



ORIGINAL ARTICLE

# Trends of maxillofacial and mandibular fractures in level I and II trauma patients in a tertiary hospital in Saudi Arabia



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## KEYWORD

Maxillofacial trauma

**Abstract** *Background:* Maxillofacial injury is a major health concern worldwide. Incidence of maxillofacial fractures is influenced by socio-demographic, economic, and cultural factor of the population investigated. Identifying the patterns of these fractures is crucial to establish effective treatments and prevention measures. The aim of the study was to analyze the incidence, etiology, and types of maxillofacial fractures in a tertiary trauma center.

*Methods:* A retrospective analysis was conducted for all patients who were admitted with maxillofacial fractures at King Abdulaziz Medical City, Riyadh, Saudi Arabia. A total of 422 patients with 978 maxillofacial fractures were enrolled over a 4-year period.

*Results:* Among the 422 patients, 387 (91.8%) were males, and 35 (8.2%) were females. The mean age of our population was 31.1 years old. Our study has shown that motor vehicle accidents are the leading cause of maxillofacial fractures, followed by pedestrian trauma. The most common maxillofacial fractures were orbital fractures, followed by maxillary fractures. The mandibular body was most fractured among mandibular fractures. Our data has shown that males have higher incidence of maxillofacial fractures than females.

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*Conclusion:* Our study further validated that road traffic accidents are the most common cause of maxillofacial fractures in our region. These findings emphasized the importance of improving road safety protocols and enforcing traffic laws.

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## 1. Introduction

Traumatic injuries are the leading cause of morbidity and mortality worldwide (Saudi, 2014). The 2010 Global Burden of Disease Study (GBD) shows that injuries caused 11.2% of disability-adjusted life-years (DALYs) worldwide, with RTAs accounting for 27% of these injuries (Murray et al., 2012). Motor vehicle accidents (MVAs) are one of the most prevalent health hazards and can result in devastating morbidities (Murray et al., 2012; "Road traffic injuries," n.d.). In Saudi Arabia, road traffic accidents (RTAs) are becoming a serious public health concern. An analysis of RTAs in SA found that road traffic injuries accounted for 83.4% of all trauma admissions, with the head and neck being the most injured body regions (Mansuri et al., 2015). Injuries to the maxillofacial region are common among RTAs, ranging from minor fractures to severe or gross injuries (Jose et al., 2016; Patil et al., 2018; Singaram et al., 2016). Multiple factors affect the incidence and characteristics of maxillofacial fractures, such as sociodemographic, economic, and cultural aspects of the population studied (Mabrouk et al., 2014; Singaram et al., 2016). Prior studies conducted in Saudi Arabia reported motor vehicle accidents as the leading cause of maxillofacial fractures (Al-Bokhamseen et al., 2019; Ali-Alsuliman et al., 2018; Almasri et al., 2015; Samman et al., 2018). In other countries, however, maxillofacial fractures are mostly caused by assaults (Boffano et al., 2015a; Ceallaigh et al., 2006). A variety of patterns of maxillofacial injuries have been reported in literature. Fractures of the mandible were most prevalent in SA (Abdullah et al., 2013; Al-Bokhamseen et al., 2019; Samman et al., 2018). Injury to the maxillofacial region often leads to other systemic injuries resulting in long-term effects, both functionally and aesthetically (Nayak et al., 2021). Several types of concomitant serious injuries were reviewed in the literature, and traumatic brain injuries were the most prevalent associated with traumatic facial injuries (Patil et al., 2018; Scherbaum Eidt et al., 2013). A comprehensive understanding of the trends and severity of maxillofacial injuries is vital for the establishment of effective treatments and prevention measures. Although several studies examined various aspects of maxillofacial trauma in Saudi Arabia, a further addition is needed to obtain a better understating of these fractures. Thus, the aim of this study is to identify the trends and characteristics of maxillofacial fracture in level I and II trauma patients in a tertiary trauma center in Riyadh, Saudi Arabia. In addition, this study determines the incidence of concomitant injuries associated with maxillofacial fractures.

## 2. Methods

### 2.1. Study setting and design

This is a retrospective cross-sectional study conducted at King Abdulaziz Medical City (KAMC), Department of Emergency

Medicine, Riyadh, Saudi Arabia. This hospital is an advanced trauma center that provides care to the population of the national guard and their dependents as well as non-national guard patients through its medical eligibility system. The bed capacity of KAMC includes 1973 operational beds.

