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Determination of types and treatment modalities of facial bone fractures associated with road traffic accidents in Duhok City

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Abstract

Background and objectives: The maxillofacial region being the most exposed part of the body, is particularly vulnerable to trauma, resulting in injuries to skeletal components, dentition, and soft tissues. This study aims to investigate the causes, characteristics, and treatment outcomes of trauma affecting the maxillofacial region, with a focus on injuries to skeletal components, dentition, and soft tissues.

Methods: This retrospective cross-sectional study was reviewed 80 files with maxillofacial trauma as a result of road traffic accidents, who's attended the Emergency Hospital in Duhok city during the period from January 2018 to end of December 2022, were included. We analyzed their medical records and data related to the cause of injury, type of fracture, treatment modality and post operative complications.

Results: Have shown with varying degrees of maxillofacial trauma. The highest frequency of cases occurred in 2022 (33.8%), while the lowest was in 2018 (10%). In 68.8% of patients, only one maxillofacial bone was fractured, with the mandible being the most frequently affected (58.9%). The combined approach of dental and osseous fixation was utilized in 39.3% of cases. Mandibular fracture was significant in most patients.

Conclusion: The primary causative factor for maxillofacial injuries has been identified as road traffic accident, particularly affecting young adult males.

Keywords: Accidents, Facial bones, Fractures, Maxillofacial Injuries, Traffic

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Introduction

The maxillofacial region (MFR), encompassing the anatomical structures from the frontal bone superiorly to the mandible inferiorly, comprises both soft and hard tissues that form the face. This region, being the most exposed part of the body, is particularly vulnerable to trauma, resulting in injuries to skeletal components, dentition, and soft tissues. The etiology of maxillofacial trauma exhibits significant variability across geographical regions, influenced by socioeconomic, cultural, and environmental factors. The spectrum of injuries ranges from relatively simple soft tissue lacerations to intricate fractures of the maxillofacial skeleton, necessitating collaborative treatment approaches involving neurosurgeons, ophthalmologists, and orthopedic surgeons.[1] The severity and pattern of maxillofacial trauma are contingent upon the anatomic site of impact, the magnitude of force, and the direction of the force.[2,3] In the context of fractures, the preeminence of mandibular fractures stands out as the highest among cases attributed to road traffic accidents (RTA), closely followed by fractures in the middle third of the face.[4] A noteworthy phenomenon is observed wherein victims of RTAs instinctively attempt to shield their heads during accidents, inadvertently leading to a heightened impact on the mandible. Empirical studies underscore mandibular fractures as the predominant type, with Para symphyseal fractures exhibiting the highest incidence among all mandibular fractures, succeeded by fractures in the body, dentoalveolar region, angle, symphysis, condyle, and coronoid process.[5-8] In mid-face fractures, the zygoma is most frequently affected, followed by the zygomatic arch, naso-orbito-ethmoid (NOE) complex, dentoalveolar region, nasal bone, and Le Fort fractures (Le Fort II, Le Fort III, and Le Fort I). Additionally, orbital fractures are prevalent in this context. Classifications for fractures are essential for a systematic understanding and management approach. The Le Fort classification system (René Le Fort) categorizes maxillary fractures into Le Fort I, Le Fort II, and Le Fort III.[9] The Manson classification system is employed for the assessment and classification of zygomatic fractures, differentiating between low-energy, medium-energy, and high-energy injuries.[10] Treatment strategies for maxillofacial trauma are diverse and contingent upon the specific pattern and severity of the injury. These may range from conservative measures involving debridement and sutures to dental fixation with arch bars or eyelets and, in more severe cases, surgical intervention through osseous fixation. Procedures involving open reduction have demonstrated favorable outcomes, including improved facial aesthetics, shorter work and less duration, early preservation of function, and a reduced incidence of complications.[11] The therapeutic approach to mandibular fractures entails a comprehensive strategy encompassing intermaxillary fixation using the Erich arch bar and stainless-steel wire, coupled with close reduction, ensuring the patient maintains centric occlusion for a period of 45 days. Additionally, an intraoral methodology involving osteosynthesis with monocortical screws and plates may be employed. In the case of angle fractures, adherence to Champy's osteosynthesis principles forms the cornerstone of treatment. Conversely, for Zygomaticomaxillary fractures (ZMF), a strategic delay of several days is observed, allowing for clinical assessment post-edema subsidence. Diverse approaches, including those pioneered by Gillies, Carol Girard, Keen, and the subcilliary approach, are then employed for the effective management of zygomatic fractures. For LeFort fractures, close reduction with internal fixation is commonly employed. In the case of

