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The Role of Multi Detector Computerized Tomography in Evaluation of Maxillofacial Fractures.

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Original Research Article

Abstract

Objective: The current study's goals are to assess the effectiveness of Multi Detector Computerized Tomography (MDCT) in treating patients who have experienced maxillofacial trauma, describe demographic variations, describe the frequency and types of fractures that were subjected to CT scans in the Benghazi region of Libya, and compare the results with those of comparable studies carried out elsewhere in the world.

Materials and Methods: We collected information from the radiology department of the al-Jala teaching hospital in Benghazi to conduct a descriptive, cross-sectional hospital-based study Between 2010 and 2013, 417 patients' medical records who underwent head and face CT scans after suffering maxillofacial trauma were examined for the study (4 years).

Results: The peak frequency, which occurred in the age group of 21 to 30, covered a range of ages from 2 to 85 years. The median age, measured by mean and standard deviation, was 29.9 +/- 12.2 years. There were six men for every woman. Road traffic accidents (RTAs) were the leading cause of fractures (75%), followed by assault (7.67%), and we found no association between gender and the cause of fracture ($p = 0.537$). While the orbital walls (61%) were the most frequently broken bone in simple maxillofacial fractures, the zygomaticomaxillary complex (ZMC), which makes up 22.2% of the midface, was the most vulnerable area in complex facial fractures. There was no connection between gender and the location of the fracture.

Conclusion: Maxillofacial trauma can occasionally occur with serious cosmetic and functional repercussions. MDCT is required for the identification and classification of maxillofacial fractures and provides an accurate diagnosis for the design of treatment plans. Early surgical intervention is crucial for the successful management of these fractures.

Keywords: Fracture, Midface, Benghazi, Image.

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INTRODUCTION

Facial fractures can be detected using The Multi Detector Computerized Tomography (MDCT) as it's considered to be the golden standard method due to its non-invasive technique, accessibility, speed of acquisition, and exceptional accuracy in detecting even minute fractures. Additionally, acute intracranial pathology, which might be more urgent, is assessed concurrently. [1,2] Blunt or penetrating trauma that uses moderate-to-strong force is the most common cause of facial fractures. These fractures may result from a gunshot wound, a fall, a physical assault, or a motorcycle accident. The MDCT can promptly spot any related facial buttresses and soft tissue injuries that might require surgery. When a complicated fracture develops, many issues could arise, such as lefort fractures, are kind of midfacial fractures which damage the pterygoid plates in their entirety and can separate the maxilla from the skull in whole or in part like in Lefort III type , increasing the risk of intracranial infections, or like type II involving the medial part of midface, and Lefort I in which the palate is separated from the dentition Hemorrhage and cerebrospinal fluid leakage rise when a frontal sinus fracture extends through the posterior sinus wall. Other types of complex fractures include the zygomaticomaxillary complex, which disrupts all four zygomatic sutures and may result in enophthalmos due to increased orbital volume because of the angulation of the lateral orbital wall, and the naso-orbito-ethmoid complex fractures, which frequently involve the medial orbital wall, the nasal bone, the ethmoid sinuses, and the location where the medial canthal tendon attaches. [1,3] While it is the radiologist's obligation to recognize and accurately diagnose facial fractures on imaging, it is equally important to simply and clearly state the findings in the radiology report. An excellent report should show understanding of the clinically significant factors that might influence management. The craniofacial anatomy includes a complex section known as the midface. It consists of numerous distinct bone components that interact with one another, communication. The midface merits special consideration when it comes to evaluation and management because, in addition to its structural characteristics, it serves functional purposes related to breathing, speech, swallowing, mastication, olfaction, and vision.