### 2.2. Data collection

The data used in this study were extracted from the hospital trauma registry and the patients' electronic files from January 2018 to December 2021. The population of the study included all adult patients, 14 years and older, from all nationalities who were admitted with maxillofacial trauma. Patients who were treated in an outpatient setting, transferred to another hospital, or who announced death upon arrival were excluded. The following data were collected from the patients: demographic variables, initial vital signs, trauma level, Glasgow Coma Scale score, cause of injury, and maxillofacial fracture pattern based on CT imaging and surgery reports. Maxillofacial fractures were classified as frontal, nasal, zygomatic, maxillary, orbital, and alveolar. Patients were also evaluated for the presence of any associated injuries. The associated injuries were categorized into head injuries, abdominal/pelvic injuries, chest injuries, spinal injuries and limb injuries.

### 2.3. Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) (IBM Corp. Released 2021 IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY). Data on categorical variables are reported as frequency and proportion, while data on numerical variables are reported as mean and standard deviation. The chi-square test was used to determine if two categorical variables are associated. A p-value of less than 0.05 was considered significant.

## 3. Results

### 3.1. Demographic distribution

The baseline characteristics of patients with maxillofacial fractures are listed in Table 1. Over the study period from January 2018 to December 2021, a total of 422 patients with 978 maxillofacial fractures were recorded and analyzed. Most of the patients were male ( $n = 387$ , 91.8%). Mean patient age was 31 (SD  $\pm$  13) years. An initial Glasgow Coma Scale of less than 10 was recorded in 204 patients. The rate of death in the emergency department was 1.4% (6 cases). The number of patients who were intoxicated was 7 (1.7%). Nearly-two-thirds ( $n = 272$ , 64%) of the patients were intubated in the emergency room. Patients were mostly transferred from the ED to an intensive care unit ( $n = 208$ , 49%) or to an operation room ( $n = 98$ , 23.2%).

**Table 1** Baseline characteristics of patients with maxillofacial fractures.

		Number	Percentage/ SD
Gender	Male	387	91.80%
	Female	35	8.20%
Age		31	13
GCS	15	122	28.90%
	14	28	6.60%
	13	24	5.70%
	12	14	3.30%
	11	18	4.30%
	10	12	2.80%
	9	18	4.30%
	8	36	9%
	7	42	10.00%
	6	26	6.20%
	5	10	2.40%
	4	10	2.40%
	3	62	14.70%
	Injury mechanism	MVA	263
Motorcycle accident		28	6.60%
Pedestrian		69	16.40%
Stab wound		4	1%
Gunshot		3	0.70%
Fall		45	10.70%
Blast injuries		7	1.70%
Other		3	0.70%
Intubation		272	64%
Intoxicated		7	1.70%
Disposition from ER	ICU	208	49%
	OR	98	23.20%
	Ward	76	18.00%
	Discharge from ER	34	8.10%
Death in the ER		6	1.40%

### 3.2. Patterns of maxillofacial fractures

A detailed distribution of maxillofacial fractures is shown in [Table 2](#) and [Table 3](#). The most common maxillofacial fractures were orbital fractures ( $n = 203$ , 20%), followed by maxillary fractures, nasal fractures, frontal fractures, mandibular fractures, zygomatic fractures, and the alveolar bone fractures. For maxillary fractures, Le Fort-1 fractures were the most common ( $n = 114$ , 63.33%), followed by Le Fort-2 fractures, and Le Fort-3 fractures. Among mandibular fractures, the mandibular body was the most fractured site ( $n = 49$ , 5%). As for the fracture distribution according to gender, the most common fractured bone for males is the orbital bone, while the most common fractured bone for females is the nasal bone. There was no significant correlation between gender and any of the types of maxillofacial fracture ( $p > 0.05$ ).

### 3.3. Associated injury

Concomitant injuries to other organ systems were reported in 384 patients. As shown in [Table 4](#), head injury ( $n = 301$ ) was found to be the most common associated injury with maxillofacial trauma, followed by chest injury ( $n = 255$ ), abdomino-

**Table 2** Distribution of maxillofacial fractures.

Fractures	N	Percent
Frontal Bone	144	14.72%
Zygomatic Bone	116	11.86%
Maxillary Fractures	180	18.40%
Le Fort I	114	
Le Fort II	35	
Le Fort III	31	
Alveolar Bone	36	3.68%
Nasal Bone	174	17.79%
Orbital	203	20.76%
Mandibular Fractures	125	12.78%
Coronoid	20	
Ramus	20	
Mandibular Angle	15	
Mandibular Body	49	
Symphysis	12	
Condyle	9	
Total	978	100%

**Table 3** Patterns of maxillofacial fractures according to gender.

Fractures	Female N	Male N
Zygomatic bone	7	109
Frontal bone	9	135
Orbital fracture	12	191
Le fort I	6	108
Le fort II	1	34
Lef fort III	2	29
Alveolar bone	2	34
Coronoid	2	18
Ramus	2	18
Mandibular angle	1	14
Mandibular body	5	44
Symphysis	1	11
Condyle	1	8
Nasal bone	18	156

pelvic injury ( $n = 183$ ), limb injury ( $n = 130$ ), and spinal injury ( $n = 56$ ). Concomitant injuries were most caused by road traffic accidents (62.5%), followed by pedestrian trauma (17.21%) and falls (10.67%). The incidence of associated injuries was not statistically associated with age or gender.

