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The Epidemiology, Incidence and Patterns of Maxillofacial Fractures

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Abstract

Background and Objectives: The incidence of recorded maxillofacial trauma continues to increase worldwide and as expected the etiology and types of injuries vary among different countries. Previous studies support that the differences in both patterns and etiology of maxillofacial fractures depend to a large extent on cultural, social and economic variables. As an example, in developed countries, especially in Europe, physical assaults were the main cause of maxillofacial fractures, followed by motor vehicle accident (MVA). The aim of this retrospective chart study was to analyze the demographics, causes, incidence and patterns of maxillofacial fractures in patients from the western region of Saudi Arabia treated at King Fahd Hospital, Saudi Arabia (KFGH). ***Methods:*** Patients treated between 1998 and 2018 at the department of maxillofacial surgery in KFGH were reviewed. Patient's age, sex, pattern of facial fracture, and causes of injury were recorded. Data was analyzed using SPSS Pc+ 21.0 version statistical software. ***Results:*** A total of 616 patients (87% n = 536 male and 13% n = 80 female) with 886 fractures were recorded. The age group ranging between 20 to 29 years (39.2%; n = 238) sustained the highest incidence of maxillofacial fractures. Of the different causes of trauma, i.e., MVA, falling from heights, fighting, sports injuries and others MVA was listed as the main cause in 369 (59.9%) patients [male (n = 316) / female (n = 53)]. Of the different potential anatomical sites (Maxillary, Orbital, Nasal, ZMC, Frontal, Mandibular, Dentoalveolar, Lefort I, Lefort II and Lefort III), the mandible was found to have the highest rate 61.2% (377 out of 616), followed by ZMC (37.2%), Orbital (12.8%), Nasal (7.5%), and Frontal (6.3%). In all types of maxillofacial injuries MVA is the most frequently causative factor (n = 369) compared to Non-MVA factors (n = 247). The association between the cause of accidents and type of injury is statistically significant ($p<0.01$). ***Conclusions:*** In this study, MVA was found to be the most common cause of maxillofacial injuries with the mandible being the most frequent anatomical site affected. Appropriate health education programs and design engineering can be initiated to avoid road traffic accidents and reduce related injuries.

Keywords: Trauma Etiology Maxillofacial Fractures Epidemiology Injury pattern Incidence.

INTRODUCTION

Maxillofacial injuries can have a profound effect on quality of life, including physiological, psychological, and aesthetic disturbances. Moreover, this anatomical location and depending on the etiology or mechanism of injury, there is always the potential for severe concomitant injuries including incapacitating injuries to the central nervous system. The associated morbidity and mortality can exceed those related to other causes including heart disease and cancer with tremendous strain on available resources and/or training to properly manage [1-3].

Reported incidences vary from country to country and even within the same country This large variability depends on a variety of contributing factors, most significantly on, sex, age, socioeconomic, cultural and environmental factors in different periods of the year, as well as the precise mechanism of injury [2-5].

The most common causes of facial fractures are motor vehicle accidents (MVA), assaults, falls from height, sports, and work related injuries [2]. Road traffic accidents, i.e. accidents involving a motor vehicle with another vehicle, animal, or pedestrian are becoming increasingly more common in Saudi Arabia. This is partly due to a large increase in the number of vehicles and expansion of road networks, driver errors and negligence including excess speed and violation of signals at intersections, road safety and vehicle condition [6].

Investigators in Jordan [7], Nigeria [8, 9] New Zealand [10] and Denmark [11] have found that motor vehicle accidents remain the most common cause of maxillofacial trauma in these countries while in Finland [12] Scotland [13] and Sweden [14] interpersonal assault is the most common etiological factor.

In Riyadh, Saudi Arabia [16, 17] road traffic accidents were closely associated with head and/or facial injury accounting for 30% of injuries and causing 26% of fatalities. Thus, a keen awareness and knowledge of the cause, frequency and severity of maxillofacial fractures play an important role in establishing effective community treatment and prevention measures[4]. In addition, an understanding of the demographic patterns of maxillofacial fractures will assist health care providers as they plan and manage the treatment of traumatic maxillofacial injuries.

The purpose of this retrospective chart study was to analyze the demographics, causes and characteristics of maxillofacial fractures from the western region of Saudi Arabia treated at King Fahd General Hospital (Jeddah city, KSA), which is the main regional trauma center. Our ultimate goals are to identify the different epidemiological factors and to suggest potential targets of preventive measures.

