Trauma Mon. 2019 July; 24(4):e87169. doi: 10.5812/traumamon.87169.

Published online 2019 July 23. **Systematic Review**

Patterns of Maxillofacial Fractures: A Systematic Review

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Received 2018 December 08; **Revised** 2019 April 20; **Accepted** 2019 April 24.

Abstract

Context: The face is the most exposed part of the body; therefore, the maxillofacial region is vulnerable to trauma. The evaluation of the incidence and etiology of maxillofacial traumas is necessary to disclose the pattern of fractures.
Objectives: The study aimed to evaluate the pattern of maxillofacial fractures (MFs) and associated injuries by a literature review.
Data Sources: Original papers investigating the pattern of MFs and associated injuries published before November 2018 were examined. Online sources including PubMed, Scopus, Medline, Wiley, ISI Web of Knowledge, and EMBASE were searched for these papers. The extracted data included study characteristics, participants' characteristics, MFs causes, and distribution of various MFs.
Results: In total, 17,055 patients (men: 83.61%; women: 16.38%) were examined. The age range was 21 - 30 years in 40.89% of the patients with MFs. The most common risk factor of fractures was road traffic accidents (45.33%). Mandibular fractures were more frequent than other injuries. Condyle was the most common mandibular fracture (25.89%). Le Fort II was the most common site in the middle-third fractures (30.29%).
Conclusions: The results showed that maxillofacial fractures were more frequent in men, in the age of 21 to 30 years, in the site of the mandible, and mainly caused by road traffic accidents.

Keywords: Maxillofacial, Pattern, Fractures, Trauma

1. Context

The face is the most uncovered part of the body; therefore, the maxillofacial region is vulnerable to trauma. The evaluation of incidence and etiology of maxillofacial traumas is necessary to disclose the pattern of fractures (1-3). Maxillofacial fractures (MFs) have various causes in different countries due to cultural, social, and environmental differences (4-7). MFs more frequently originate from interpersonal violent behaviors in the form of fights, assaults, and gunshot injuries in more economically advanced countries. Studies from these countries demonstrate that road traffic accidents are the main reason for maxillofacial injuries (8).

Hard and soft tissues of the face are involved in maxillofacial injuries from the frontal bone to the mandible (9). Maxillofacial traumas present as dental, skeletal, and soft tissue injuries (3). MFs can appear alone or combined with the fractures of other bones. The mechanism of injury, the anatomy of the traumatized site, and the direction or size of crash forces can change the fracture pattern in maxillofacial injuries (9).

The maxillofacial patterns in different countries can be used to establish efficient procedures for the prevention of injuries (10). MFs occur usually following road traffic accidents, assaults, falls, and sports injuries. The incidence of injuries has been reported at a ratio of 6:2:1 for the mandible, zygomatic complex, and maxilla fractures (8).

Motor vehicle accidents are the most general cause of MFs in adults and falls are the main cause in the younger population (8). Gender and age are the significant factors affecting the incidence of maxillofacial traumas according to epidemiologic studies (9); patients aged 21 to 30 years have the highest frequency and patients aged > 60 years or < 5 years have the least frequency of MFs. Maxillofacial injuries can cause mortality due to their approximation to the brain and the digestive and respiratory tracts (11).

2. Objectives

The aim of this study was to assess the pattern of MFs and associated injuries in the literature.

3. Data Sources

Original papers investigating the pattern of MFs and associated injuries published before November 2018 were examined in this study. Online sources including PubMed, Scopus, Medline, Wiley, ISI Web of Knowledge, and EMBASE were searched for these papers.

The MeSH terms for searching the papers included injuries, maxillofacial, injury, facial, mandibular, maxillary, zygomatic, orbital, fracture, fractures, jaw, trauma, wound, etc. Two researchers evaluated the titles and abstracts of all studies retrieved by electronic searching. Disagreements were resolved by a third author. In addition, two authors extracted the data and disagreements were resolved by a third author. The extracted data included the study characteristics, participants' characteristics, MFs causes, and the distribution of various MFs.

4. Results

Overall, 20 articles were used in this study with a total number of 17,055 patients (men: 83.61%; women: 16.38%). Tables 1 and 2 summarize the distribution of MFs based on the patient's age and sex. The patients' age varied between 1 and 80 years. The age range was 21 - 30 years in 40.89% of the patients with fractures at the maxillofacial site (Tables 1 and 2 and Figure 1).