### 3.4. Etiology of maxillofacial fractures

Causes of maxillofacial fractures are shown in [Table 5](#) and [Fig. 1](#). Most of the patients sustained their maxillofacial injuries due to motor vehicle accidents ( $n = 263$ , 62%), followed by pedestrian trauma ( $n = 69$ , 16.4%). The number of males and females with fractures caused by motor vehicle accidents is not statically significant ( $p = 0.12$ ). Among motor vehicle-related fractures, the nasal bone was most frequently involved ( $n = 126$  fractures). Fall-related fractures were most common in orbital bone ( $n = 31$  fractures), followed by frontal bone ( $n = 20$  fractures). For zygomatic bone fractures, motor vehi-

**Table 4** Associated injury.

Associated injury with MFT	Number	Percentage of total MFT
Brain injury	301	78.4%
Chest injury	255	66.4%
Abdomino-pelvis injury	183	47.6%
Limb injury	130	33.8%
Spinal injury	56	13.6%

cle accidents were responsible for 67 fractures, followed by pedestrians with 21 fractures.

#### 4. Discussion

Traumatic injury is one of the most prevalent health concerns worldwide. Among the numerous injuries, maxillofacial fractures is one of the most common due to the anatomically exposed position of the face. The purpose of this epidemiological study was to investigate the prevalence and etiology of maxillofacial fractures in a tertiary hospital in Saudi Arabia.

Our study found that motor vehicle accidents are the leading cause of maxillofacial fractures, representing 62% of the etiologies. Followed by pedestrian trauma at 16.4%, falls at 10.7%, and motorcycle accidents at 6%. Prior studies conducted in Saudi Arabia also reported similar results attributing motor vehicle accidents as the leading cause of maxillofacial fractures (Alghamdi et al., 2017; Ali-Alsuliman et al., 2018). The results in our region correspond to international data in Malaysia (Abosadegh et al., 2017; Chelvan et al., 2020) and South India (Patil et al., 2018). On the contrary, a multicentric European study has found that the primary cause of faciomaxillary fractures is assaults, followed by falls, sports accidents, and road traffic accidents (Boffano et al., 2015a). An additional study conducted in Spain revealed that assaults accounts for 43% of maxillofacial fractures, followed by falls (32%) and motor vehicle accidents (14%) (Jarrod Ferrer et al., 2018). The variation in these outcomes may be attributed to a variety of factors including environment, socioeconomic conditions and cultural aspects of the population studied. Moreover, deprived

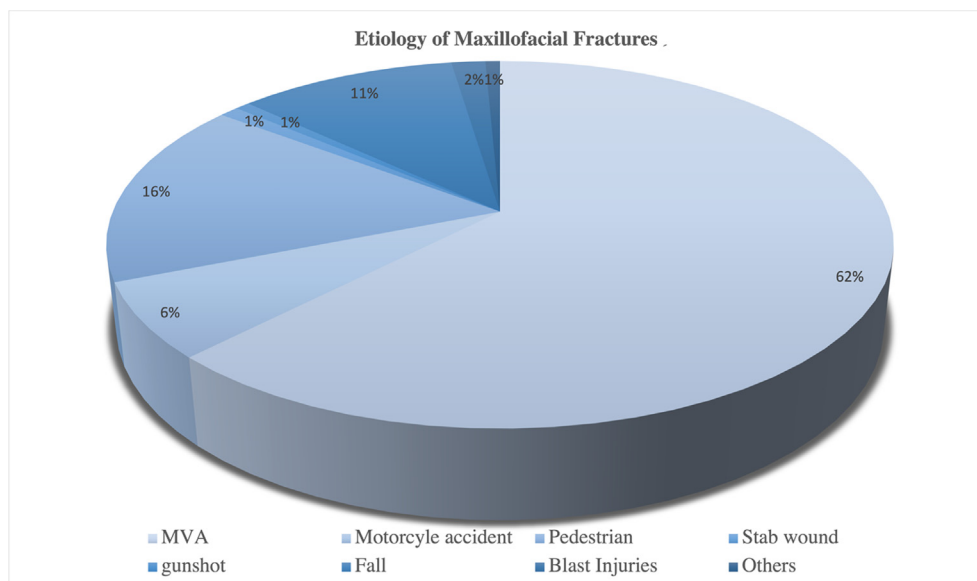
social and economic status was linked to greater susceptibility to facial traumatic injuries. A higher proportion of maxillofacial fractures resulting from motor vehicle accidents occurs in low- and middle-income countries compared with developed countries (Hyman et al., 2016; Romeo et al., 2022).