MATERIALS AND METHODS

A retrospective review of all maxillofacial fracture patients presented to King Fahd General Hospital (KFGH) between 1998 and 2018 was performed on patients treated by the Oral and Maxillofacial Surgery department.

Patients with incomplete data and/or records that could not be retrieved were excluded. As a result, a total of 616 patients with 886 fractures were analyzed.

A systematic computer-assisted database, medical records (trauma evaluation sheets, consults, operative reports, and outpatient clinic notes) and digitized radiographic imaging (computed tomography scans) were used to collect the patient information. Data collected included patient age, sex, injury type and maxillofacial fracture patterns determined from CT scans and classified as fractures of the mandible, orbital, zygomatic - maxillary complex (ZMC), nasal, le fort fractures divided according to le fort types I, II, and III.

The following categories of cause of injury were considered: falling from height, motor vehicle accidents (MVA), assaults, and sport injuries, work related injuries and other causes. Road traffic accidents were classified according to the mechanism of injury (car accident, motorbike accident, pedestrian, bicycle accident, unknown/other). Ethical approval was given for our study.

STATISTICAL ANALYSIS

Data was copied from the data sheets and keyed into an SPSS (ver. 16.0; SPSS Inc., Chicago, IL, USA) spreadsheet for statistical analysis. The chi-square test was used to test the association between two categorical variables or factors (age group, cause) with p value set at $p<0.05$, and t-test value at <0.05 and independent. Finally, the results were analyzed and presented in tables and figures.

RESULTS

Age and gender

In this study, 87% (n =536) of patients were men and 13% (n = 80) were women (Table.1). Not surprisingly, patients in the age group from 20 to 29 years (39.2%; n = 238) sustained the highest incidence of maxillofacial fractures.

Table-1: Age distribution in relation to gender

			Sex		Total
			Male	Female	
Age	0-10	Count	30	12	42
		% within Age	71.4%	28.6%	100.0%
	11-20	Count	163	21	184
		% within Age	88.6%	11.4%	100.0%
	21-30	Count	215	23	238
		% within Age	90.3%	9.7%	100.0%
	31-40	Count	80	14	94
		% within Age	85.1%	14.9%	100.0%
	41-50	Count	28	8	36
		% within Age	77.8%	22.2%	100.0%
	51-60	Count	11	0	11
		% within Age	100.0%	.0%	100.0%
	>60	Count	9	2	11
		% within Age	81.8%	18.2%	100.0%
Total		Count	536	80	616
		% within Age	87.0%	13.0%	100.0%

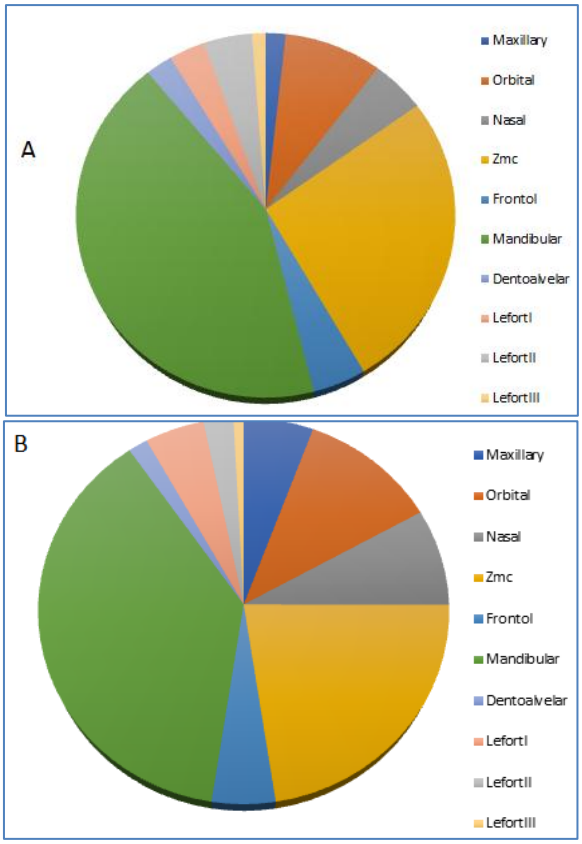

Fig-1-(A, B): Distribution of facial fractures in male and female patients

Localization of maxillofacial fractures

The anatomical classification showed that the most frequently observed fracture involved the mandible (n = 377, 61.2%), followed by ZMC fractures (37.2%), orbital fractures (12.8%), nasal fractures (7.5%), and frontal sinus fractures (6.3%) (Table:2). In all types of maxillofacial injuries MVA is the most frequent causative factor (n = 369) compared to non-MVA factors (n = 247). The association between the cause of accident and type of injury is statistically significant ($p<0.01$) (Table.4).

