Patterns of Maxillofacial Injures Caused by Motorcycle Accidents

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Abstract

Introduction Motorcycles are used as a common means of transportation, and motorcycle accidents are responsible for a major portion of trauma injuries.

Objectives The purpose of this study was to analyze the patterns of facial injuries in motorcyclists, to evaluate the types of injuries, and to investigate if the accident-related factors had any impact on the characteristics of the injuries.

Methods This retrospective observational study included 74 patients with maxillofacial injuries following motorcycle-related accidents. Investigated data were divided into four main categories: sociodemographic, accident-related, injury-related, and treatment-related.

Results All the patients were males with a mean age (±SD) of 25.03 (±9.986) years. Most accidents ($n = 44$, 59.4%) occurred in the evening. Most of the patients ($n = 40$, 54%) were traveling on motorcycle models that had maximum speed of over 120 km/h. Furthermore, 15 patients (18.9%) were under the influence of alcohol during the crashes and only one patient was wearing a helmet. Fractures of the maxillofacial bones were observed in 50 (67.5%) crash victims; 24 of them (48%) had middle third fractures, 11 (22%) had mandibular fractures, and 15 patients (30%) presented with a combination of lower, middle, and upper third fractures.

Conclusion Almost all patients were not wearing helmets at the moment of the crash. The most common fractured site was the maxilla. The majority of the patients received surgical treatment. Increased enforcement of safety measures for riders and raising awareness about the dangers of motorcycle crashes are required measures to improve traffic safety and, ultimately, population health.

Keywords
- maxillofacial injuries
- head protective devices
- motorcycles
- accidents
- traffic

Introduction with Objectives

Traffic accidents are among the most common causes of presentations in an emergency department. They are responsible for nearly 1.2 million deaths per year, 50 million injured people all over the world, and have interrupted the life of thousands of people, especially during the first decades of life, in the economically active age (adolescents and young adults).[1]

Motorcycles are a common means of transportation, but they are responsible for a major portion of traffic-related

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trauma injuries and deaths.[2] They are of relatively small size, low weight, and less stable compared with other vehicles; they also lack safety equipment such as seatbelts, which adds to the risk of injury. Furthermore, they are often not noticed by car drivers due to their small size, and their accidents are mostly speed-related.[3] Because of the socio-economic changes in Iraq since 2003, there has been an increasing development in the private transport sector in general, and an increasing number of motorcycles.[4] However, data regarding motorcycle crashes is limited, which may explain the lack of awareness about this issue. Awareness regarding maxillofacial trauma from motor vehicle accidents is crucial because the face is a symbol of identity and an important part of the body. The victims of maxillofacial trauma experience challenges such as psychosocial, functional, and aesthetic problems, which ultimately affect the patient's quality of life[5]

Proper management of maxillofacial trauma requires the assessment of vulnerable groups and the factors contributing to trauma. The objectives of this study were to evaluate oral and maxillofacial trauma in motorcyclists, to identify the most common types of injuries, and to investigate if the accident-related factors had any impact on the characteristics of the injuries.

Method

This retrospective observational study included patients with maxillofacial injuries following motorcycle-related accidents who were treated during the period of May 2018, to May 2021. The exclusion criteria were patients with injuries due to causes other than motorcycle accidents.

This study was exempt from institutional review board approval due to its retrospective observational nature and all the data were de-identified.

The patients received preliminary care in the Emergency and Accident Unit of our hospital before being admitted for definitive care. A thorough history was obtained from patients and/or their escorts, and clinical and radiographic examinations, including conventional radiographs and/or computed tomographic scans, were performed to assess the extent of the injuries.

The investigated data were divided into four main categories: sociodemographic, accident-related, injury-related, and treatment-related data.

The sociodemographic data included age, gender, occupation, and whether the patients were residents of urban or suburban areas.

The accident-related data were the date and time, type of the motorcycle according to the maximum speed, whether the patients were wearing a safety helmet at the time of the accident, whether the patients were sober at the time of the accident, and the patient's status divided into driver, pillion, or pedestrian.

The injury-related data were classified into the pattern of injury (comminuted, linear, total), type of injury (soft tissue injury, hard tissue injury, or a combination thereof), in addition to other concomitant body injuries classified according to their anatomical site. The hard tissue maxillofacial injuries were classified into those involving: the upper third (frontal bone), middle third (maxilla, zygomaticomaxillary complex, naso-orbit-ethmoidal, and nasal), and lower third (mandible). Mandibular fractures were further divided according to the anatomic subsites: condyle, angle, body, parasymphysis, symphysis, and dentoalveolar fractures. The patterns of fractures were classified to linear and comminuted fractures; the soft tissue injuries were classified as abrasion and laceration.