Therefore, any injury or deformity in this area can have a significant impact on a person's quality of life. Due to the complexity of the midface anatomy, specialized imaging techniques like CT scans are often required to accurately diagnose. The posterior boundary is made up of the frontal bone superiorly and the sphenoid inferiorly, while the lateral boundary is the temporal bone. Midface structure has thin bone parts supported by a hard frame of buttresses. structural pillars of the mid-face are canines, zygomatic, and pterygoid buttresses [4]

The midface is made up of several bony structures including two maxillae, zygomatic bones, zygomatic processes of temporal bones, lacrimal, palatine, and nasal bones, the vomer bone, the ethmoid, with the connected conchae, two inferior conchae, and the pterygoid plates of the sphenoid bone [5].

MATERIAL AND METHOD

Data were collected from the Radiology Department at Al-Jala Teaching Hospital in Benghazi to conduct a descriptive, cross-sectional, hospital-based study. Between 2010 and 2013, the medical records of 417 patients who underwent head and facial CT scans following maxillofacial trauma were reviewed. The study utilized a General Electric (GE) 128-slice helical CT scanner. CT scans of the face were performed with the patient in a supine position, and axial slices were acquired at 0.625 mm collimation, with a field of view extending from the top of the frontal sinuses to the chin. Supine axial imaging was selected to ensure rapid acquisition and patient comfort, with a total exposure time of approximately 16 seconds. Coronal and sagittal reconstructions were generated, and 3D volume-rendered images were also obtained.

Imaging modality:

Computed tomography (CT) scans, which offered fine-grained visualisation of fracture patterns, were used to evaluate all fractures. Two primary catego-

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ries were used to classify fractures: Simple fractures: affecting the mandible, orbital walls, nasal bone, isolated zygomatic arch, frontal sinus, and maxillary sinus. Complex fractures include naso-orbito-ethmoidal (NOE) fractures, LeFort I, II, and III fractures, and zygomaticomaxillary complex (ZMC) fractures. Descriptive statistics were used to summarise clinical and demographic features in the statistical analysis, which was carried out using SPSS version 23 for Windows. Associations between variables were examined using chi-square tests or other suitable statistical techniques; a p-value of less than 0.05 was deemed statistically significant.

The study received approval from the Head of the Radiology Department as well as ethical approval from the hospital's Research and Ethics Committee.

RESULTS

Age and gender distribution:

The age of the patients was ranged from 2 to 85 years at the time of the injury, with a mean age (SD) of 29.9 years. The age group from 21 to 30 years had ranked the highest incidence of maxillofacial trauma (n = 180; 43.2%). Up until the third decade, the age-specific distribution of patients showed an upward trend, after which the incidence fell with each succeeding decade. Injuries happened 21 times (5%) in the first decade, 51 times (12.2%) in the second, 180 times (43.2%) in the third, 104 times (24.9%) in the fourth, 35 times (8.4%) in the fifth, 18 times (4.3%) in the sixth, 05 times (1.2%) in the seventh, and three times (0.7%) in the eighth. Pediatric (less than 18 years of age) fracture accounted for 12.7% (n = 53) of patients, and 2.87% (n=12) was more than 60 years of age table 1. Men were mostly affected than women in all age groups table1.

Table 1: Distribution of the Study Sample by their age group and sex.

Age group	Male	Female	Total	Percent%	Mean ± SD	P value
(1-10)	17	4	21	5%	29 ± 12.2	P=0.008
(11-20)	40	11	51	12.2%		
(21-30)	165	15	180	43.2%		
(31-40)	91	13	104	24.9%		
(41-50)	27	8	35	8.4%		
(51-60)	12	6	18	4.3%		
(61-70)	4	1	5	1.2%		
>70	3	0	3	0.7%		
Total	359	58	417	100		

The male to female ratio was 6:1. Figure 1 shows the distribution of the patients according to their sex.

