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ORIGINAL ARTICLE

Incidence of maxillofacial fractures in motor vehicle accidents treated in Dubai

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KEYWORDS

Maxillofacial;
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Abstract *Aims:* To analyze the incidence of maxillofacial fractures due to motor vehicle accidents in Dubai, as well as age, sex, etiology, patterns, treatment, and complications. To compare the findings with similar studies and provide recommendations for the prevention and management of these fractures.

Materials and methods: A 7-year retrospective study of maxillofacial fractures due to motor vehicle accidents was done.

Results: We found that most of the accidents took place in December, and the majority of the patients were pedestrians (27%). Male to female ratio was 6:1, and patients in their third decade of life were the most affected (39%). The parasymphysis was the most prominently affected region (27.7%), followed by the orbital bone (18.6%). Open reduction surgery was done in 56% of the cases, and postoperative complications were found in 18.4%.

Conclusions: Pedestrians were most commonly involved in the accidents. An increase in awareness, trauma centers, and better facilities would perhaps improve the management of such fractures.

1. Introduction

A WHO statistics report indicated that each year, one million people die, and between 15 and 20 million are injured due to road traffic accidents (RTA) (Bumb et al., 2013). It has been reported in various studies that maxillofacial injury is common in 20% to 60% of motor vehicle accidents (Akama et al., 2007), as well as the second principal cause of mortality in young people aged 5 to 25 years. Ninety percent of deaths arise as a consequence of RTAs in low-income and middle-income countries. The RTAs are of chief importance and thus, are believed to be a public health concern (Shekar and Reddy, 2008). Therefore, particular importance has been given to assess the incidence and prevention of such injuries (Motamedi et al., 2014). It has been reported that the prevalence of maxillofacial fractures differs from one country to another (Al Ahmed et al., 2004). The patterns of maxillofacial fractures vary depending on etiology, cultural differences, and

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other local factors. General behavior patterns in a country may influence the incidence of traffic accidents. Aggressive driving and driving offenses play an important role in the etiology of maxillofacial fractures in the United Arab Emirates (UAE) (Bener and Crundal, 2005).

Due to the increase in road construction and the number of motor vehicles, traffic accidents lead to a serious public health hazard in the UAE and thus pose as the second common cause of deaths in the UAE after cardiovascular diseases (Bener et al., 1995). Previous research reported a higher motor vehicle accident mortality rate in the Gulf Cooperation Council countries compared with the United States (Shekar and Reddy, 2008) and other developing countries where vehicle ownership levels can be compared. An important risk factor would be road user behavior. Therefore, a decrease in the extent of the problem can be achieved by accurate measures regarding road user behavior (Bener and Crundal, 2005).

The anatomical location of the maxillofacial bones poses a serious clinical problem once fractured. Thus, the knowledge of the distribution and treatment of maxillofacial fractures can be supportive of its adequate prevention (Malara et al., 2006).

This study aimed to analyze the incidence of maxillofacial fractures due to motor vehicle accidents in Dubai and to determine age, sex, etiology, patterns, treatment, and complications of these maxillofacial fractures and compare the results with other studies within UAE and outside the UAE.

2. Methodology

Ethical clearance was obtained from the Ethical Committee of the College of Dentistry, Ajman University, (Reference Number: SS-2014/15-01). A similar clearance was also obtained from Rashid Hospital, Dubai, (Reference Number: (DSREC-SR-03/2015_01).

Rashid Hospital is a part of the Dubai Health Authority, which provides highly specialized tertiary-level care services. The hospital is the busiest in the region and is highly recognized for its trauma and emergency care services. Moreover, approximately 500 patients are evaluated in the trauma center on a daily basis, and thus, it is considered as the major disaster facility in Dubai.