Table 3 shows the frequency of MFs causes. The most common risk factor of MFs was road traffic accidents (45.33%).

Mandibular fractures were more frequent than other injuries as shown in Table 4. The condyle site was the largest major fracture at the mandibular site (25.89%) (Table 4).

Le Fort II was the most common site in middle-third fractures (30.29%) (Table 5).

5. Discussion

The integrated data of MFs studies showed that MFs were predominant in males in the age group of 21 to 30 years. These findings are in agreement with the results of studies from other parts of the world (8, 11-20).

Most studies of MFs patterns have reported similar results respecting the age distribution of MFs (8, 9, 11-29). The probable cause is that men in the third decade of life are more vulnerable to traffic accidents and interpersonal violence due to their greater levels of commuting, making them more exposed to traumatic events and thus MFs (14-17). In addition, children in the first decade of life comprise the least affected age group, as their facial skeletons are more elastic and they are more supported by parental care. Thus, they are less likely to experience influential injuries than adults are (14-16).

In this systematic review, the road traffic accident was the main cause of MFs. Similar findings were reported in other studies, as well (9, 11-27). Assault showed to be the most common risk factor of fractures at the maxillofacial site in studies from developed countries and some other studies (33, 34). The decreased incidence of road traffic accidents in some countries is widely attributed to an extensive variety of road security measures such as the use of seat belts, traffic pacification devices, and obligation to obey the traffic police (35). Alcohol consumption is generally known as a contributing factor to a notable portion of assaults and traffic accidents in some studies (36). Therefore, it appears that paying attention to decreasing road traffic accidents is effective in preventing MFs.

Nonetheless, the effect of the increased number of vehicles, and consequently the increased traffic load was not assessed in the literature. Therefore, considering these problems may lead to valuable information for reducing road traffic accidents and MFs (14).

In this study, the mandible was the most common site involved in the MFs, as shown by previous studies. In this systematic review, the most common fractures were the symphysis-parasymphysis fracture and the condyle fracture (11-20). This majority could be due to that the mandible site is the most common noticeable and the only mobile bone in the face, exposing it to a larger risk of traumatic events than the well-articulated midfacial bones (11-20). The occurrence of fractures at the mandibular site was reported high in most studies, with the chief etiology being road traffic accidents (8, 9, 11-32).

The parasymphysis fracture was the most common mandibular fracture, followed by the condylar fracture. This is comparable with other investigations (9, 11-32). In addition, studies reported the road traffic accidents as the main cause of MFs and showed the parasymphysis and condyle fractures to be the most frequent fractures (8, 9, 11-32). The mandibular body and angle fractures are more prevalent due to violent actions (12-17).

Evidence shows that the mandibular site is more at risk of trauma fractures than the midfacial region. The lower rate of fractures in the midfacial region is associated with the safety in the mandible and the head, which captivate most injuries, as well as the point that bones in the midfacial region are very flexible. Nonetheless, several studies have shown zygoma fractures as the most frequent midfacial fractures because of the outstanding position of the region (35). Zygomatic complex fractures were the most frequent fractures of the midfacial region, followed by Le Fort II fractures. This result is confirmed by other studies (8, 9, 11-32).