The mean age of our population was 31 years old. Our data corresponds to the data in the literature, where the age group distribution was mainly between 20 s and 30 s years of age (Al-Bokhamseen et al., 2019; Boffano et al., 2015a; Patil et al., 2018). The nature of the social and economic activities young individuals partake in might be indicative of their increased susceptibility to traumatic injuries of all sorts; therefore, maxillofacial fractures are a common injury in this age group (Pollansky silva Farlas et al., 2017). Regarding the genders of the affected individuals, our data has shown that males have a higher incidence of maxillofacial fractures than females, with males representing 91.8% of our population and females representing 8.2%. Similar results were reported in the kingdom, where maxillofacial fractures are more prevalent in males, with percentages of 89.3% in Alhafouf (Al-Bokhamseen et al., 2019), 86.4% in Jeddah (Alghamdi et al., 2017), and 88.6% in Riyadh (Ali-Alsuliman et al., 2018). Other studies conducted in different countries, have consistently found a higher frequency of maxillofacial injuries among males than females (Gupta et al., 2015; Septa et al., 2014; Singaram et al., 2016).

Unlike multiple studies in the region, our study has found that the most common maxillofacial bone fracture is the orbital bone, with a percentage of 20% of our population consisting of 203 fractures, followed by maxillary fractures, nasal fractures, frontal fractures, mandibular fractures, zygomatic fracture, and the alveolar bone fracture. Studies in the respective regions, Alhafouf, Southern Region, Riyadh, and Al Madina, have stated contrary results and indicate that the most commonly fractured bone was the mandible. Moreover, the European Maxillofacial Trauma (EURMAT) project also demonstrated similar results, reporting that mandibular fractures are the most prevalent fractured bone (Boffano et al., 2015b). However, mandibular fractures were found to be the sixth most common fractures in our population, consisting of 105 fractures in total, with fractures to the body of the mandible making the majority of the total number of fractured

**Table 5** Etiology of maxillofacial Fractures.

Fracture	Cause of injury						
	MVA	Motorcycle	Pedestrian	Stab wound	Gunshot	Fall	Others
Coroniod	13	1	4	0	0	2	0
Ramus	14	2	3	0	0	1	0
Mandibular Angle	9	1	3	0	0	1	0
Mandibular Body	33	5	7	0	0	4	0
Symphysis	9	2	1	0	0	0	0
Condyle	7	0	1	0	0	0	0
Zygomatic Bone	67	9	21	1	1	16	1
Frontal Bone	82	9	29	1	1	20	0
Orbital	114	15	40	1	0	31	1
Le Fort I	67	5	25	0	2	13	1
Le Fort II	27	1	6	0	0	1	0
Le Fort III	22	4	2	0	1	2	0
Alveolar Bone	27	0	3	0	1	4	0
Nasal Bone	126	6	25	2	0	11	2



**Fig. 1** Etiology of maxillofacial Fractures.

mandibles. In addition, our data revealed that the orbital bone is the most fractured maxillofacial bone in males, while in females, the nasal bone is the most commonly fractured. In terms of associated body injuries, a total of 384 patients were found to have concomitant injuries with head injuries being the most prevalent (78.4%), followed by chest injuries with (66.44%). Similarly, A study conducted in Malaysia, demonstrated that traumatic head injuries are common among patients with maxillofacial fractures (Abosadegh et al., 2017). This can be attributed to the proximity of maxillofacial bones to the cranium. In contrast, a study conducted in Riyadh, found that orthopedic injuries were the most common injury associated with maxillofacial fractures, with a percentage of 36%, followed by brain injuries at 25% (AlHammad et al., 2020). Our study showed that motor vehicle accidents are associated with a high rate of concomitant injuries, ICU admissions, and mortality. These findings indicate that motor vehicle accidents significantly impact hospital resources and individual health.

One limitation of this study was that some patient records were incomplete or lacked proper documentation. Another is that this study is based on data from a single tertiary center and does not reflect all hospitals in the city, country, or region. In addition, data from the present study was obtained from the KAMC trauma registry, therefore, patients who were not triaged as level I or II trauma were omitted, since they were not included in the data registry.

Further studies about the morbidity and mortality resulting from maxillofacial fractures should be conducted to evaluate the severity and magnitude of those fractures on the quality of life. Moreover, the data from our study emphasizes the need to improve road safety protocols and advocates to raise awareness about road safety and enforcement of traffic laws.