The treatment-related data included the type of treatment provided, and was divided into conservative treatment, which entailed active observation of the patients; surgical treatment, which included suturing of the soft tissue lacerations; and treatment of fractures, which was further divided into closed treatment—consisting of closed reduction with or without indirect fixation, indicated for minimally displaced fractures—or open treatment—consisting of open reduction and direct internal fixation (ORIF) using wires or plates indicated for displaced fractures. Other treatment-related data collected were duration of hospital stay, type of anesthesia, and complications encountered.

The statistical analysis was performed using Prism (GraphPad Software, San Diego, CA, USA) version 6, for Windows. For the descriptive analysis, the categorical variables were recorded as percentages and the continuous variables as the mean $\pm$ standard deviation (SD). For the inferential analysis, the variables were analyzed using the Fisher exact and Chi-square tests. Probability values of < 0.05 were considered statistically significant.

Results

A total of 74 patients who sustained motorcycle accidents during the study period were admitted and treated for maxillofacial trauma. All the patients were males with an age range of 9 to 60 years and mean age ($\pm$SD) of 25.03 ($\pm$9.986) years. The distribution of patients according to the sociodemographic characteristics is summarized in ►**Table 1**. It should be noted that 10 patients (13.5%) in this study were below 18 years of age.

Table 1 Frequency distribution of the patients according to sociodemographic data

Sociodemographic characteristic	Frequency ($n = 74$)	%
Age groups (years)		
9–17	10	13.5
18–30	50	67.6
31–50	11	14.9
> 50	3	4
Locality		
Suburban	25	33.8
Urban	49	66.2

Table 2 Frequency distribution of patients according to accident-related data

Circumstance	Frequency ($n = 74$)	%
Time of crash		
Morning	11	14.9
Midday	19	25.7
Evening	44	59.4
Types of motorcycle according to maximum speed		
120 km/h or less	34	46
Above 120 km/h	40	54
Helmet use		
Yes	1	1.3
No	73	98.7
Influence of alcohol		
Drunk	15	20.3
Sober	59	79.3
Patient's role		
Driver	61	82.4
Pillion/passenger	13	17.6

Concerning the time of the accidents, most accidents ($n = 44$, 59.4%) occurred in the evening. More than half of the victims ($n = 40$, 54%) claimed that they were traveling on a motorcycle model that had a maximum speed of over 120 km/h. Furthermore, 15 patients (18.9%) were under the influence of alcohol during the crashes. The majority ($n = 61$, 82.4%) of the victims were drivers. Only one patient was wearing a helmet. (►**Table 2**)

The distribution of patients according to the type of maxillofacial injuries is summarized in ►**Table 3**; most of the patients ($n = 43$, 58.1%) presented with a combination of both hard and soft tissue injuries.

Table 3 Types and number of injuries

Type of injury	N. of injured patients	%
Hard tissue injury	7	9.5
Soft tissue injuries	24	32.4
Combination	43	58.1
Total	74	100
Type of soft tissue injury (N. of injured patients = 67)		
Laceration	48	71.6
Abrasion	19	28.4
Total	67	100
Concomitant injuries		
Yes	32	43.2
No	42	56.8
Total	74	100

Fractures of the maxillofacial bones were observed in 50 (67.5%) patients; 24 of them (48%) had middle third fractures, 11 (22%) had lower third (mandibular) fractures, while 15 patients (30%) presented with a combination of lower, middle, and upper third fractures.

Regarding the mandible, the body was the most commonly fractured site, followed by the parasymphysis and condylar region, while the angle was the least affected site (►**Table 4**). The fractures of the middle third of the face involved the maxilla in 35 patients (40.7%), followed by the zygomaticomaxillary complex fractures ($n = 24$, 27.9%). The naso-orbital-ethmoidal fractures were the least commonly observed ($n = 5$, 5.8%).

