

## Original Research Article

# Epidemiological aspects of facial trauma in a third level hospital in Mexico

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## ABSTRACT

**Background:** Facial trauma is common in early adulthood and may require complex surgery and even high mortality.

**Methods:** Retrospective, cross-sectional study at the Hospital General de México during the period from January 2018 to December 2021. Patients with a diagnosis of fracture of the facial region, who had a complete clinical record, of any age, were included. Patients who did not comply with the treatment in the hospital unit, with incomplete clinical records, were excluded. Through non-probability sampling, a sample of 156 patients was formed. The descriptive data analysis was carried out by calculating frequencies and percentages for the qualitative variables. For the quantitative variables, measures of central tendency and dispersion were calculated according to the distribution of the variables (mean and standard deviation). for variables with normal distribution and median with interquartile range for variables with non-normal distribution).

**Results:** 156 patients were included, the male sex predominated (89.7%), the age group from 21 to 30 years (35.3%), the injury mechanism of aggression by a third party (54.5%). Facial fractures occurred in the following descending order: orbit (64.7%), zygoma (41.7% n=65), mandibular (23.1% n=36), nasal (22.4% n=35), maxilla (21.8% n=34), NOE (4.5% n=7), Le Fort (3.8% n=6), and palate (3.8% n=6). Within orbital fractures, the most frequently affected region was the orbital floor (42.3%). The patients with orbital fracture were mostly men (88.1% versus 11.9%). The highest frequency of these fractures was between the ages of 21 and 30 (38.6%). Surgical treatment of fractures in general was established in 44.9%, performing open reduction and internal fixation of fractures in 41.0%.

**Conclusions:** The most frequent facial fractures are: orbit, zygoma, and mandibular; they mainly affect the male sex in the second decade of life, they are produced mainly by aggressions to third parties. The management of facial fractures is predominantly surgical, through open reduction and internal fixation.

**Keywords:** Orbital fracture, Facial trauma, Epidemiology

## INTRODUCTION

The face is a part of the body that is normally exposed without external protection, which when traumatized results in serious injuries due to tractions capable of overcoming the resistance of the bone.<sup>1</sup> It should be noted that facial fractures are a common cause of visits to the emergency room, with an estimated 400,000 annual visits in the United States alone.<sup>2</sup> However, the incidence is highly variable depending on age, gender, geographic

location and cultural aspects, socioeconomic level, influence of climate and weather, use of alcohol and drugs illicit, variation in traffic laws, domestic violence, bone pathologies and etiological factors.<sup>3</sup> Car ownership and violent behavior are behaviors in contemporary humanity that are unlikely to change any time soon. Automobile accidents, assaults and altercations, industrial accidents, and sporting and recreational mishaps continue to pose the challenge of facial fracture repair.<sup>4</sup>

Another population that is the recipient of a significant proportion of patients is represented by the pediatric population and that of older adults, whose main mechanism of injury is falls.<sup>5</sup> This fact is confirmed by the fact that older adult women are more prone to falls. Falls (2.6 times) than men, with a higher risk of facial fracture.<sup>6</sup> However, according to reports in the clinical literature that interpersonal violence and sports injuries are the major cause in societies with more developed economies.<sup>7</sup>

Not only demographic characteristics condition the risk of fracture, it has also been described that alcohol consumption represents an important risk factor for the epidemiology of trauma, since it increases the risk of interpersonal violence and automobile accidents. This social factor must be reconsidered given the recent COVID-19 pandemic; which conditioned that the sequelae of social restrictions, home confinement and isolation include a higher incidence of problems related to mental health, and greater psychological stress associated with financial loss and social isolation. Therefore, with high probability, they can result in more domestic violence.<sup>8</sup>

In certain cases, orbital fracture can have devastating consequences, for example, a fracture of the orbital floor with extraocular muscle entrapment leading to permanent dysfunction of congruent eye movements. In addition, there can be a considerable burden of such injuries in under-resourced areas of the world that lack access to timely and effective care, even if surgical intervention is not indicated.<sup>9</sup>