Etiology of maxillofacial fractures

Motor vehicle accidents among males were the most widespread cause of injury 369 (59.9%) in all age groups except those aged 0–9 years. Among this age group, falls were the most common cause (50%) (Table.2). in female patients also motor vehicle accidents were the most common cause of injury 66.3% (n= 53).

The second most common cause was interpersonal violence affecting 17.2% (n=106) of cases; [male: n=99 (18.5%), female: n=7 (8.8%)]. Other causes of fracture are shown in (Table 3). Significant differences by age group were seen in the entire sample.

DISCUSSION

The epidemiological features, incidence, etiology, and injury patterns of maxillofacial fractures are consistently influenced by factors such as the geographic location, population density, socioeconomic status, and cultural differences with great variations among the numbers of patients and populations of different countries or even within the same country [1-7].

In the present study, the main cause of maxillofacial fractures was found to be MVA. Our finding support the results of other reports conducted in Middle Eastern countries such as Jordan [10], Libya [28] Saudi Arabia [29] Kuwait [30] and Iran [21]. In contrast to our results, a 10-year review in Austria[9] showed that the most common cause of maxillofacial fractures where activities of daily life and falls.

Our findings are also consistent with other studies from other parts of the world [35, 37, 38]. An Australian study [25] found a persistently high rate of maxillofacial injuries due to MVAs. On the other hand, assault-related maxillofacial injuries were reported to be more common in developed countries; whereas in developing countries, MVAs remain the most frequent etiological factor because of inadequate enforcement of road safety regulations and poor compliance of using the seat belt and abiding to speed limits [7, 8].

Table-2: anatomical site distribution in relation to age and gender

Types	AGE								GENDER	
	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total		M
	F	Total								
Maxillary	1 2.4%	7 3.8%	5 2.1%	3 3.2%	3 8.3%	0 .0%	1 9.1%	20	13 2.4%	7 8.8%	20
Mandibular	27 64.3%	123 66.8%	151 63.4%	46 48.9%	18 50.0%	8 72.7%	4 36.4%	377	329 61.4%	48 60%	377
Orbital	10 23.8%	22 12.0%	32 12.6%	12 12.8%	4 11.1%	0 .0%	1 9.1%	79	65 12.1%	14 17.5%	79
ZMC	4 9.5%	63 34.2%	87 36.6%	46 48.9%	18 50.0%	6 54.5%	5 45.5%	229	201 37.5%	28 35.0%	229
Frontal	3 7.1%	11 6.0%	12 5.0%	9 9.6%	3 8.3%	0 0%	1 9.1%	39	33 6.2%	6 7.5%	39
Nasal	0 .0%	11 6.0%	18 7.6%	11 11.7%	2 5.6%	2 18.2%	2 18.2%	46	36 6.7%	10 12.5%	46
Dentoalveolar	3 7.1%	2 1.1%	10 4.2%	3 3.2%	2 5.6%	0 .0%	0 .0%	20	18 3.4%	2 2.5%	20
Le Fort I	0 .0%	7 3.8%	13 5.5%	6 6.4%	2 5.6%	1 9.1%	1 9.1%	30	24 4.5%	6 7.5%	30
Le Fort II	0 .0%	8 4.3%	18 7.6%	5 5.3%	2 5.6%	1 9.1%	2 18.2%	36	33 6.2%	3 3.8%	36
Le Fort III	0 .0%	3 1.6%	2 0.8%	4 4.3%	0 .0%	0 .0%	1 9.1%	10	9 1.7%	1 1.3%	10
Total	42	184	238	94	36	11	11	616	536	80	616