Table 4 Distribution of motorcycle crash victims according to the number of fractured sites, anatomical location of mandibular fracture, and types of midface fractures

Number of fracture sites per person (n. of patients = 50)		
N. of fractures	**N. of patients**	**%**
One	21	42
More than one	29	58
Total	50	100
Anatomical site of fractures		
Site	**N. of patients**	**%**
Middle third	24	48
Lower third	11	22
Combination	15	30
Total	50	100
Anatomical location of fracture of the mandible ($n = 32$)		
Anatomical site	**N. of fractures**	**%**
Symphysis	3	9.4
Parasymphysis	7	21.9
Body	8	25
Angle	2	6.2
Condyle	7	21.9
Alveolar bone	5	15.6
Types of middle and upper face fractures ($n = 86$)		
Anatomical site	**N. of fractures**	**%**
ZMC	24	27.9
Maxilla	35	40.7
Orbital	12	14
Nasal	6	7
Naso-orbital-ethmoid	5	5.8
Frontal	4	4.6
Patterns of facial fractures (n. of patients = 50)		
Pattern	**N. of patients**	**%**
Comminuted	27	54
Linear	23	46
Total	50	100

Abbreviations: ZCM, Zygomaticomaxillary complex.

Table 5 Distribution of patients according to treatment options and complications

Treatment options		
Type of treatment	N. of patients	%
Conservative	6	12
Closed	24	48
ORIF	20	40
Total	50	100
Complications		
Type of complication	N. of patients	%
Limitation in mouth opening	6	18.2
Malunion	15	45.4
Loss of teeth	7	21.2
Facial scars	5	15.2
Total	33	100

Abbreviations: ORIF, open reduction and internal fixation.

Comminuted fractures were recorded in 27 patients (54%), while 23 patients (46%) had linear fractures. Concomitant injuries were found in 32 patients (43.2%); limb injuries were the most commonly encountered ($n = 22$, 68.7%), followed by head injuries ($n = 6$, 18.7%), and a combination of different parts of the body ($n = 4$, 12.5%). (►**Table 4**)

Of the 50 patients who sustained facial fractures, 44 patients (88%) were treated surgically and 6 patients (12%) conservatively. Surgical treatment consisted of closed reduction and immobilization in 24 patients (48%), and ORIF using titanium miniplates in 20 patients (40%). The duration of hospital stay ranged from 1 to 7 days, with the majority of patients ($n = 48$, 64.9%) being admitted for only one day.

There were 33 patients (44.6%) who developed complications after injury (►**Table 5**), of those 15 patients (45.4%) demonstrated malunion after treatment of the fractures.

One of the aims of this study was to investigate if the accident-related factors had any impact on the characteristics of the injuries. ►**Table 6** summarizes the correlation of the maximum speed limits of motorcycles with the data related to the injury, treatment, and complications. The status of the patient (driver, pillion, or pedestrian) showed non-significant correlations with the type of injury ($p = 0.3289$) and the number of fractures ($p = 1.000$).

The effect of alcohol consumption at the time of accident demonstrated a non-significant correlation with the type of injury ($p = 1.000$), but it correlated significantly with the number of fractures encountered ($p = 0.0293$) where intoxicated patients demonstrated more than one fracture. The area of residence correlated significantly with the type of

Table 6 Correlation between the type of motorcycle according to speed and variables

Variables	**Type of motorcycle according to speed**		***p*-value**
	≤ 120 km/h	**>120 km/h**	
Type of injury			
Fractures with or without soft tissue injury	18	32	0.0239 * (S)
Soft tissue injury	16	8	
Type of fracture			
Linear	10	13	0.3817* (NS)
Comminuted	8	19	
Number of fractures			
One fracture	8	14	1.0000 * (NS)
More than one fracture	10	18	
Anatomical site of fractures			
Lower third	4	7	0.6369 † (NS)
Middle third	10	14	
Combination	4	11	
Treatment			
Conservative	4	2	0.0818 † (NS)
Closed	10	14	
ORIF	4	16	
Complication			
Yes	12	21	0.1640 * (NS)
No	22	19	

Abbreviations: NS, not significant; ORIF, open reduction and internal fixation; S, significant. **Notes:** * Fisher exact test, † Chi-square.

injury ($p = 0.0086$) where patients from suburban areas presented with more fractures than soft tissue injuries when compared with patients from urban areas. With respect to the time of the accident, there was a non-significant correlation with the type of fracture ($p = 0.3817$). It should be noted that 54% of the patients with maxillofacial fractures (27/50) presented with injuries in other parts of the body as compared with 20.8% patients (5/24) who presented with soft tissue injuries, with a significant difference ($p = 0.0114$).

Discussion

Road traffic accidents are a common etiology of maxillofacial injuries.[6] especially when involving motorcyclists.[7] The present study aimed to evaluate oral and maxillofacial trauma in motorcyclists and to determine the most common injuries and correlations between these injuries and other variables. To the best of our knowledge, this analysis is the first to describe maxillofacial injuries associated with motorcycle crashes in Iraq.