In very severe cases, maxillofacial trauma can be fatal, due to proximity to the brain and respiratory and digestive tracts, and concomitant injuries can be fatal. Fracture treatment remains a challenge for surgeons in developing countries because it generally requires a lot of skill and sophisticated equipment for diagnosis and treatment that is often lacking in developing countries.<sup>10</sup>

For this reason, it is extremely important to know the causes, the most affected age group and sex, and the most affected anatomical regions so that prevention strategies can be developed and prevent the number of people who suffer facial fractures from continuing to increase. The objective of this study was to identify the clinical and demographic characteristics of patients with facial fractures who were treated at the General Hospital of Mexico in a period of 5 years, from January 2018 to December 2021.

## METHODS

A retrospective, cross-sectional study was carried out at the Hospital General de México with information from clinical records for the period 2018-2021. Patients with a diagnosis of fracture of the facial region, who had a complete clinical record, of any age were included. Patients who did not comply with the treatment in the hospital unit, with incomplete clinical records, were

excluded. Through non-probability sampling, a sample of 156 patients was formed. The clinical records were recovered and the information obtained was captured to the statistical software IBM statistical package for the social sciences (SPSS) in its version 25 for Windows. The descriptive data analysis was carried out by calculating frequencies and percentages for the qualitative variables.

For the quantitative variables, measures of central tendency and dispersion were calculated according to the distribution of the variables (mean and standard deviation) for variables with normal distribution and median with interquartile range for variables with non-normal distribution).

## RESULTS

In the population made up of 156 patients, the male sex predominated (89.7% n=140), and the age group of 21 to 30 years (35.3% n=55). Regarding the mechanism of injury, aggression by a third party (54.5% n=85) was more frequent, followed by a motorcycle accident (21.8% n=34). In the comparison by sex, the age group from 0 to 10 years was more frequent in women (12.5% versus 1.4%). Likewise, third-party aggression was predominant in men (59.3% versus 12.5%), while falls from heights predominated in women (37.5% versus 4.3%) (Table 1).

Regarding the type of fracture, the simple facial fracture was more prevalent (55.1% n=86), while the multiple facial fracture was the second most frequent (32.7% n=51), the double facial fracture (11.5% n=18) and finally panfacial fracture (0.6% n=1). Facial wounds occurred in 58.3% of patients (n=91), and intraoral/extraoral wounds occurred in 58.3% (n=91). Fractures occurred in the following descending order: orbit (64.7% n=1), zygoma (41.7% n=65), mandibular (23.1% n=36), nasal (22.4% n=35), maxillary (21.8% n=34), NOE (4.5% n=7), Le Fort (3.8% n=6), and palate (3.8% n=6). The evolution time had a median of 0 days, with an interquartile range of 0 to 8 days.

Regarding the detail by anatomical region, the fracture in the mandibular region occurred in 23.1% (n=36), in this region the parasymphysis (9.0% n=14), body (4.5% n=7), and angle (3.8% n=6), symphysis (2.6% n=4), ramus and subcondylar (1.3% respectively n=2), and condyle-neck (0.6% n=1).

The fracture in the zygomatic region occurred in 41.7%, the most frequently affected region was the frontozygomatic border (4.50%) and frontozygomatic; frontozygomatic, sphenozygomatic; and sphenozygomatic (3.8% respectively) (Table 2).

The fracture in the orbital region occurred in 64.7% (n=101), the most frequently affected region being the orbital floor (42.3% n=66) and the floor region plus the medial region (14.7% n=23). Enucleation occurred in 3.2% (n=5) (Table 3).

