trauma are very important.
- As children, especially young children could not express their feelings properly and the condylar fractures are common in this group, the condylar examination should be systematic, in order to avoid serious problems including malocclusion, growth disturbances and facial asymmetry, and in some instances ankylosis.
- Definite diagnosis is only possible with radiological examinations. The panoramic radiograph remains the basic diagnostic tool and is the most accessible X-ray available. While Computerized Tomographic scan provides more accurate information, including the location of fracture line, the degree of fragment dislocation and displacement especially for condylar fractures.
- Considering the high number of traffic related injuries in our study, the safety and preventive measurements should be focused in these fields.

References