In Iraq, political instability and economic changes over the past years, as well as the poor condition of the roads in most of the cities and increased traffic jams, have encouraged the use of motorcycles for private and commercial uses. The affordability, maneuverability, and cost-effectiveness of motorcycles make them a popular choice of transport in busy cities, towns, and villages.[8] However, this transition was not accompanied by the enforcement of appropriate laws which serve to guide riders and passengers and control the proper use of motorcycles, resulting in the increase of motorcycle-related accidents.

In this study, all the patients were males. The male predominance in maxillofacial injuries has been reported in several other studies.[7,9–11] Perhaps, as the provider for many Iraqi families tend to be men, they are more exposed to the associated risks. Although no law in Iraq prohibits females from driving motorcycles, social factors, traditions, and customs contribute to lower the rates of female riders. In most western and developed countries, motorcycles are associated with recreation and leisure.[10] This is also the case in Saudi Arabia and other Arab Gulf countries.[12]

In terms of age, most of the patients (67.6%) were 18 to 30 years old, which is consistent with the results obtained by Usha et al.,[13] and Bali et al.[14] The higher prevalence of accidents in this age group can be attributed to their intense social interaction making them more susceptible to transport accidents.[2,12]

In the age group of 9 to 17 years, the incidence of maxillofacial fractures was 13% in the present study. This finding was close to the reported data of previous studies, in which the range of incidence was of 6 to 12%.[8,14] This can be explained by their careless and inexperienced driving, as well as their higher involvement in social activities.[15]

This study demonstrated that the use of motorcycles in older age groups is expanding, and the results were slightly higher than those reported in several studies.[14,15] This can be attributed to the enhanced mobility of motorcycles in heavy-traffic urban areas. Some evidence suggests that age is generally an important predictor of mortality related to traumatic events.[16]

In the current study, 66.2% of the crashes occurred in urban areas, as the majority of the victims were urban inhabitants. The occurrence of crashes in urban areas could be attributed to the absence of traffic law enforcement, as the motorcyclists were not bound by traffic rules and regulations which applied to other motor vehicle users; this gives them the freedom to drive carelessly and increases chances of crashes. Moreover, the lack of wide roads and side roads exclusive for motorcycles, along with the increased number of vehicles, may lead to accumulated and overcrowded streets, thereby increasing the chances of crashes. These findings are also supported by studies conducted in in Tanzania,[17] Malaysia,[10] and Cameroon.[18]

In most developing countries, riders frequently ignore the stablished safety measures due to a lack of strict law enforcement regarding the use of safety helmets.[17] This is also the case in Iraq, as nearly none of the riders or pillions were using a helmet at the time of the accident.

The analysis of the patient data in the present study regarding the time of the day exhibited that most accidents occurred at night (59.4%). Active nightlife results in an increase in traffic during the night. Other reasons may be the glare of headlights at night, and drivers being more fatigued late at night. These factors are similar to those previously considered by studies from India.[14,19] In contrast, studies from Kenya[20] and Tanzania[17] reported that most of the motorcycle collisions occur during the day and less at night (62.6% and 73.9%, respectively).

In the current study, we observed that 82.4% of the patients were driving the motorcycles during the crashes, which was a slightly higher rate than what has been reported in other studies.[7,14,17] Physically, the drivers were the first ones to come into contact with whatever object they collided with.

Furthermore, motorcyclists are usually even more vulnerable to accidents when driving while intoxicated with alcohol, which affects balance, reaction times, and concentration.[21] Only 20.3% of the patients in this study had consumed alcohol. In other studies, only 10% of the casualties had consumed alcohol.[19] the relatively high percentage of alcohol victims in our study may be due to the small sample size.

In terms of soft tissue injuries, lacerations were the most reported injury type, followed by abrasions. A similar observation was made by other studies.[22] Most of our patients presented with a combination of hard and soft tissue injuries, which is in agreement with Kraus et al.,[23] but in contrast with Oginni's 2006 study,[7] which reported isolated soft tissue injuries were the most predominant injuries.

Combined hard and soft tissue injuries, in our study, correlated significantly with the maximum speed limits of the motorcycle, and could be attributed to how, when an object is moving at high speed, it has higher kinetic energy, and once it comes to a sudden stop, the force generated becomes higher. Thus, the severity of the injury is determined by the traumatic agent's force.[24]

The current study revealed a non-significant association between the multiplicity of fractures and the speed of

motorcycles during crashes, in contrast to studies from Tanzania where the odds of the multiplicity of fractures increased with the increased speed of motorbikes.[17] The non-significant results in our study could be due to our relatively small sample size.