**Table 1: Demographic characteristics of the patients.**

Characteristics	Frequency	Percentage
<b>Gender</b>		
Female	16	10.3
Male	140	89.7
<b>Age (years)</b>		
0-10	4	2.6
11-20	33	21.2
21-30	55	35.3
31-40	24	15.4
41-50	17	10.9
51-60	16	10.3
61-70	4	2.6
71-80	3	1.9
<b>Mechanism of injury</b>		
Assault by third party	85	54.5
Assault by third party, firearm	1	0.6
Motorcycle	34	21.8
Motoring	3	1.9
Bicycle	2	1.3
Firearm	8	5.1
Height fall	12	7.7
Ethyl state	1	0.6
Contusion with object	9	5.8
Pyrotechnics	1	0.6
<b>Anatomical location</b>		
Mandibular region	36	23.1
Zygoma region	65	41.7
NOE	7	4.5
Le fort	6	3.8
Orbital region	101	64.7
Palate region	6	3.8
Maxillary region	34	21.8
Nasal region	35	22.4

The fracture in the palate region occurred in 3.8% (n=6), the most frequently affected region being the alveolar and the parasagittal region (1.9%, respectively, n=3). The fracture in the maxillary region occurred in 21.8%, the most frequently affected region being the anterior region (5.1%) and the region of the medial pillar and lateral pillar with anterior region (3.2% respectively). Finally, dentoalveolar fracture occurred in 4.5% (n=7). Fracture of the nasal region occurred in 22.4% of patients.

Surgical treatment was established in 44.9% (n=70), while conservative management was established in 23.7% (n=37). Some fixation method was used in 44.2%; For those patients in whom some fixation method was used, the most frequently used was plate and screw (41.0% n=64), followed by IMF (1.9% n=3), and finally plate and screw, arch splint (n =1); and plate and screw, IMF (n=1) with 0.6% respectively. Bone graft (n=2) and rib graft (n=2) were used in 1.3% respectively; the least used technique was the regional flap (0.6% n=1).

**Table 2: Detail of the anatomical locations of the zygomatic fractures in the patients.**

Parameters	Frequency	Percentage
No zygomatic fracture	91	58.3
Edge	2	1.3
Edge, frontozygomatic	7	4.5
Edge, frontozygomatic, sphenozygomatic	2	1.3
Rim, frontozygomatica, sphenozygomatica, arch, lateral crus, body	1	0.6
Border, frontozygomatica, lateral crus	2	1.3
Edge, arc	1	0.6
Edge, side pillar	1	0.6
Rim, side pillar, body	1	0.6
Edge, body	1	0.6
Frontozygomatic	6	3.8
Frontozygomatica, border, lateral crus	1	0.6
Frontozygomatic, sphenozygomatic	6	3.8
Frontozygomatic, sphenozygomatic, arch	5	3.2
Frontozygomatic, sphenozygomatic, arch, lateral crus	3	1.9
Frontozygomatic, sphenozygomatic, body	1	0.6
Frontozygomatic, arch	3	1.9
Frontozygomatic, lateral crus	1	0.6
Frontozygomatic, body	1	0.6
Sphenozygomatic	6	3.8
Sphenozygomatic, arch	3	1.9
Arch	5	3.2
Arch, sphenozygomatic	1	0.6
Side pillar	3	1.9
Body	2	1.3
<b>Total</b>	<b>156</b>	<b>100.0</b>

**Table 3: Detail of the anatomical locations of the orbital fractures in the patients.**

Parameters	Frequency	Percentage
None	55	35.3
Floor	66	42.3
Floor, medial	23	14.7
Floor, medial, roof	2	1.3
Floor, roof	2	1.3
Medial	5	3.2
Medial, roof	1	0.6
Roof	2	1.3
<b>Total</b>	<b>156</b>	<b>100.0</b>