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edentulous patients, an observational approach is favored due to the atrophic nature of the maxillary bones. Different surgical approaches are necessary for Le Fort II and III fractures, with coronal incisions being preferred for Le Fort III fractures. Even in Lefort II and III fractures, intra-oral incisions are usually necessary to achieve access for reduction and fixation need.[12] The aim of this study was to determine the frequency and degree of maxillofacial bone injuries caused by road traffic accidents in Duhok city and describe the therapeutic modalities.

Patients and methods

A retrospective cross-sectional study was conducted by reviewing files related to adult patient (older than 18 years old) with Maxillofacial trauma as a result of road traffic accidents (RTA), who's attended to the Emergency Hospital in Duhok city during the period from January 2018 to the end of December 2022, were included. According to the patient files, personal history including name, age, sex, residence, occupation, and education level was collected. We analyzed their medical records and data were collected concerning the cause of injury, type of fracture, treatment modality and post operation complications. In addition to this, information related to the accident was also considered vehicle involve, location, time, day, month, etiology, and use of the protective seat belt by the patients and passenger at the time of accident. Maxillofacial fractures were diagnosed with clinical and imaging examination (conventional radiograph or CT scan). Fractures of the facial skeleton were classified as follows: mandibular bone, zygomatic complex, naso-orbito-ethmoidal, maxillary, and dentoalveolar process fractures. Fractures were assessed according to anatomical regions to fractures of the mandible (according to AO/ASIF classification subdivided into Para symphysis, symphysis, body, angle, ramus, coronoid process, and condyle), middle-third of the face fractures were record as Le Fort, I, II, and III types (according to LeFort classification system), zygomatic complex according to Manson and et al 1990 (zygomatic bone, zygomatic arch), nasal bone, Naso –orbito- ethmoidal complex, orbital blow-out, and other dentoalveolar injuries (dentoalveolar fractures, avulsion and fracture of teeth). Inclusion criteria included facial injuries as a result of road traffic accidents were automobile or motor vehicle accident, motorcycle or bicycles accident, drivers, passengers, and pedestrian or another road user struck by moving vehicle. The patients were older than 18 years at time of admission to hospital. Exclusion Criteria was isolated from oro-facial soft tissue injury. Treatment modalities were conservative treatment (observation, soft diet, analgesia, and follow up), open reduction or close reduction, fixation which is either dental fixation (arch bar/ eyelet) or bony fixation (intra osseous wiring, plate, and screw, splints/circum-mandibular wiring), and combination of both. The complications that were considered were infection, malunion, asymmetry, exposed hardware, paresthesia, foreign body reactions, and scarring in all types of fractures and enophthalmos, diplopia, epiphora in LeFort, orbital floor, and ZMC fractures and trismus in mandibular and zygomatic arch fractures, deviated septum, nasal obstruction, sinusitis specifically in LeFort fractures. The data were analyzed using Statistical Package for Social Sciences (SPSS) program (version 26). The numerical data as the age of patients was described by mean and standard deviation. All other categorical data as the bones involved, associated injuries, classification of fractures, treatment modalities …etc. were described by frequency tables. Graphs were also added for better clarification. This study, approved

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by the Ministry of Health Duhok Directorate General of Health.

Results

Eighty patients subjected to road-traffic accidents were involved in this study whom they had different maxillofacial trauma. The age and gender classification of these patients is shown in Table (1). The mean age of all patients was 30.2 years with a standard deviation of 12.44 years. The majority of them (63.7%) were young in the age group 18-30 years, followed by 27.5% in the age group of 31-45 years. Only 2 of them (2.5%) aged more than 60 years. Males constituted 83.8% of the participants with a mean age of 29.2 years compared to 35.4 years of females.