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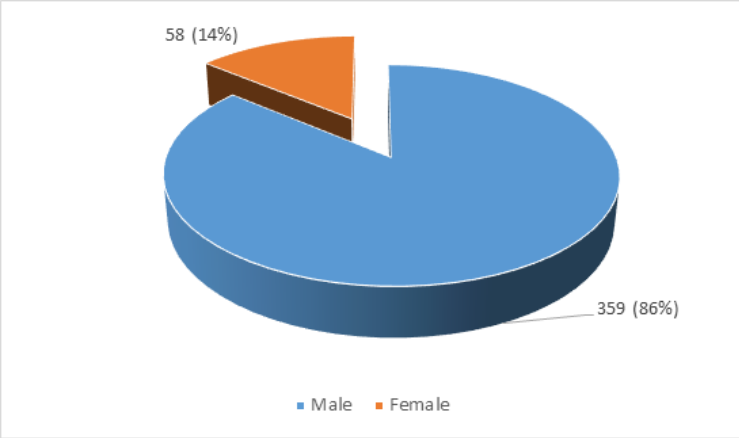


Figure 1: Distribution of the patients according to their sex.

ETIOLOGY

The most common reason for maxillofacial trauma were maxillofacial trauma (n = 314; 75.29%), followed by physical assault (n = 32; 7.67%), gunshot wound (n = 29; 6.95%), and unintentional falls (n = 29; 6.95%). Sports-related injuries occurred in 13 cases (3.1%) of the remaining fractures, which were caused by a variety of factors. Injury etiologies are displayed in Table 2 and Figure 2.

Regarding the etiologies of trauma, our findings showed a statistically significant difference between genders (p = 0.032).

Table 2: Distribution of the patients by their gender and cause of maxillofacial trauma

Etiology of Trauma	Road Traffic Accident	Fall from Height	Physical Assault	Sport Injuries	Bump Explosive	Gun Shot	Total	P value
Male	261 (62.5%)	25 (5.9%)	32 (7.67%)	2 (0.47)	11 (2.63%)	28 (6.71%)	359 (86%)	0.032
Female	53 (12.7%)	4 (0.95%)	0 (0)	0 (0)	0 (0)	0 (0.23%)	58 (14%)	
Total	314 (75.29%)	29 (6.95%)	32 (7.67%)	2 (0.47%)	11 (2.63%)	29 (6.95%)	417 (100)	

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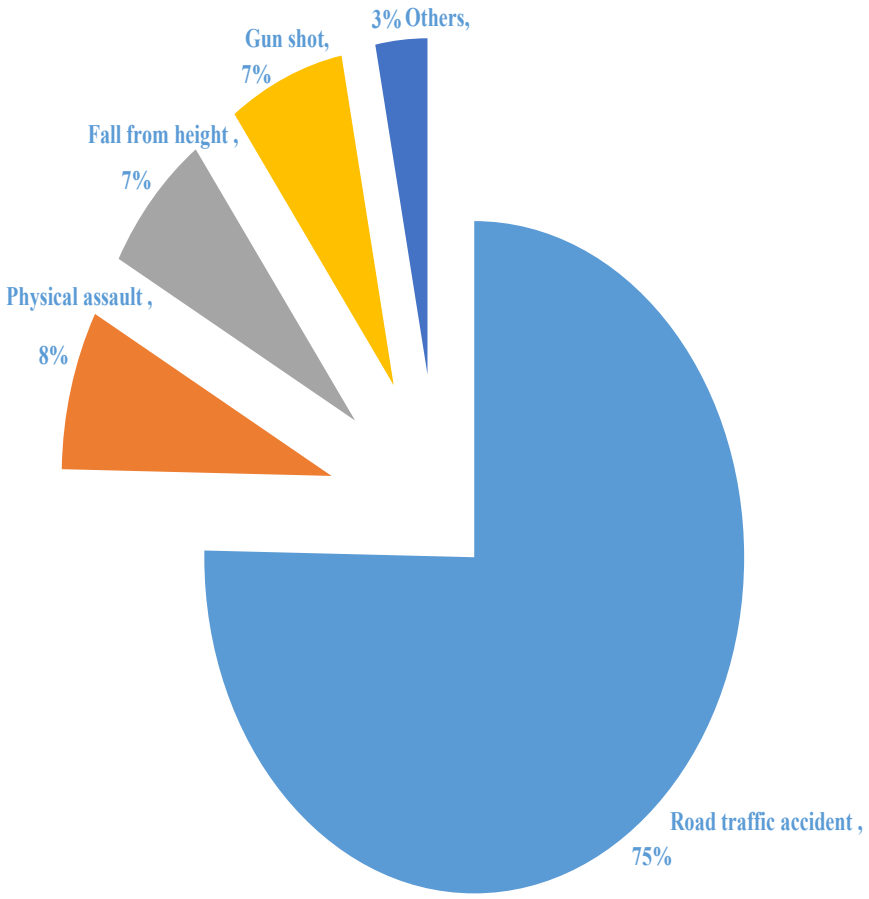