Head trauma occurred in 7.1% of patients with facial fracture; cervical spine trauma was reported in 1.9% of patients (n=3); ocular trauma occurred in 19.9% of patients, the most frequent being hemorrhage (12.2% n=19), followed by another (4.5% n=7), open trauma (1.9% n=3), and finally, emphysema (1.3% n=2). Varied trauma was reported in 10.9% of patients, predominantly other (3.2% n=5), followed by frontal fracture (1.9% n=3), temporomandibular joint dislocation (1.3% n=2); and finally clavicular fracture (n=1), rib fracture (n=1), pterygoid fracture (n=1), frontozygomatic dislocation (n=1), radius and ulna fracture (n=1), liver laceration (n=1), and temporal fracture (n=1) representing 0.6% respectively). Statistically finding that clavicular fracture was more frequent in women (6.3% versus 0.0%, p=0.003).

## DISCUSSION

Functionally, the structural support of the facial skeleton can be organized by describing the facial buttresses. The nasofrontal/nasomaxillary, zygomatic, and pterygomaxillary buttresses are the main vertical support structures of the maxilla; while the mandibular, maxillopalatine, zygomatic and frontal buttresses are responsible for the anteroposterior projection; and the orbital buttress has vertical and horizontal components. These are the pillars of support of the facial skeleton.<sup>11</sup> With this functional knowledge of the bony skeleton, it is clear that the extent of damage to the face is determined by the degree of force of the impact and the strength of the supporting tissues and structures. The severity of the fractures depends on the direction and point of application of the force generated in the impact, which provides a pattern of damage according to the trauma that caused the injury.<sup>3</sup> Injury to the upper third can condition fractures of the frontal sinus. Fracture patterns of the midface may include characteristic Le Fort fracture patterns, or orbitozygomatico-maxillary complex, orbital, nasal, and naso-orbito-ethmoidal (NOE) fractures alone or in combination with fractures of the lower third of the face, that is, those of the mandible, also show reproducible patterns.<sup>11</sup>

Regarding the demographics of the patients, in this study it was found that the male sex predominated (89.7%), and the age group of 21 to 30 years (35.3%). Regarding the mechanism of injury, aggression by a third party was more frequent (54.5%). This demographic behavior is similar to that reported by Róselo et al where the majority of patients with facial trauma are men (56.8-92.8%), and the mean age in the reported series ranges from 24.6 to 51.0 years.<sup>12</sup> The most frequent causes are assaults (44-61%), accidents of traffic (15.8%) and falls (15%).<sup>7,12</sup>

Simple fractures occurred in 55.1% of patients, which is fully consistent with the study by Yu et al who reported that simple fractures occurred in 55.2%, while fractures occurred less frequently (20.6%), multiple facials.<sup>13</sup> Panfacial fracture occurred only in 0.6% of patients; but this interpretation must be taken with caution, since

panfacial fractures are those that involve multiple facial thirds. Traditionally, this meant the participation of all three facial thirds. However, in contemporary practice, the definition is applied to those fractures that involve two or more facial thirds.<sup>14</sup> Therefore, this consideration may cause variations in the operational definition of panfacial fractures and, therefore, affect the reported prevalence.

Regarding the mechanism of injury, aggression by a third party was more frequent (54.5%), in the comparison by sex, the age group from 0 to 10 years was more frequent in women (12.5% versus 1.4%). Likewise, third-party aggression was predominant in men (59.3% vs 12.5%), while falls from heights predominated in women (37.5% versus 4.3%). This finding coincides with the report by Ogunbowale et al who found that the most frequent aetiology in women was both a fall (64.9%) and interpersonal violence (20%); for men they were interpersonal violence (51%) and falls (25.9%).<sup>7</sup> In addition, in an analysis of etiology by age group, George et al found that injuries associated with assault, alcohol use, sports, and traffic crashes are more common in young men; while in the older adult population facial fractures are caused by accidental injuries.<sup>15</sup> It is obvious that men are more involved in violence, in the use of motorized vehicles and in the practice of sports; while women are more exposed to injuries in offices and homes given their lower participation in risky activities.