Electronic data was taken from the Dubai Health Authority system from October 2006 to February 2013. Out of the 666 records present, 282 cases that had been treated at Rashid Hospital, Dubai for maxillofacial fractures, along with associated fractures due to motor vehicle accidents, were reviewed. The fractures were diagnosed using the ICD-10 diagnosing system. The variables obtained included age, sex, month, year, etiology, site of the fracture, treatment method, and complications. The cases that did not involve any facial bone fracture, cases with only soft tissue injuries, and cases that did not require any treatment were not included in the study.

Ages were categorized into the following: 1–10, 11–20, 21–30, 31–40, 41–50, 51–60, and 61–70. The etiological factors that were checked included pedestrians, drivers, front and back passengers, motorcyclists, cyclists, quad bike use, tire explosions, and a few unspecified cases. The mandibular fractures included fracture of the condyle, subcondyle, body, angle, symphysis, parasymphysis, ramus, coronoid process, and a few combination fractures such as body/angle, angle/parasymphysis, subcondyle/parasymphysis, and angle/condyle. Fractures of the midface comprised of the frontal bone, nasal bone, zygoma, orbital bone, zygomatico-orbital complex, nasoethmoidal–orbital, nasoethmoidal, panfacial, and Le Fort I, II, and III, along with a few others. The fractures were treated by open reduction, closed reduction, or other modalities. Numerous postoperative complications were found such as posterior open bite, ankylosis, blind one eye, hypertrophic scars, telecanthus, mandibular deviation, permanent paresthesia, anterior open bite, bilateral blindness, epiphora, nasal deformity, enophthamus, blurred vision, temporomandibular joint (TMJ) dysfunction, fractured/displaced plate, infection, 6 months paresthesia, limited mouth opening, flattening of cheek, and double vision.

The data were tabulated and analyzed with Microsoft Excel. Descriptive analysis was performed, followed by a calculation of the probability of occurrence of maxillofacial fractures treated over the total number of motor vehicle accidents treated in the same period in the same center.

3. Results

A total number of 282 patients sustained maxillofacial fractures due to RTAs during the period under review. There were 240 males and 42 females. Males accounted for 85% of the cases, whereas females accounted for 15%, with a male to female ratio of 6:1. The age of the patients ranged from 4 to 68 years, with those in the category of 21–30 and 31–40 years of age being most frequently affected (39% and 29%, respectively). Following them were patients 11–20 years of age (14%), 41–50 years of age (12%), 51–60 years of age (4%), and 1–10 years of age (2%). Only one case was reported from the 61–70 age group. Pedestrians lead the etiology by 27%, followed by drivers (23%), front and back passengers (17%), motorcyclists (10%), cyclists (3%), and quad bike users (1%). There was one case of a tire explosion and 6 unspecified cases (Fig. 1).

Unilateral mandibular fractures (56.4%) were more common than bilateral mandibular fractures (43.6%). Eighteen cases of mandibular and maxillary dentoalveolar fractures were reported. In a total of 112 fractures of the mandible, parasymphysis was the most prominently affected region, accounting for 27.7%. Next was the condyle (15.8%), followed by the mandibular body (12.5%), symphysis (11.6%), angle/-parasymphysis combination fracture (8.04%), angle of the mandible (7.1%), subcondyle (5.4%), ramus and a combination fracture of subcondyle/parasymphysis (4.5%), body/angle combination fracture (1.8%), and the coronoid process (0.9%) (Fig. 2). Of the 322 fractures to the midface, the orbital bone had the highest percentage (18.6%), making it the most common fracture of the maxillofacial bones, followed by the zygomatico-orbital complex (16.1%), frontal fracture (15.8%), zygoma (13.04%), nasal fracture (10.6%), panfacial fractures (7.8%), Le Fort I (6.8%), Le Fort II (6.2%), other fractures (2.5%), nasoorbitoethmoidal (1.2%), and Le Fort III (0.3%). Nasoethmoidal bone (0.9%) was the bone that was least involved in the fractures (Fig. 3).