Figure 2: Etiologies of Maxillofacial Trauma.

Fracture site:

Among the simple maxillofacial fractures, the orbital walls were the bone that fractured most frequently. There were 254 cases overall (or 60.9%) where the orbital wall fracture was present. The second most affected area of maxillofacial trauma was the maxillary sinus wall (n = 216; 51.8%), followed by the nasal bone (n = 180; 43.2%), the isolated zygomatic arch (n = 132; 32%), the mandible fracture (n = 105; 25.2%), and the frontal sinus fracture (n = 80; 19.2%) , Table 3 and figure 3.

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Table3: Distribution of patients by their gender and the site of the simple Maxillofacial Fracture.

Computed Tomography Finding (CT)	Male	Female	Number (no)	Percent%
Orbital Wall Fracture	229	25	254	61.0%
Maxillary Sinus Fracture	195	21	216	52.0%
Nasal Bone Fracture	152	28	180	43.2%
Isolated Zygomatic Arch Fracture	117	15	132	32.0%
Mandible Fracture	90	15	105	25.2%
Frontal Sinus Fracture	72	8	80	19.2%

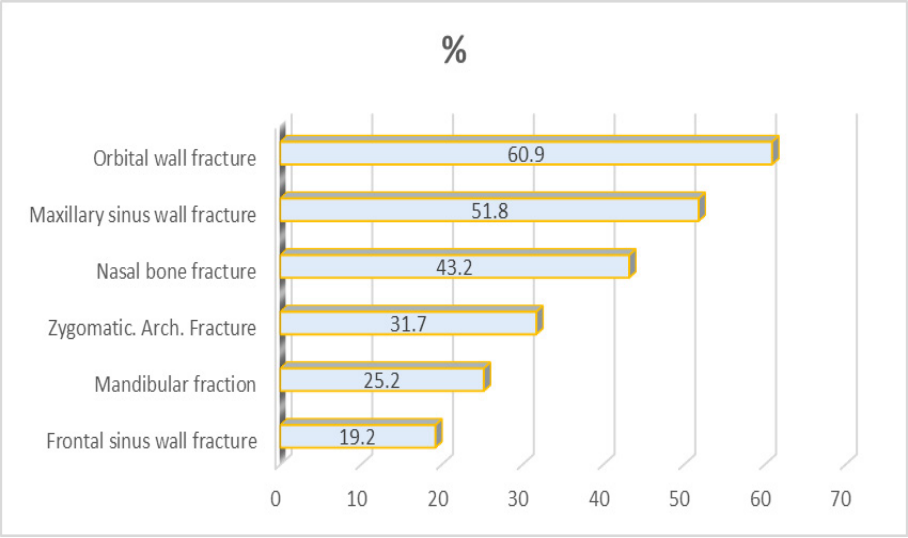


Figure 3: Distribution of the patients by the site of Simple Maxillofacial Fractures According to the MDCT Findings.