Fractures occurred in the following descending order: orbit (64.7% n=1), zygo (41.7% n=65), mandibular (23.1% n=36), nasal (22.4% n=35), maxillary (21.8% n=34), NOE (4.5% n=7), Le Fort (3.8% n=6), and palate (3.8% n=6). This finding is inconsistent with the compilation made by Roselló et al.<sup>12</sup> that the most frequently fractured bone is the mandible (41.6-75.2%). The second and third most frequently fractured bones vary, being the maxilla and orbit (39.8% each) in some studies, but the malar bone (15.2%) and maxilla (6.4%) in others. The explanation for such differences can be explained by differences in the ages of the patients, likewise, in the kinetics of the injury; and even to the differences in the economies of the countries that condition differences in the prevalence of car accidents, in the practice of contact sports or even in the rates of violence by third parties.

The patients with orbital fracture were mostly men (88.1% versus 11.9%). The highest frequency of these fractures was between the ages of 21 and 30 (38.6% n=39). This is consistent with the study by Seen et al where 83.6% of affected patients were male.<sup>16</sup> In this study, the orbital region most affected was only the floor (42.3%), which is inconsistent with the report by Gafurov et al who described that in 29-37% of patients, fractures of two orbital walls are identified.<sup>17</sup> Fractures of all three orbital walls have been reported in 12 to 18% of patients and of all four walls in 3 to 7% of patients. In another series, and also in disagreement with the present study, Young et al, when reporting the anatomical location of the orbital fracture, found that the isolated fracture of the medial wall of the

orbit was the most frequent type (61.4%), followed by of the combined fracture of the floor and medial wall (20.5%) and the isolated fracture of the floor (18.2%).<sup>18</sup>

The explanation for such discrepancies results from the analysis of the injury mechanics, since orbital fractures occur as a result of various mechanisms: by the energy transmitted directly to the wall(s), indirectly by the increase in orbital pressure or a combination of the above mechanisms.<sup>16</sup> And in addition to the analysis of the mechanism, it should be noted that there are currently two common theories of how orbital fractures occur after blunt trauma, including the hydraulic and buckling theories. Hydraulic theory postulates that the force is transmitted from the balloon to the orbital walls. Buckling theory suggests that force is transmitted from the strong orbital rim to the weaker orbital walls that fracture in place.<sup>14</sup> Although fractures of any of these bones can occur, blow-out fractures are the most common type orbital fractures. They affect the weaker bones of the orbital wall, specifically the inferior and medial bones, and the lamina papyracea. Less commonly, fracture fragments of the frontal or maxillary bones can cause a blow-in fracture.<sup>2</sup>

Regarding the zygomatic fracture, it occurred in 41.7% of patients, it was more frequent in men (87.7% versus 12.3%) and the age group of 21 to 30 years predominated (29.2% n=19). This is consistent with the report by Padmanavam et al where the incidence of fractures of the zygomatic complex reaches its maximum point around the second and third decades in men and the fourth and fifth decades in women, with fractures being common in men in a ratio of approximately 4:1.<sup>19</sup> The predominance of the zygomatic area as the affected area is explained by the bony prominence it represents and the ease of access during acts of physical violence. While, on the other hand, Le Fort type fractures are rare fractures given the very high energy required to generate them, which are typical of traffic accidents.

Mandibular fractures occurred only in men of men (100% n=36 versus 0% n=0). The highest frequency was between the ages of 21 and 30 (38.9% n=14). This male predominance agrees with the study by Ogunbowale et al who found that mandibular fractures were more frequent in men (21.1%) than in women (12%).<sup>7</sup> In addition, Nardi et al reported that mandibular fractures occur predominantly in men, showing a 5:1 ratio compared to women.<sup>20</sup> In the mandibular region, the parasymphysis (9.0% n=14), body (4.5% n=7), angle (3.8% n=6), symphysis (2.6% n=4), ramus and subcondylar (1.3% respectively n=2), and condyle-neck (0.6% n=1). These frequencies are similar to what was reported by Nardi et al who, in general, classified the occurrence of mandibular fractures as: symphysis/parasymphysis (30-50%), horizontal branch (21-36%), angle (15-26%), ramus (2-4%), condyle (20-26%) and coronoid process (1-2%).<sup>20</sup> However, there are conflicting reports such as that of Shah et al where the most common to least common region was dentoalveolar fractures (26.4%), parasymphysis (12.3%),