Table-3: Causes distribution in relation to age and gender

			The Cause					Total
			Fighting	Domestic Accident	MVA	Falling	Sport Injury	
Age	0-10	Count	0	1	21	20	0	42
		% within Age	0.0%	2.4%	50%	47.6%	0.0%	100.0%
	11-20	Count	28	2	124	20	10	184
		% within Age	15.2%	1.1%	67.4%	10.9%	5.4%	100.0%
	21-30	Count	52	5	140	31	10	238
		% within Age	21.8%	2.1%	58.8%	13%	4.2%	100.0%
	31-40	Count	17	4	56	13	4	94
		% within Age	18.1%	4.3%	59.6%	13.8%	4.3%	100.0%
	41-50	Count	8	0	21	7	0	36
		% within Age	22.2%	0.0%	58.3%	19.4%	0.0%	100.0%
	51-60	Count	1	2	1	7	0	11
		% within Age	9.1%	18.2%	9.1%	63.6%	0.0%	100.0%
	>60	Count	0	0	6	5	0	11
		% within Age	0.0%	0.0%	54.5%	45.5%	0.0%	100.0%
Total		Count	106	14	369	103	24	616
		% within Age	17.2%	2.3%	59.9%	16.7%	3.9%	100.0%
Sex	Male	Count	98	12	316	85	24	536
		% within Sex	18.5%	2.2%	59.0%	15.9%	4.5%	100.0%
	Female	Count	7	2	53	18	0	80
		% within Sex	8.8%	2.5%	66.3%	22.5%	0.0%	100.0%
Total		Count	106	14	369	103	24	616
		% within Sex	17.2%	2.3%	59.9%	16.7%	3.9%	100.0%

Table-4: distribution of injury type in relation to the causes

			Types of injury										Total
			Maxillary	Orbital	Nasal	ZMC	Frontal	Mandibular	Dentoalveolar	Lefort I	Lefort II	Lefort III	
Cause	Fighting	Count	2	15	3	35	3	62	4	1	2	0	106
		% within Cause	1.9%	14.2%	2.8%	33.0%	2.8%	58.5%	3.8%	.9%	1.9%	0.0%	
	Domestic Accident	Count	0	2	2	6	2	7	0	0	1	0	14
		% within Cause	0.0%	14.3%	14.3%	42.9%	14.3%	50.0%	0.0%	0.0%	7.1%	0.0%	
	MVA	Count	16	51	33	143	28	229	11	27	30	9	369
		% within Cause	4.3%	13.8%	8.9%	38.8%	7.6%	62.1%	3.0%	7.3%	8.1%	2.4%	
	Falling	Count	2	10	8	32	6	68	5	2	3	1	103
		% within Cause	1.9%	9.7%	7.8%	31.1%	5.8%	66%	4.9%	1.9%	2.9%	1.0%	
	Sport Injury	Count	0	1	0	13	0	11	0	0	0	0	24
		% within Cause	0.0%	4.2%	0.0%	54.2%	0.0%	45.8%	0.0%	0.0%	0.0%	0.0%	
Total		Count	20	79	46	229	39	377	20	30	36	10	616

In our study, assault-related maxillofacial fractures constituted only 17.2% of cases. This may be attributed to cultural differences since in Saudi Arabia the conservative and strict regulations regarding alcohol consumption might be a significant factor. Moreover, the under-reporting of women, physical assault and giving unreal different cause of injury (falling from height) can affect such Results.