Table (1): Age-gender classification of the study participants

Age group	No (%)	
18-30 years	51 (63.7)	
31-45 years	22 (27.5)	
46-60 years	5 (6.3)	
> 60 years	2 (2.5)	
Gender	No. (%)	Age in years Mean (SD)
Male	67 (83.8)	29.2 (11.26)
Female	13 (16.2)	35.4 (16.89)
Total	80 (100.0%)	30.2 (12.44)

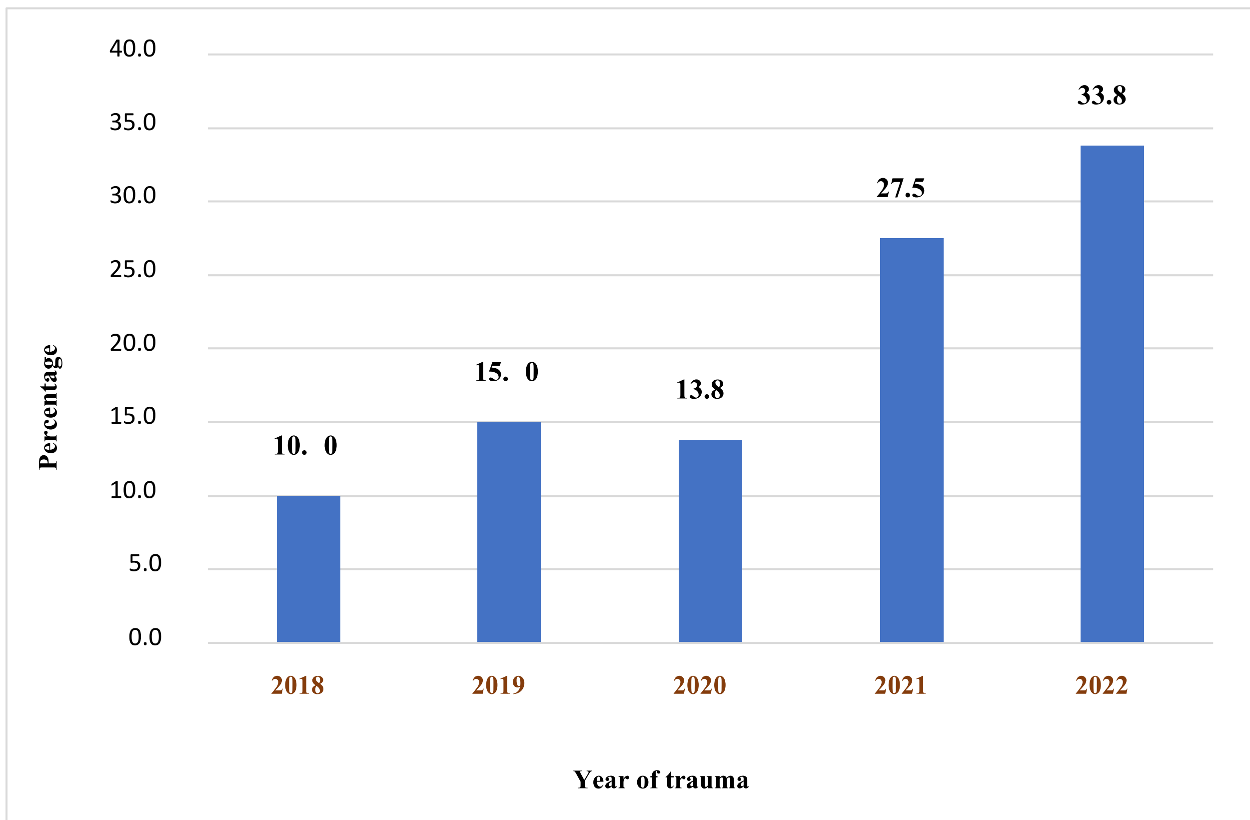

Figure (1): Frequency of trauma according to year of occurrence

These accidents and traumas were from the years 2018 to 2022 with the highest frequency (33.8%) being in the year 2022 and the least (10%) in the year 2018 as shown in Figure (1).