## 5. Conclusion

Our study has further vindicated that motor vehicle accidents continue to be the leading cause of maxillofacial injuries in

Saudi Arabia despite laws and guidelines addressing their prevention. Young males in their early fourth decade of age are more likely to be the victims of maxillofacial fractures. Nevertheless, orbital bone fractures were found to be the most common maxillofacial bone fractures preceded by maxillary fractures.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## References

- Abdullah, W.A., Al-Mutairi, K., Al-Ali, Y., Al-Soghier, A., Al-Shnwani, A., 2013. Patterns and etiology of maxillofacial fractures in Riyadh City, Saudi Arabia. *Saudi Dent. J.* 25. <https://doi.org/10.1016/j.sdentj.2012.10.004>.
- Abosadegh, M.M., Rahman, S.A., Saddki, N., 2017. Association of traumatic head injuries and maxillofacial fractures: A retrospective study. *Dent. Traumatol.* <https://doi.org/10.1111/edt.12349>.
- Al-Bokhamseen, M., Salma, R., Al-Bodbaaj, M., 2019. Patterns of maxillofacial fractures in Hofuf, Saudi Arabia: A 10-year retrospective case series. *Saudi Dent. J.* 31. <https://doi.org/10.1016/j.sdentj.2018.10.001>.
- Alghamdi, S., Alhabab, R., Alsalmi, S., 2017. The epidemiology, incidence and patterns of maxillofacial fractures in Jeddah city, Saudi Arabia. *Int. J. Oral Maxillofac. Surg.* 46, 255. <https://doi.org/10.1016/j.ijom.2017.02.861>.
- AlHammad, Z., Nusair, Y., Alotaibi, S., Ababtain, R., Alsulami, S., Aljumah, G., 2020. A cross-sectional study of the prevalence and severity of maxillofacial fractures resulting from motor vehicle