The most common complex maxillofacial fractures overall (n= 94; 22.5%) were zygomatic maxillary complex fractures, followed by naso-orbito-ethmoid complex fractures (n=31; 7.4%), maxillary fracture le fort III with total number of 26 and percentage 6.2% and le fort II (n=23; 5.5%), and le fort I (n=9; 2.2%), table 4 and figure 4.

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Table 4. Distribution of patients by their gender and the site of the complex Maxillofacial Fracture.

Computed Tomography Finding (CT)	Male	Female	Number (n)	Precent %
Zygomatic-Maxillary Complex Fracture	48	46	94	22.5%
Naso-Orbital-Ethmoidal Complex Fractur	28	3	31	7.4%
Le Fort Type III Fracture	23	3	26	6.5%
Le Fort type II Fracture	21	2	23	5.5%
Le Fort type I Fracture	8	1	9	2.2%

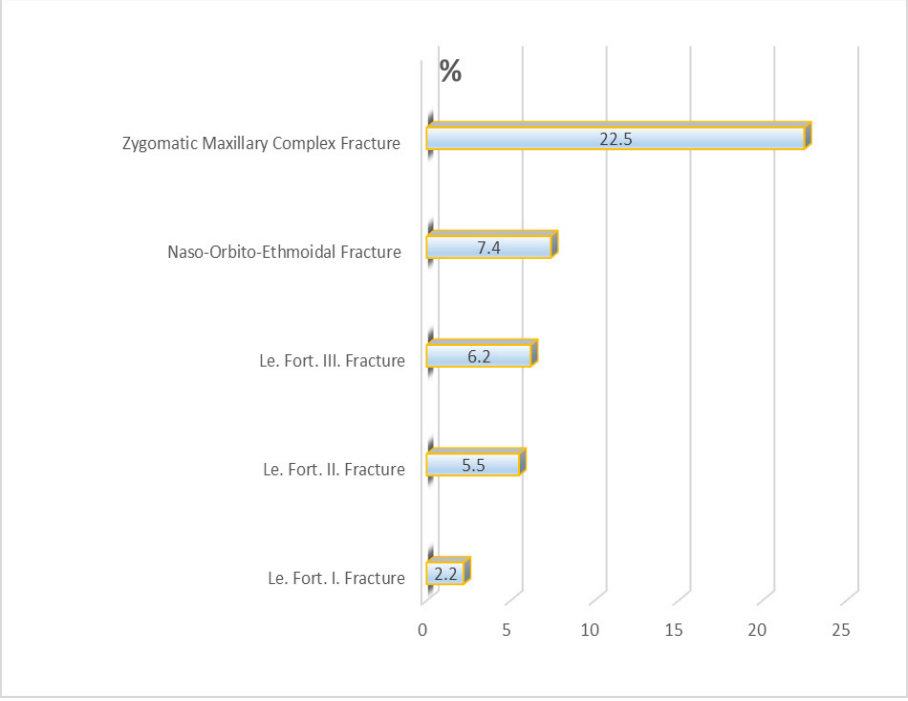


Figure 5: Distribution of patients according to the site of the complex Maxillofacial Fracture.

Regarding the distribution of fractures by age group, ZMC, lefort I, and II fractures were observed in all age groups with the exception of children aged 0 to 10 years. Patients between the ages of 21 and 30 made up the majority of mid facial fracture cases (43.2%), with orbital wall fractures making up the most common simple fracture pattern in this group and Zygomaticomaxillary complex the most common complex fracture pattern. It is also noteworthy that isolated orbital fractures were most common in the youngest age group (0 to 10), and maxillary sinus wall fractures were most prevalent in the oldest group (60+), table 5.

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Table 5. Distribution of the patients according to the site of the fractures and age Group Category.