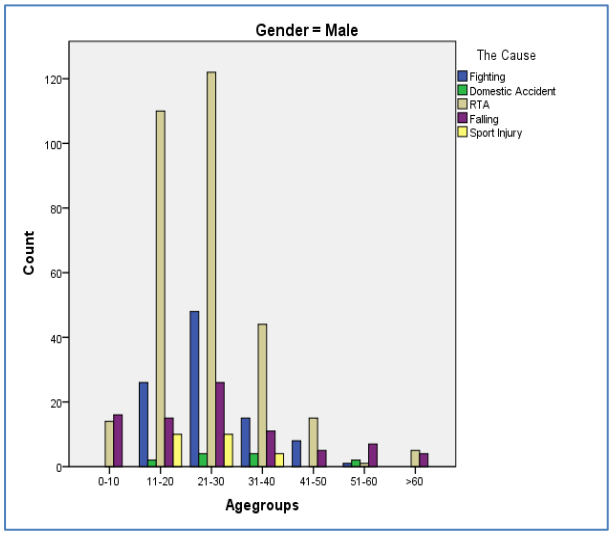

Fig-2-A: Causes of facial fractures in female patients by age groups

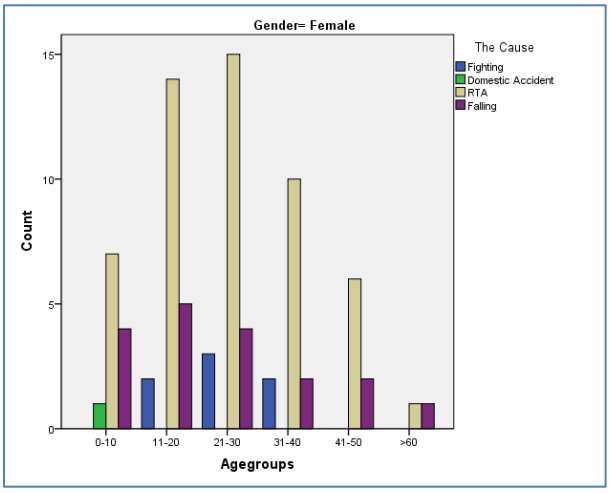

Fig-2-B: Causes of facial fractures in female patients by age groups

Some study in the UAE found that the incidence of maxillofacial fractures was highest in the 20-29 years' age group. Other studies also reported the predominance of incidences of maxillofacial fractures occurring most frequently in the peak age of 20 to 30 years [25, 31-33]. All are consistent with our findings of most age group (20-30) years affected [3-4-9]. These reports reflect the fact that people in the third decade of life are more active regarding work, sports, violent activities, and high-speed transportation.

Among maxillofacial injury victims, a high male-to-female ratio has been widely reported by previous literature, with male to female ratios ranging between 2:1 to 8:1 [3, 4, 30, 34, 35, 36].

In the present study, 87% men and 13.0% women were involved suggesting that a larger proportion of patients with maxillofacial fractures are male with a male-to-female ratio (4:1). This can be attributed to men are more involved in social activities, thus being more susceptible to traffic accidents, violent interactions, high-risk occupations and sport-related injuries [4].

A study by Bali [29] showed similar results (81.8% men and 18.92% women) and many previous studies have shown that men tend to be the victims of facial fractures more often than women [8, 11], results from other present studies also suggested that a larger portion of patients visiting hospital-based emergency departments for facial fractures tend to be male [2, 8, 15, 17].

Recent reports showed a trend toward a more equal male-to-female ratio [3, 9]. This trend can be attributed to a changing workforce and the fact that increasing numbers of women are working outdoors in more high-risk occupations; thus, they've become more exposed to RTAs and other causes of maxillofacial fracture [3,7,18,19].

In the present study, mandibular fractures were found to be the most common affected anatomical region (61.2%). The second most common fracture was the ZMC (37.2%), these findings are consistent with that of Maliska *et al*. [38] reported that mandibular fractures accounted for 54.6% of maxillofacial fractures in Brazil. Similarly, studies by Naveen and van Hout [2, 5]. reported the mandible to be the bone fractured most often. In contrast to our results, a 10-year review in Austria [9] showed that the most common facial injury site was the middle-third of the face. Arangio et al. review in Italy [39] reported that the zygomatic bone, followed by isolated fractures of the orbital floor is the most frequently fractured anatomical site.

Facial injuries of all severity levels can be reduced by 25% by the use of restraints, thereby decreasing the frequency of health care services [40]. A deeper understanding of maxillofacial fractures and the behavior pattern of the people afflicted with maxillofacial fractures can be helpful when deciding which preventive measures, such as the obligatory wearing of a crash helmet and seat belts, better enforcement of the law regarding "drinking and driving", social education about the dangers of all-terrain injuries, and providing proper safety guidelines before the purchase of a vehicle, have been shown to significantly reduce the number of road traffic accidents [41, 42].

CONCLUSION

In the present study, a review of 616 patients with 886 fractures type from the western region of KSA revealed that MVA is the most common cause of maxillofacial injury (n = 369; 59.9%) affecting most frequently the mandible (n = 377, 61.2%) in the peak incidence of age group (20-30) years with higher male to female prevalence.

Understanding epidemiology will allow us to more effectively target prevention and awareness programs enforced and followed by every citizen.

Conflict of interest

The authors have no conflict of interest to declare.

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