- accidents in Riyadh, Saudi Arabia. *Saudi Dent. J.* 32. <https://doi.org/10.1016/j.sdentj.2019.09.009>.
- Ali-Alsuliman, D., Ibrahim, E.H., Braimah, R., 2018. Patterns of zygomatic complex bone fracture in Saudi Arabia. *J. Emerg. Trauma Shock* 11. [https://doi.org/10.4103/JETS.JETS\\_12\\_18](https://doi.org/10.4103/JETS.JETS_12_18).
- Almasri, M., Amin, D., AboOla, A.F., Shargawi, J., 2015. Maxillofacial Fractures in Makka City in Saudi Arabia; an 8-year Review of Practice. *Am. J. Public Health Res.* 3, 56–59. <https://doi.org/10.12691/ajphr-3-2-4>.
- Boffano, P., Rocchia, F., Zavattono, E., Dediol, E., Uglešić, V., Kovačić, Ž., Vesnaver, A., Konstantinović, V.S., Petrović, M., Stephens, J., Kanzaria, A., Bhatti, N., Holmes, S., Pechalova, P.F., Bakardjiev, A.G., Malanchuk, V.A., Kopchak, A.V., Galteland, P., Mjøen, E., Skjelbred, P., Koudougou, C., Mouallem, G., Corre, P., Løes, S., Lekven, N., Laverick, S., Gordon, P., Tamme, T., Akermann, S., Karagozlu, K.H., Kommers, S.C., Forouzanfar, T., 2015a. European Maxillofacial Trauma (EURMAT) project: A multicentre and prospective study. *J. Cranio-Maxillofac. Surg.* 43. <https://doi.org/10.1016/j.jcms.2014.10.011>.
- Boffano, P., Rocchia, F., Zavattono, E., Dediol, E., Uglešić, V., Kovačić, Ž., Vesnaver, A., Konstantinović, V.S., Petrović, M., Stephens, J., Kanzaria, A., Bhatti, N., Holmes, S., Pechalova, P.F., Bakardjiev, A.G., Malanchuk, V.A., Kopchak, A.V., Galteland, P., Mjøen, E., Skjelbred, P., Koudougou, C., Mouallem, G., Corre, P., Løes, S., Lekven, N., Laverick, S., Gordon, P., Tamme, T., Akermann, S., Karagozlu, K.H., Kommers, S.C., Forouzanfar, T., 2015b. European Maxillofacial Trauma (EURMAT) project: A multicentre and prospective study. *J. Cranio-Maxillofac. Surg.* 43, 62–70. <https://doi.org/10.1016/j.jcms.2014.10.011>.
- Ceallaigh, P.O., Ekanayake, K., Beirne, C.J., Palton, D.W., 2006. Diagnosis and management of common maxillofacial injuries in the emergency department. Part 1: advanced trauma life support. *Emerg. Med. J.* 23, 796–797. <https://doi.org/10.1136/EMJ.2006.035931>.
- Chelvan, K.T., Loong, S.C., Pergigian, K., Gemok, T., Pergigian, K., Rompin, D., 2020. Aetiology and Patterns of Maxillofacial Injuries in Rural Pahang, Malaysia: A Retrospective Study. *Malaysian Dent. J.*
- Gupta, B., Mathur, P., Prasad, A., Ramchandani, S., Singhal, M., 2015. Facing the airway challenges in maxillofacial trauma: A retrospective review of 288 cases at a level I trauma center. *Anesth. Essays Res.* <https://doi.org/10.4103/0259-1162.150142>.
- Hyman, D.A., Saha, S., Nayar, H.S., Doyle, J.F., Agarwal, S.K., Chaiet, S.R., 2016. Patterns of Facial Fractures and Protective Device Use in Motor Vehicle Collisions From 2007 to 2012. *JAMA Facial Plast. Surg.* 18, 455–461. <https://doi.org/10.1001/jamafacial.2016.0733>.
- Jariod Ferrer, Ú.M., Blanco Sanfrutos, S., Gavin Clavero, M.A., Simon Sanz, M.V., Uson Bouthelie, T., Nadal Cristobal, B., 2018. Epidemiological Study of the Socioeconomic Impact of Mandible Fractures in a Spanish Tertiary Hospital: Review of the Literature. *J. Maxillofac. Oral Surg.* 18 (2), 217–223. <https://doi.org/10.1007/S12663-018-1148-6>.
- Jose, A., Nagori, S.A., Agarwal, B., Bhutia, O., Roychoudhury, A., 2016. Management of maxillofacial trauma in emergency: An update of challenges and controversies. *J. Emerg. Trauma Shock.* <https://doi.org/10.4103/0974-2700.179456>.
- Mabrouk, A., Helal, H., Mohamed, A., Mahmoud, N., 2014. Incidence, Etiology, and Patterns of Maxillofacial Fractures in Ain-Shams University, Cairo, Egypt: A 4-Year Retrospective Study. *Cranio-Maxillofac. Trauma Reconstr.* 7, 224–232. <https://doi.org/10.1055/S-0034-1374061>.
- Mansuri, F.A., Al-Zalabani, A.H., Zalat, M.M., Qabshawi, R.I., 2015. Road safety and road traffic accidents in Saudi Arabia A systematic review of existing evidence OPEN ACCESS. *Saudi Med. J.* 36, 418–424. <https://doi.org/10.15537/smj.2015.4.10003>.