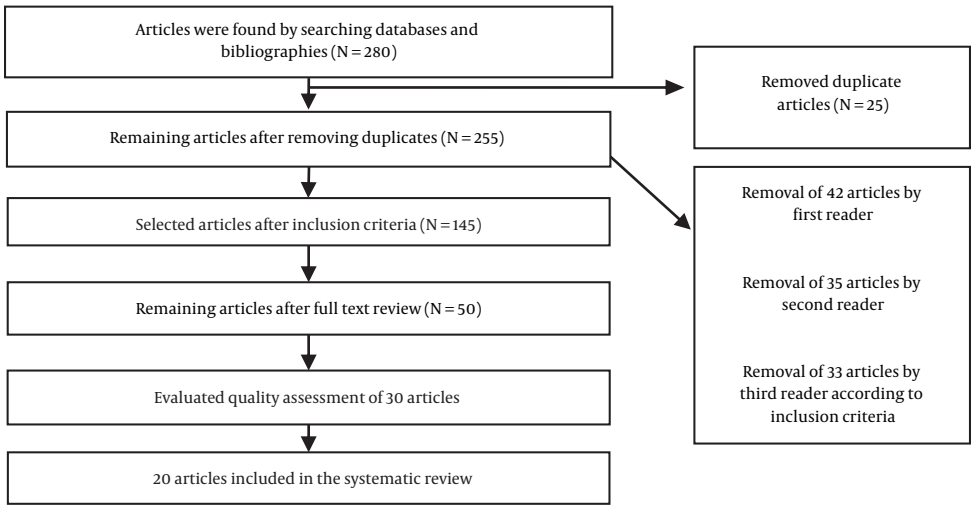

Figure 1. The flowchart of paper screening

Table 1. Distribution of Fractures According to Age

Studies	Age							
	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80
Kumar et al. (2013) (8)	68	207	1535	300	276	200	214	
Elarabi and Bataineh (2017) (11)	16	37	73	42	11	4	2	2
Pandey et al. (2013) (12)	43	174	443	226	123		50	
Zhou et al. (2013) (13)	58	205	304	298	176		90	
Motamedi et al. (2014) (14)	420	2139	3457	1355	693	382	179	118
Naveen Shankar et al. (2011) (15)	79	381	784	456	182	95	50	
Momeni et al. (2011) (16)	33	56	69	15	14	2	3	2
Gandhi et al. (2011) (17)	43	160	397	247	121	64	34	9
Ozkaya et al. (2009) (18)	19	42	69	37	28	11	7	3
Deogratius et al. (2006) (19)	8	62	130	75	25		14	
Ugboko et al. (1998) (20)	25	69	173	93	53	22	7	
Total number	812	3532	7434	3144	1702		1564	
Total percentage	4.46	19.42	40.89	17.29	9.36		8.60	

6. Conclusions

The results showed that MFs were more frequent in men, in the age of 21 to 30 years, in the site of the mandible, and caused by road traffic accidents.

Footnotes

Authors' Contribution: Study concept and design: Nima Sadeghi, Parastoo Parandoosh and Mohammad Hosein Kalantar Motamedi; acquisition of data: Nima Sadeghi and Parastoo Parandoosh; analysis and interpretation of data: Nima Sadeghi and Parastoo Parandoosh; drafting of the manuscript: Nima Sadeghi, Parastoo Parandoosh and Mohammad Hosein Kalantar Motamedi; critical revision of the manuscript for important intellectual content: Mohammad Hosein Kalantar Motamedi; statistical analysis: Nima Sadeghi and Parastoo Parandoosh; administrative, technical, and material support: Nima Sadeghi and Parastoo Parandoosh; study supervision: Nima Sadeghi, Parastoo Parandoosh and Mohammad Hosein Kalantar Motamedi.

Conflict of Interests: The authors have no conflicts of interest.

Ethical Considerations: Non applicable

Funding/Support: This study was not supported by any grant.

Table 2. Distribution of MFs Regarding Sex

Studies	Male	Female
Kumar et al. (2013) (8)	2386	345
Elarabi and Bataineh (2017) (11)	161	26
Zhou et al. (2013) (13)	137	55
Motamedi et al. (2014) (14)	7396	1376
Naveen Shankar et al. (2011) (15)	1775	252
Momeni et al. (2011) (16)	134	60
Ozkaya et al. (2009) (18)	163	53
Deogratius et al. (2006) (19)	261	53
Ugboko et al. (1998) (20)	356	86
Emodi et al. (2017) (21)	859	238
Obimakinde et al. (2017) (22)	180	53
Alves et al. (2014) (23)	181	28
Zhou et al. (2012) (24)	881	250
Joshi et al. (2013) (25)	108	48
Kyrgidis et al. (2013) (26)	1010	229
Al Ahmed et al. (2004) (9)	212	18
Adebayo et al. (2003) (27)	366	77
Total number	16566	3247
Total percentage	83.61	16.38