body (10.5%), angle (8.7%), condyle (6.5%), symphysis (4.3%) and finally branch (1.1%).<sup>21</sup> Also, contrary to the present study, Hassanein et al found that the most affected region was the body (30.98%), followed by parasymphysis (24.33%), subcondylar (17.15%), angle (16.67%), dentoalveolar (6.06%), ramus (2.1%), symphysis (1.87%), and coronoid process (0.52%).<sup>22</sup>

The more frequent involvement of the mandible than other maxillofacial sites may be attributed to the anatomic prominence and exposed anatomic position of the mandible on the face. During a car accident, most victims can try to avoid head injuries and may receive the maximum impact on the jaw, which puts the jaw at greater risk of fracture than other facial bones.<sup>10</sup> In addition, the jaw it is more prone to injury than the zygomatic complex due to its mobility and less bone support compared to the maxilla.<sup>23</sup>

The fracture in the maxillary region occurred in 21.8%, being more frequent in men (97.1%) and presenting mainly in the age of 21 to 30 years. (35.3%). This finding is discordant with the age described by Cohn et al who reported that maxillary fracture occurred mostly in men (75%) with a mean age of 45.3 years.<sup>24</sup> However, Khan et al reported a predominance of the age group of 21 to 30 years that is completely consistent with the present study.<sup>25</sup>

Nasal fracture predominated in men (91.4% n=32) and was more frequent in the age group from 21 to 30 years (42.9% n=15). This result is consistent with the report by Byun et al that nasal fracture was more than 3.3 times more frequent in men than in women (76.79% versus 23.21%).<sup>26</sup> In addition, when analyzing by age groups, those in their twenties were the most frequent age (38.58%) and those in their seventies the least frequent (1.04%). The study by Li et al also found that nasal fracture was more frequent in men (83.2%).<sup>27</sup> The age group most affected was between 18 and 64 years old, which represented 84.53%. The high percentage of occurrence in men is explained by the greater participation of men in sporting activities and the fact that they drive motorized vehicles more frequently than women; in addition, the fact that the nose is an outstanding point of the facial silhouette that is easily reached by the impacts that generate fractures must be added.

Surgical treatment was established in 44.9% (n=70). While the most frequent fixation material was plate and screw (41.0% n=64). As a complement, bone graft (n=2) and rib graft (n=2) were used in 1.3% respectively. This fact is inconsistent with what was described by Ogunbowale et al where the majority of patients (77%) received conservative management, while the minority of patients (23%) received surgical treatment.<sup>7</sup> Elsharkawy et al also reported that most fractures (72%) were treated by open reduction and internal fixation while the remaining 28% were treated by closed reduction, mainly for the younger age group.<sup>28</sup> Abhinav et al also reported that internal fixation with open reduction was the treatment performed

in 89.1% of patients.<sup>23</sup> The remaining 10.9% of patients were managed by closed reduction procedures using arch bars or by conservative management. The use of plates is also described by Silva et al who found that the most frequently performed type of treatment was the use of miniplates (66%).<sup>29</sup>

## CONCLUSION

Facial fractures mostly affect males in the second decade of life, they are mostly caused by attacks on third parties; and are an important cause of the use of fixing material. The most frequent facial fractures in our environment are: orbit, zygoma, and mandibular. The management of facial fractures is predominantly surgical, using open reduction and internal fixation.

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