Age Group	Orbital Wall Fracture	Maxillary sinus wall Fracture	Nasal Bone Fracture	Isolated zygomatic arch fracture	Mandible fracture	Frontal sinus	ZMC	NOE	Le Fort I	Le Fort II	Le Fort III
(1-10)	14	3	3	2	5	3	0	2	0	0	2
(11-20)	28	21	25	16	8	10	12	4	1	1	3
(21-30)	111	87	80	55	45	38	42	13	3	9	8
(31-40)	61	68	51	34	34	22	23	8	1	7	9
(41-50)	22	18	12	11	6	6	8	2	2	1	2
(51-60)	13	12	4	11	6	1	8	0	1	3	2
(61-70)	3	4	3	2	0	0	0	0	1	1	0
>70	2	3	2	1	1	0	1	2	0	1	0
Total	254	216	180	213	105	80	94	31	9	23	26

The ZMC fracture was the most prevalent complex bone fracture in both sexes; however, in men, the most common fracture pattern was an isolated orbital wall fracture. A solitary fracture of the nasal bone was the most frequent simple bone fracture in females, Fisher's exact test was utilized to investigate the relationship between gender and fracture site, Fisher's exact test ($p = 0.812$) found no association between gender and fracture site.

DISCUSSION

The most frequent cause of maxillofacial fractures, according to this study, was traffic accidents, the occurrence of maxillofacial trauma in developing nations is influenced by a lack of traffic laws, along with inadequate road infrastructure, older cars lacking safety standards, and cell phone use while driving [6]

Previous research has revealed that in affluent countries, violence is more common than traffic accidents as a reason for maxillofacial fractures [7]

In this study, the ratio of male to female patients in maxillofacial fractures was 6:1.

An additional study also came to a similar conclusion which done by [8,9] Men typically became the family's breadwinner and tend to spend more time outside, which increases their risk of trauma, whereas women are more frequently at home and have fewer trauma risk factors.

a MDCT scanner and a modern workstation are now essential diagnostic tools for any emergency room, to provide the best acute therapy of the midfacial trauma, the surgeon must fully understand the morphology and severity of the fractures [10].

there are considerable geographical disparities in the frequency of midfacial fractures, the majority of research reported in the literature indicates that mandibular fractures occur more frequently than mid-facial fractures [11,12, 13].

In this study, 61% of all facial bone fractures involved the orbital bone coinciding with other studies [14,15,16] the second most typical type of fractured bone was the maxillary sinus wall, which made up 52% of all fractured bones; the third most often fractured isolated bone was the nasal bone, with an average incidence of 43.2%. Separate fractures of the zygomatic arch made up about 32% of the fractures, mandibular fractures made up 25.2%, and frontal sinus fractures made up 19.2%.

Zygomatico-maxillary complex fractures are the most prevalent type of complicated facial fractures, accounting for 22.5% of occurrences, similar to sizable studies [17,18,19]. followed by the naso-orbital-ethmoidal complex fracture at 7.4%. Le Forte III contributed 6.5%, Le Forte II 5.5%, and Le Forte I 2.2% to the total.

We proved that the CT scan is an effective diagnostic tool for assessing face fractures. Because it makes 3-D investigation and high-resolution multiplanar reconstructions possible.

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CONCLUSION

In Benghazi, one of the major health problems is maxillofacial trauma. Maxillofacial fractures can become an aesthetic and functional issue if they are not promptly and effectively treated. Trauma affects a person's psychological well-being and has a detrimental socioeconomic effect on society, in people between the ages of 21 and 30 have the highest maxillofacial fractures (43.2%), according to our study. In the current study, 75% of the causes were related to road accidents. The zygomaticomaxillary complex (22.5%) was the most broken area of the midface, according to our study, which also found that ocular wall fractures predominated among people with simple maxillofacial trauma (61%). The findings of our investigation showed that car accidents were the main cause of maxillofacial injuries in Benghazi.

RECOMMENDATION

Public awareness campaigns are needed to educate the population—particularly drivers—about the importance of adhering to driving regulations and using safety equipment. These findings also highlight the need for authorities to strictly enforce existing traffic laws to reduce reckless, high-speed driving on highways.

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