Table 3. Distribution of Fractures According to Causes

Studies	Causes of MFs						
	Motor Vehicle Accident	Road Traffic Accident	Assault	Gunshot	Fall	Sports	Occupational/ Industrial
Kumar et al. (2013) (8)	2086		315		260	54	16
Elarabi and Bataineh (2017) (11)	109		32	21	19		
Pandey et al. (2013) (12)		543	248	10	240		12
Zhou et al. (2013) (13)	42		17		62	5	
Motamedi et al. (2014) (14)	5620		769		1226	198	187
Naveen Shankar et al. (2011) (15)	309		183		296	15	6
Momeni et al. (2011) (16)	87	50	2		39	16	
Gandhi et al. (2011) (17)		784	84		179	8	17
Ozkaya et al. (2009) (18)		145	42		27	2	
Deogratius et al. (2006) (19)		43	181		62		
Ugboko et al. (1998) (20)	73	245	37		48	14	9
Emodi et al. (2017) (21)	428		12	35	495	1	
Obimakinde et al. (2017) (22)	127	56	2		2	2	
Alves et al. (2014) (23)		145	6				35
Zhou et al. (2012) (24)		595	71	159	257	20	27
Joshi et al. (2013) (25)		25	38		67	21	
Kyrgidis et al. (2013) (26)		853	91		53		30
Al Ahmed et al. (2004) (9)		174	18		28	6	4
Adebayo et al. (2003) (27)		246	56		108	22	11
Mabrouk et al. (2014) (28)	88		88	22	17		
Ascani et al. (2014) (29)	81		71		59	48	
Mesgarzadeh et al. (2011) (30)		68	23		35	16	9
Total number	8963	3972	2298	247	3579	448	363
Total percentage	65.09		11.56	1.24	18.01	2.25	1.82

Table 4. Distribution of MFs

Study	Parasymphysis	Symphysis	Angle	Condyle	Body	Dentoalveolar	Coronoid Process	Ramus
Kumar et al. (2013) (8)	312	117	149	292	92		4	9
Elarabi and Bataineh (2017) (11)	38	29	38	38	23	11	9	4
Zhou et al. (2013) (13)		395	147	662	234	16	25	14
Motamedi et al. (2014) (14)	950	610	1038	1394	1210	240	114	172
Gandhi et al. (2011) (17)		237	88	47	47	35		3
Ozkaya et al. (2009) (18)	29	12	16					
Deogratius et al. (2006) (19)	2	3	27	8	176	4	1	1
Ugboko et al. (1998) (20)		40	31	44	151	58		18
Obimakinde et al. (2017) (22)		24	28	32	43	41		4
Zhou et al. (2012) (24)		62	22	156	43	3	1	1
Joshi et al. (2013) (25)	24		5	40	14	10	1	4
Al Ahmed et al. (2004) (9)		27	35	38	30	12	2	6
Adebayo et al. (2003) (27)	26	57	86	27	238	34	1	22
Mesgarzadeh et al. (2011) (30)	16	14	23	29	15	15	6	32
Abdullah et al. (2013) (31)	56	12	33	42	30	11	3	2
Total number	1453	1639	1766	2849	2346	490	167	292
Total percentage	13.20	14.89	16.05	25.89	21.32	4.45	1.51	2.65

Table 5. Distribution of Maxilla Fractures

Study	Le Fort I	Le Fort II	Le Fort III	Dentoalveolar	Nasal Bone	Isolated Zygomatic Arch	Nasoethmoidal Complex
Kumar et al. (2013) (8)	83	148	48				62
Elarabi and Bataineh (2017) (11)	7	11	2	15	9	8	7
Pandey et al. (2015) (12)	172	123	72				
Zhou et al. (2013) (13)	30	15	13	41	30	288	
Motamedi et al. (2014) (14)	723	701	164			242	
Naveen Shankar et al. (2011) (15)	43	114	15		57		40
Gandhi et al. (2011) (17)	60	88	27	52	172	25	
Deogratius et al. (2006) (19)	10	3	2	61			
Ugboko et al. (1998) (20)	9	6	5	62			
Zhou et al. (2012) (24)	1		1	20		14	
Joshi et al. (2013) (25)		9	5		37	6	
Al Ahmed et al. (2004) (9)	30	11	11	50	2		
Adebayo et al. (2003) (27)	26	60	8	12	25		
Mesgarzadeh et al. (2011) (30)	4	8	2	3	5	8	
Abdullah et al. (2013) (31)	14	6	2	13	6		
Shah et al. (2016) (32)	9	2		1	4	3	
Total number	1251	1319	378	388	321	588	109
Total percentage	28.73	30.29	8.68	8.91	7.37	13.5	2.50

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