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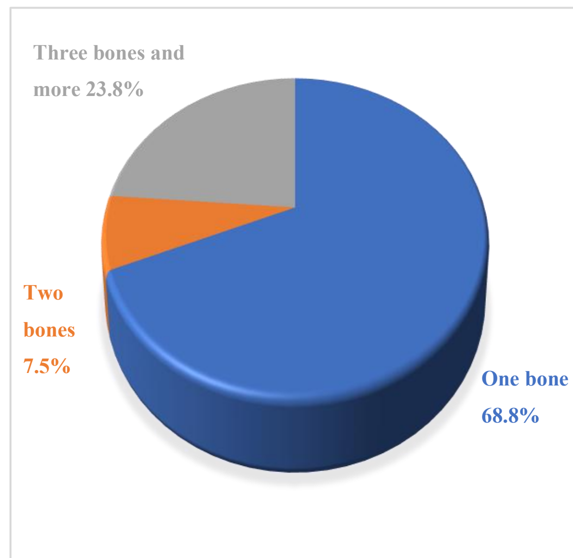

Figure (2): Number of bones fractured

Only one maxillofacial bone was traumatized as it happened in 68.8% of patients. Two bones were fractured in only 7.5% of patients and in 23.8% of them three bones and more were fractured as shown in Figure (2).

Table (2): Frequency of associated injuries and postoperative complications

	No.	%
Associated injuries		
Yes	10	12.5
No	70	87.5
Postoperative complications	18	22.5
Yes	62	77.5
No		

Only 10 (12.5%) out of the 80 patients had other associated injuries as fracture of upper or lower limbs bones. Regarding postoperative complications, they happened in 18 patients (22.5%) and they were mostly paraesthesia in the lips in some case of body of mandibular fractures or cheeks in some case of zygomatic and LeFort II fractures. These frequencies of associated injuries and postoperative complications are shown in Table (2).