- Murray, C.J.L., Vos, T., Lozano, R., Naghavi, M., Flaxman, A.D., Michaud, C., Ezzati, M., Shibuya, K., Salomon, J.A., Abdalla, S., Aboyans, V., Abraham, J., Ackerman, I., Aggarwal, R., Ahn, S.Y., Ali, M.K., AlMazroa, M.A., Alvarado, M., Anderson, H.R., Anderson, L.M., Andrews, K.G., Atkinson, C., Baddour, L.M., Bahalim, A.N., Barker-Collo, S., Barrero, L.H., Bartels, D.H., Basáñez, M.G., Baxter, A., Bell, M.L., Benjamin, E.J., Bennett, D., Bernabé, E., Bhalla, K., Bhandari, B., Bikbov, B., bin Abdulhak, A., Birbeck, G., Black, J.A., Blencowe, H., Blore, J.D., Blyth, F., Bolliger, I., Bonaventure, A., Boufous, S., Bourne, R., Boussinesq, M., Braithwaite, T., Brayne, C., Bridgett, L., Brooker, S., Brooks, P., Brughga, T.S., Bryan-Hancock, C., Bucello, C., Buchbinder, R., Buckle, G., Budke, C.M., Burch, M., Burney, P., Burstein, R., Calabria, B., Campbell, B., Canter, C.E., Carabin, H., Carapetis, J., Carmona, L., Cella, C., Charlson, F., Chen, H., Cheng, A.T.A., Chou, D., Chugh, S.S., Coffeng, L.E., Colan, S.D., Colquhoun, S., Colson, K.E., Condon, J., Connor, M.D., Cooper, L.T., Corriere, M., Cortinovis, M., Courville De Vaccaro, K., Couser, W., Cowie, B.C., Criqui, M.H., Cross, M., Dabhadkar, K.C., Dahiya, M., Dahodwala, N., Damsere-Derry, J., Danaei, G., Davis, A., de Leo, D., Degenhardt, L., Dellavalle, R., Delossantos, A., Denenberg, J., Derrett, S., des Jarlais, D.C., Dharmaratne, S.D., Dherani, M., Diaz-Torne, C., Dolk, H., Dorsey, E.R., Driscoll, T., Duber, H., Ebel, B., Edmond, K., Elbaz, A., Eltahir Ali, S., Erskine, H., Erwin, P.J., Espindola, P., Ewoigbokhan, S.E., Farzadfar, F., Feigin, V., Felton, D.T., Ferrari, A., Ferri, C.P., Fèvre, E.M., Finucane, M.M., Flaxman, S., Flood, L., Foreman, K., Forouzanfar, M.H., Fowkes, F.G.R., Fransen, M., Freeman, M.K., Gabbe, B.J., Gabriel, S.E., Gakidou, E., Ganatra, H.A., Garcia, B., Gaspari, F., Gillum, R.F., Gmel, G., Gonzalez-Medina, D., Gosselin, R., Grainger, R., Grant, B., Groeger, J., Guillemin, F., Gunnell, D., Gupta, R., Haagsma, J., Hagan, H., Halasa, Y.A., Hall, W., Haring, D., Haro, J.M., Harrison, J.E., Havmoller, R., Hay, R.J., Higashi, H., Hill, C., Hoen, B., Hoffman, H., Hotez, P. J., Hoy, D., Huang, J.J., Ibeanusi, S.E., Jacobsen, K.H., James, S. L., Jarvis, D., Jasrasaria, R., Jayaraman, S., Johns, N., Jonas, J.B., Karthikeyan, G., Kassebaum, N., Kawakami, N., Keren, A., Khoo, J.P., King, C.H., Knowlton, L.M., Kobusingye, O., Koranteng, A., Krishnamurthi, R., Laden, F., Lalloo, R., Laslett, L.L., Lathlean, T., Leasher, J.L., Lee, Y.Y., Leigh, J., Levinson, D., Lim, S.S., Limb, E., Lin, J.K., Lipnick, M., Lipshultz, S.E., Liu, W., Loane, M., Lockett Ohno, S., Lyons, R., Mabweijano, J., MacIntyre, M.F., Malekzadeh, R., Mallinger, L., Manivannan, S., Marcenes, W., March, L., Margolis, D.J., Marks, G.B., Marks, R., Matsumori, A., Matzopoulos, R., Mayosi, B.M., McAnulty, J.H., McDermott, M.M., McGill, N., McGrath, J., Medina-Mora, M.E., Meltzer, M., Memish, Z.A., Mensah, G.A., Merriman, T.R., Meyer, A.C., Miglioli, V., Miller, M., Miller, T.R., Mitchell, P.B., Mock, C., Mocumbi, A.O., Moffitt, T.E., Mokdad, A.A., Monasta, L., Montico, M., Moradi-Lakeh, M., Moran, A., Morawska, L., Mori, R., Murdoch, M.E., Mwaniki, M.K., Naidoo, K., Nair, M.N., Naldi, L., Narayan, K.M.V., Nelson, P. K., Nelson, R.G., Nevitt, M.C., Newton, C.R., Nolte, S., Norman, P., Norman, R., O'Donnell, M., O'Hanlon, S., Olives, C., Omer, S. B., Ortblad, K., Osborne, R., Ozgediz, D., Page, A., Pahari, B., Pandian, J.D., Panozo Rivero, A., Patten, S.B., Pearce, N., Perez Padilla, R., Perez-Ruiz, F., Perico, N., Pesudovs, K., Phillips, D., Phillips, M.R., Pierce, K., Pion, S., Polanczyk, G.V., Polinder, S., Pope, C.A., Popova, S., Porrini, E., Pourmalek, F., Prince, M., Pullan, R.L., Ramaiah, K.D., Ranganathan, D., Razavi, H., Regan, M., Rehm, J.T., Rein, D.B., Remuzzi, G., Richardson, K., Rivara, F.P., Roberts, T., Robinson, C., Rodriguez De Leon, F., Ronfani, L., Room, R., Rosenfeld, L.C., Rushton, L., Sacco, R.L., Saha, S., Sampson, U., Sanchez-Riera, L., Sanman, E., Schwebel, D.C., Scott, J.G., Segui-Gomez, M., Shahraz, S., Shepard, D.S., Shin, H., Shivakoti, R., Silberberg, D., Singh, D., Singh, G.M., Singh, J.A., Singleton, J., Sleet, D.A., Sliwa, K., Smith, E., Smith, J.L., Stapelberg, N.J.C., Steer, A., Steiner, T., Stolk, W.A., Stovner, L.J., Sudfeld, C., Syed, S., Tamburlini, G., Tavakkoli, M., Taylor, H.R., Taylor, J.A., Taylor, W.J., Thomas, B.,