Our study also showed that most of the injuries (48%) in the maxillofacial area involved the midface. This number also increased when the lower, mid, and upper face injuries occurred simultaneously, as this number includes only the isolated midface injuries. This is probably due to the nature of force and the direction of impact routing toward the middle part of the facial area, and the failure to use safety helmets. These outcomes are in contrast with previous reports from Malaysia,[10] India,[14] and Europe[11] in which the most involved area was the lower face. The maxilla was the most common bone fractured in the midfacial region. Because the maxilla is a brittle bone, it is usually subjected to impact during falls and colliding objects or surfaces. And these findings contrast with most other studies, in which zygoma was the most fractured bone in the mid face.[7,10] Regarding fractured mandible, the most frequent site was the body; this finding is similar to studies in Nigeria,[8] and in contrast with other injuries where 50% of fractures sustained occurred at the condyle, parasymphysis, and the angle of the mandible regions.[10,25] The incidence of upper third facial injury is rare, and as demonstrated in our findings, only 4 cases presented with frontal bone fracture. This is also in agreement with the study from Nigeria.[7]

The incidence of associated injuries in the present study was 43.2%. This contrasted with studies from India[14] and United Arab Emirates,[26] in which associated injuries were 22%, and with a Nigerian series which reported 23% of associated injuries.[27] The most common associated injury noted in our study was limb injuries (68.7%), while in other studies brain trauma was the most common.[28]

Most of the cases were treated surgically using either open or close reduction, and 33 patients (44.6%) developed complications after injury. This is in contrast to studies from India, in which the majority of the cases received closed treatment, and no complications concerning occlusion and mouth opening were encountered.[14]

Conclusion

Despite how this study was limited by the relatively small sample size and its retrospective nature, we can conclude that facial fractures in motorcyclists occur primarily among men under 30 years of age in the studied population. Furthermore, almost all of the patients sustaining maxillofacial fractures were not wearing helmets at the moment of the crash. Overall, the most common fractured sites on the face were in the maxilla. The majority of the patients received surgical treatments. This study highlights the significant burden of motorcycle-related injuries on the population health of Iraq. Therefore, it is necessary to increase law enforcement of safety measures for motorcycle users and to raise the population's awareness about the dangers of motorcycle crashes to improve traffic safety and, ultimately, population health.

Conflict of Interests
The authors have no conflict of interests to declare.