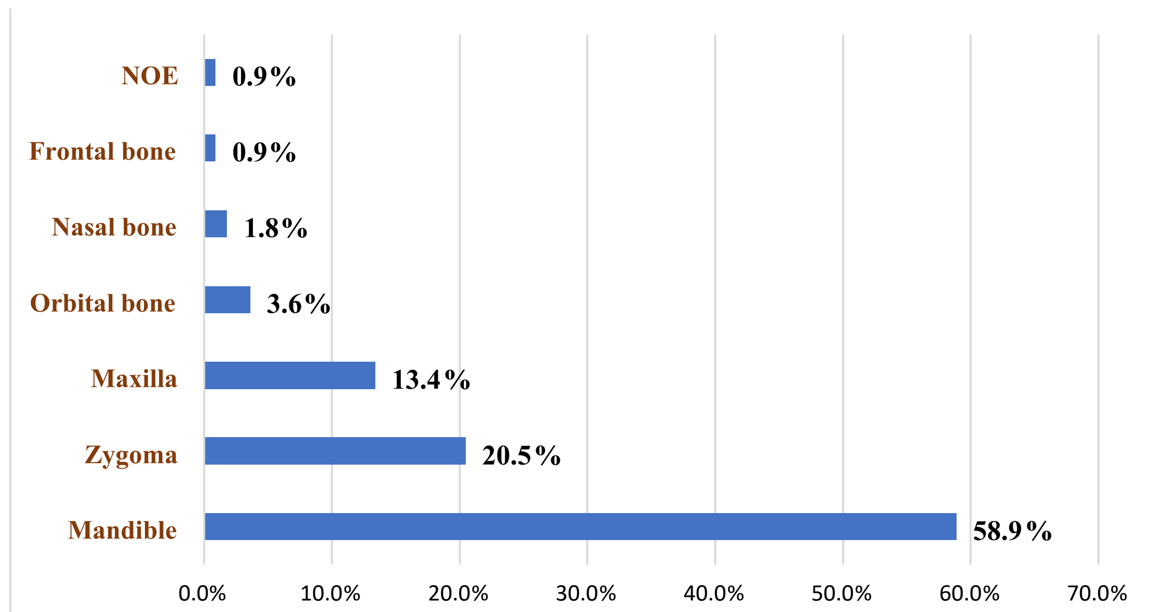

Figure (3): Frequency of different maxillofacial bone fractures

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When considering the number of maxillofacial bones fractures regardless of the number of patients, there were 112 fractures of these bones occurred among all patients. The most frequent bones subjected to trauma was the mandible (58.9%) followed by zygoma (20.5%) and then the maxilla (13.4%). The frequencies of maxillofacial bone fractures are shown in Figure (3).

Table (3): Classification of Mandible and Maxilla fractures

Site or type	No.	%
Mandible		
Body	21	31.8
Angle	11	16.7
Symphyseal	11	16.7
Parasympheseal	15	22.7
Subcondylar	7	10.6
Coronoid	1	1.5
Total	66	100.0
Maxilla		
Dentoalveolar	5	33.4
Le Fort I	3	20.0
Le Fort II	7	46.6
Total	15	100.0

The classification of the fractures of the mandible and maxilla according to the site or type of fracture is seen in table (3). About one third of mandible fractures (31.8%) were in the body and 22.7% were parasympheseal. The angle fractures and symphyseal constituted 16.7% of mandible fractures for each and the least (1.5%) was in the coronoid process. For the maxilla the highest frequency of fracture type was Le Fort II (46.6%) followed by dentoalveolar (33.4%) and then Le Fort I (20%). For zygoma fracture the distribution was nearly equal as being low, middle or high energy fracture. The classification of the fractures of the zygoma according to the severity is seen in Table (4). The most frequent type of fracture among all 112 fractures was the simple type (45.6%) followed by compound fractures (44.6%) and then comminuted fractures (9.8%). This classification of type of fractures is shown in Table (5).

Table (4): classification of Zygoma according to severity

Severity	No.	%
Low energy	8	34.8
Middle energy	8	34.8
High energy	7	30.4
Total	23	100.0

Table (5): Classification of fractures according to the type

Type of fracture	No.	%
Simple	51	45.6
Compound	50	44.6
Comminuted	11	9.8
Total	112	100.0

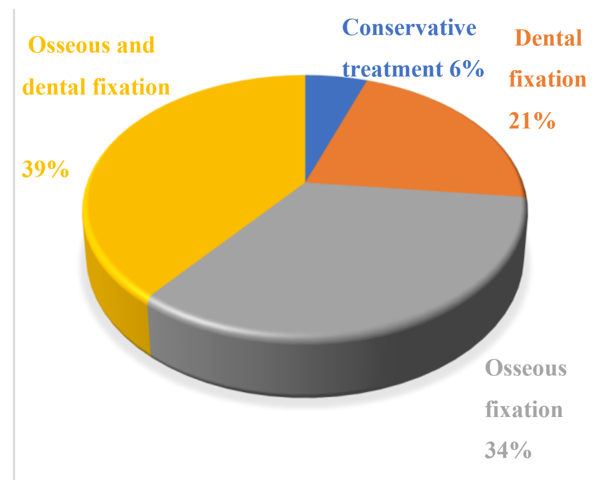

Figure (4): Treatment modalities used

Four treatment modalities were used in managing these fracture, conservative treatment, osseous fixation, dental fixation and combination of both (dental and osseous fixation). The combined osseous and dental fixation was most used (39.3% of times) followed by osseous fixation in 33.9% of fractures. Dental fixation was used in 21.4% of fracture and only 5.4% of factures were treated conservatively. Figure (4) illustrated these treatment modalities.