- Thomson, W.M., Thurston, G.D., Tleyjeh, I.M., Tonelli, M., Towbin, J.A., Truelsen, T., Tsilimbaris, M.K., Ubeda, C., Undurraga, E.A., van der Werf, M.J., van Os, J., Vavilala, M.S., Venketasubramanian, N., Wang, M., Wang, W., Watt, K., Weatherall, D.J., Weinstock, M.A., Weintraub, R., Weisskopf, M.G., Weissman, M.M., White, R.A., Whiteford, H., Wiebe, N., Wiersma, S.T., Wilkinson, J.D., Williams, H.C., Williams, S.R.M., Witt, E., Wolfe, F., Woolf, A.D., Wulf, S., Yeh, P.H., Zaidi, A.K.M., Zheng, Z.J., Zonies, D., Lopez, A.D., 2012. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *The Lancet* 380, 2197–2223. [https://doi.org/10.1016/S0140-6736\(12\)61689-4](https://doi.org/10.1016/S0140-6736(12)61689-4).
- Nayak, S.S., Kamath, A.T., Roy, S., Nayak, V.S., 2021. Effect of oral and maxillofacial injuries on the development of post-traumatic stress disorder: A cross-sectional study. *Pesqui Bras Odontopediatria Clin. Integr.* 21. <https://doi.org/10.1590/pboci.2021.039>.
- Patil, S.G., Munnangi, A., Joshi, U.K., Thakur, N., Allurkar, S., Patil, B.S., 2018. Associated Injuries in Maxillofacial Trauma: A Study in a Tertiary Hospital in South India. *J. Maxillofac. Oral Surg.* 17. <https://doi.org/10.1007/s12663-017-0998-7>.
- Pollansky sIlva Farlas, I., de Macedo BernardIno, Í., Marques da nóBrega, lorena, grotta greMPel, raFael, 2017. MAXILLOFACIAL TRAUMA, ETIOLOGY AND PROFILE OF PATIENTS: AN EXPLORATORY STUDY TRAUMAS MAXILOFACIAIS, ETIOLOGIA E PERFIL DOS PACIENTES: UM ESTUDO EXPLORATÓRIO Work conducted at the Hospital of Emergency and Trauma Dom Luíz Gonzaga Fernandes 25, 258–61. <https://doi.org/10.1590/1413-785220172506152670>.
- Road traffic injuries [WWW Document], n.d. URL <https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries> (accessed 10.15.22).
- Romeo, I., Sobrero, F., Rocchia, F., Dolan, S., Laverick, S., Carlaw, K., Aquilina, | Peter, Bojino, A., Ramieri, G., Duran-Valles, F., Coro Bescos, |, Segura-Palleres, I., Dimitra Ganasouli, |, Stelios, |, Zanakis, N., Luis, |, de Oliveira Gorla, F., Valfrido, |, Pereira-Filho, A., Gallafassi, D., Faverani, |, Perez, L., Alalawy, H., Kamel, M., Samieirad, S., Mehul, |, Jaisani, R., Sajjad, |, Rahman, A., Rahman, | Tabishur, Aladelusi, T., Ahmed, |, Hassanein, G., Goetzinger, | Maximilian, Gian, |, Bottini, B., 2022. O R I G I N A L A R T I C L E A multicentric, prospective study on oral and maxillofacial trauma in the female population around the world. <https://doi.org/10.1111/edt.12750>.
- Samman, M., Ahmed, S.W., Beshir, H., Almohammadi, T., Patil, S.R., 2018. Incidence and pattern of mandible fractures in the Madinah Region: A retrospective study. *J. Nat. Sci. Biol. Med.* 9. [https://doi.org/10.4103/jnsbm.JNSBM\\_60\\_17](https://doi.org/10.4103/jnsbm.JNSBM_60_17).
- Saudi, A., 2014. MAJor trAuMA regiStry.
- Scherbaum Eidt, J.M., de Conto, F., de Bortoli, M.M., Engelmann, J. L., Rocha, F.D., 2013. Associated Injuries in Patients with Maxillofacial Trauma at the Hospital São Vicente de Paulo, Passo Fundo, Brazil. *J. Oral Maxillofac. Res.* 4. <https://doi.org/10.5037/jomr.2013.4301>.
- Septa, D., Newaskar, V.P., Agrawal, D., Tibra, S., 2014. Etiology, Incidence and Patterns of Mid-Face Fractures and Associated Ocular Injuries. *J. Maxillofac. Oral Surg.* 13. <https://doi.org/10.1007/s12663-012-0452-9>.
- Singaram, M., G, S.V., Udhayakumar, R.K., 2016. Prevalence, pattern, etiology, and management of maxillofacial trauma in a developing country: a retrospective study. *J. Korean Assoc. Oral Maxillofac. Surg.* 42. <https://doi.org/10.5125/jkaoms.2016.42.4.174>.