References

1 Salvarani CP, Colli BO, Carlotti Júnior CG. Impact of a program for the prevention of traffic accidents in a Southern Brazilian city: a model for implementation in a developing country. Surg Neurol 2009;72(01):6–13, discussion 13–14
2 Mosaddad SA, Gheisari R, Erfani M. Oral and maxillofacial trauma in motorcyclists in an Iranian subpopulation. Dent Traumatol 2018;34(05):347–352
3 Forum IT. (2015).Improving Safety for Motorcycle, Scooter and Moped Riders.
4 Al-Ghabban S, Abdul-Sahib M, Waleed M. Risk factors and pattern of injuries in motorcycle accidents in Holy Karbala. Journal of Medicine 2013;6(01):1552–1560
5 Vaca EE, Bellamy JL, Sinno S, Rodriguez ED. Management of High-energy Avulsive Ballistic Facial Injury: A Review of the Literature and Algorithmic Approach. Plast Reconstr Surg Glob Open 2018;6 (03):e1693
6 Boffano P, Kommers SC, Karagozoglu KH, Forouzanfar T. Aetiology of maxillofacial fractures: a review of published studies during the last 30 years. Br J Oral Maxillofac Surg 2014;52(10):901–906. Doi: 10.1016/j.bjoms.2014.08.007
7 Oginni FO, Ugboko VI, Ogundipe O, Adegbehingbe BO. Motorcycle-related maxillofacial injuries among Nigerian intracity road users. J Oral Maxillofac Surg 2006;64(01):56–62
8 Adebayo ET, Ajike OS, Adekeye EO. Analysis of the pattern of maxillofacial fractures in Kaduna, Nigeria. Br J Oral Maxillofac Surg 2003;41(06):396–400
9 Nwadiaro HC, Ekwe KK, Akpayak IC, Shitta H. Motorcycle injuries in North-Central Nigeria. Niger J Clin Pract 2011;14(02):186–189
10 Ramli R, Abdul Rahman R, Abdul Rahman N, et al. Pattern of maxillofacial injuries in motorcyclists in Malaysia. J Craniofac Surg 2008;19(02):316–321
11 Ruslin M, Brucoli M, Boffano P, et al. Motor vehicle accidents-related maxillofacial injuries: a multicentre and prospective study. Oral Surg Oral Med Oral Pathol Oral Radiol 2019;128 (03):199–204. Doi: 10.1016/j.oooo.2018.12.009
12 Alghnam S, Alsulaim HA, BinMuneif YA, et al. Injuries following motorcycle crashes at a level-1 trauma center in Riyadh. Ann Saudi Med 2019;39(03):185–191
13 Usha M, Ravindran V, Soumithran CS, Ravindran Nair KS. The impact of mandatory helmet law on the outcome of maxillo facial trauma: a comparative study in kerala. J Maxillofac Oral Surg 2014;13(02):176–183
14 Bali R, Sharma P, Garg A, Dhillon G. A comprehensive study on maxillofacial trauma conducted in Yamunanagar, India. J Inj Violence Res 2013;5(02):108–116
15 Kadkhodaie MH. Three-year review of facial fractures at a teaching hospital in northern Iran. Br J Oral Maxillofac Surg 2006;44 (03):229–231
16 Granieri SS, Reitano EE, Bindi FF, Renzi FF, Sammartano FF, Cimbanassi SS, Gupta SS, Chiara OO. Motorcycle-related trauma:effects of age and site of injuries on mortality. A single-center, retrospective study. World J Emerg Surg 2020 Mar 10;15(01):18. Doi: 10.1186/s13017-020-00297-1
17 Sohal KS, Kalyanyama BM, Owibingire SS. Maxillofacial Fractures among Motorcycle Crash Victims Attended at a Tertiary Hospital in Tanzania. Panam J Trauma Crit Care Emerg Surg 2019;8(03): 158–164
18 Agbor AM, Azodo CC, Ebot EB, Naidoo S. Dentofacial injuries in commercial motorcycle accidents in Cameroon: pattern and cost implication of care. Afr Health Sci 2014;14(01):77–82
19 Nyameino S, Butt F, Guthua SW, Macigo F, Akama M. Occurrence and Pattern of Maxillofacial Injuries Caused by Motorcycle Crashes Presenting at Two Major Referral Hospitals in Nairobi,

Kenya. Craniomaxillofac Trauma Reconstr Open 2018;2(01): s-0038–s-1660434
20 Saidi H, Mutisto BK. Motorcycle injuries at a tertiary referral hospital in Kenya: injury patterns and outcome. Eur J Trauma Emerg Surg 2013;39(05):481–485
21 Galukande MJJ, Fualal J, Gakwaya ADepartment of Surgery MH, Department of Surgery, Kampala, Uganda. Boda-boda injuries a health problem and a burden of disease in Uganda: A tertiary hospital survey. East Cent Afr J Surg 2009;14(02):33–37
22 Ong TK, Dudley M. Craniofacial trauma presenting at an adult accident and emergency department with an emphasis on soft tissue injuries. Injury. 1999;30(5):357–63,Worrall SF. Mechanisms, pattern and treatment costs of maxillofacial injuries. Injury 1991;22(01):25–28
23 Kraus JF, Rice TM, Peek-Asa C, McArthur DL. Facial trauma and the risk of intracranial injury in motorcycle riders. Ann Emerg Med 2003;41(01):18–26
24 Deliverska E. Maxillofacial fractures in patients with multiple injuries and polytrauma. J of IMAB 2016;22(02): 1120–1126
25 Lindqvist C, Sorsa S, Hyrkäs T, Santavirta S. Maxillofacial fractures sustained in bicycle accidents. Int J Oral Maxillofac Surg 1986;15 (01):12–18
26 Al-Khateeb T, Abdullah FM. Craniomaxillofacial injuries in the United Arab Emirates: a retrospective study. J Oral Maxillofac Surg 2007;65(06):1094–1101
27 Adeyemo WL, Ladeinde AL, Ogunlewe MO, James O. Trends and characteristics of oral and maxillofacial injuries in Nigeria: a review of the literature. Head Face Med 2005;1:7
28 Salentijn EG, Peerdeman SM, Boffano P, van den Bergh B, Forouzanfar T. A ten-year analysis of the traumatic maxillofacial and brain injury patient in Amsterdam: incidence and aetiology. J Craniomaxillofac Surg 2014;42(06):705–710. Doi: 10.1016/j.jcms.2013.12.008