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Table (6): Type of reduction according to traumatized bone

		Type of fixation		
Bone	Conservative No. (%)	Dental fixation No. (%)	Osseous fixation No. (%)	Dental & Osseous fixation No. (%)
Mandible	5 (7.6)	19 (28.8)	5 (7.6)	37 (56.1)
Zygoma	0 (0.0)	0 (0.0)	23 (100.0)	0 (0.0)
Maxilla	1 (6.7)	5 (33.3)	2 (13.3)	7 (46.7)
Orbital	0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)
Nasal	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
Frontal	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
NOE	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)

These treatment modalities were used in different frequencies according to the bone fractured as shown in Table (6). More than half of mandible fractures (56.1%) were treated by combined dental and osseous fixation which is used also for 46.7% of maxilla fractures. All zygoma fractures as well as orbital, nasal, frontal and NOE bone fractures were treated by open reduction. Conservative treatment was used only for 7.6% of mandible fractures and 6.7% of maxilla fractures.

Table (7): Modalities of bone fixation

Modality	No.	%
Plate	46	85.2
Wire	5	9.3
Plate and wire	3	5.6
Total	54	100.0

Regarding the modalities of osseous fixation (fixing the fracture fragments or dislocation with open surgery by dissecting the tissues), in most cases it was done by plate (85.2%) followed by wire in 9.3% of cases and then plate and wire together in 5.6% of cases as seen in Table (7).

Discussions

The current study highlights a significant rise in maxillofacial injuries resulting from road traffic accidents (RTAs), which aligns with existing literature linking increased traffic incidents to economic growth, urbanization, and higher vehicle volumes.[1] The observed higher frequency of maxillofacial injuries among men, compared to women, may be attributed to societal roles and gendered driving behaviors, where men typically engage in riskier driving practices and have higher exposure to RTAs. This finding is consistent with previous studies that emphasize the impact of gender dynamics on traffic-related injuries. Additionally, the 18-30 age group was identified as particularly vulnerable to maxillofacial injuries.[7,12-18] This demographic often concludes with their post-secondary education and embarks on numerous journeys in pursuit of employment opportunities, which may increase their exposure to accidents. Research has shown that young adults exhibit more energetic and aggressive behavior, often correlating with careless driving. Targeted educational interventions aimed at this age group could play a pivotal role in reducing their involvement in accidents, emphasizing safe driving practices and risk awareness. The study found the mandible to be the most frequently injured facial structure, reflecting its anatomical prominence and exposed position on the face. This observation aligns with previous research that highlights the

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mandible's vulnerability, particularly during RTAs when individuals instinctively attempt to shield their heads, inadvertently exposing their mandibles to maximum impact. Implementing stringent traffic laws, mandatory seatbelt use, and promoting helmets with chin protection could significantly reduce the incidence of mandibular and midface fractures. Public education campaigns stressing helmet use can also cultivate a culture of safety that extends beyond mere regulatory compliance. In terms of treatment strategies, over half of the maxillofacial fractures were managed using a combination of osseous and dental fixation techniques. This dual approach was selected based on several factors, including the complexity of the fractures, the specific anatomical structures involved, and the goal of balancing optimal alignment with quicker recovery.[18] Osseous fixation allows for precise repositioning in complex cases, while dental fixation offers a less invasive option for simpler fractures. This tailored approach is supported by recent studies indicating that combining techniques can enhance functional and aesthetic outcomes, particularly in situations requiring both stability and expedited recovery. Furthermore, findings on post-treatment complications, such as numbness in the cheek and lower lip due to dysfunction of the inferior alveolar and infraorbital nerves, as well as hypertrophied scar formation, are consistent with those reported by Raveh et al. These complications highlight the need for meticulous surgical techniques and postoperative care to minimize nerve-related risks in the treatment of mandibular and zygomatic fractures.[19]

Conclusion

In conclusion, the insights gained from this study underscore the multifaceted nature of maxillofacial injuries and their management. By understanding the socio-economic factors contributing to injury prevalence and implementing targeted interventions and tailored treatment strategies, it is possible to enhance both prevention and outcomes for individuals affected by maxillofacial trauma.

Disclosure

The authors assert that they have no conflicts of interest.

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