Fifty-six percent of the cases were treated by open reduction and 13% by closed reduction. Thirty-one percent of the cases were treated by other modalities, including either functional treatment or medical management. Of the cases,

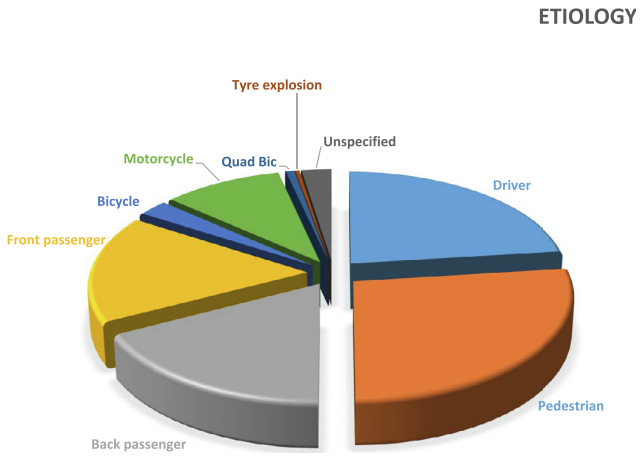

Fig. 1 Etiology of the maxillofacial injuries in the accidents.

18.4% had postoperative complications in which paresthesia over 6 months was most prevalent (25%). Other complications included double vision and infection (9.6%), flattening of the cheek, epiphora, and enophthalmus (5.8%), and limited mouth opening, nasal deformity, anterior open bite, permanent paresthesia, mandibular deviation, and telecanthus (3.8%). Fractured/displaced plate, TMJ dysfunction, blurred vision, bilateral blindness, hypertrophic scars, blind one eye, ankylosis, and posterior open bite accounted for 1.9% each (Fig. 4).

Most of the accidents took place in December (Fig. 5), and in the 7-year-review, most of them occurred in 2009 and 2008 (Fig. 6).

4. Discussion

Maxillofacial fractures occur in routine following RTAs. The etiology varies from country to country, even within the same country, and depends on the environmental, socioeconomic, and cultural factors. Even with the improvement of safety devices, maxillofacial fractures occur quite often with RTAs.

The cases that did not involve any facial bone fracture, cases with only soft tissue injuries, and cases that did not require any treatment were not included in the study.

The male prevalence in our study was higher in proportion compared with many other studies performed in different parts of the world (Bumb et al., 2013; Udeabor et al., 2014; Zachariades et al., 1983; Allen and Dally, 1990; Zachariades et al., 2006; Lee, 2012, Molina et al., 2010; Ogunmuyiwa et al., 2015; Al-Masri et al., 2015). However, in 2007, studies that were conducted in the UAE (Al-Khateeb and Abdullah, 2007) and India (Devadiga and Prasad, 2007) showed a higher male to female ratio of 7:1. According to our results, patients in the 21–30 age group sustained the most injuries. This result was in agreement with many other studies performed (Akama et al., 2007; Devadiga and Prasad, 2007; Oji, 1999; Ugboko et al., 1987; Adeyemo, 2005; Guruprasad et al., 2014; Weihsin et al., 2014; Kapoor and Kalra, 2012; Akhlaghi et al., 2019). One possible reason would be the reckless driving that people in this age group tend to do (Udeabor et al., 2014; van den Bergh et al., 2012).

The people that were affected most were the pedestrians, followed by the drivers, passengers, motorcyclists, and cyclists. These findings differ from previous studies where the most frequently affected people are motorcyclists in Nigeria and Malaysia (Abosadegh et al., 2019). An explanation for this could be that motorcycles are the main mode of transport in Nigeria (Ogunmuyiwa et al., 2015). Furthermore, in Poland, drivers had the highest incidence for maxillofacial fractures (Malara et al., 2006), whereas, in Amsterdam, they found cyclists as the most affected group probably because the usage of cycles far outnumber motor vehicles (van den Bergh et al., 2012). Pedestrians having the highest prevalence in Dubai would be because of the avoidance of designated pedestrian

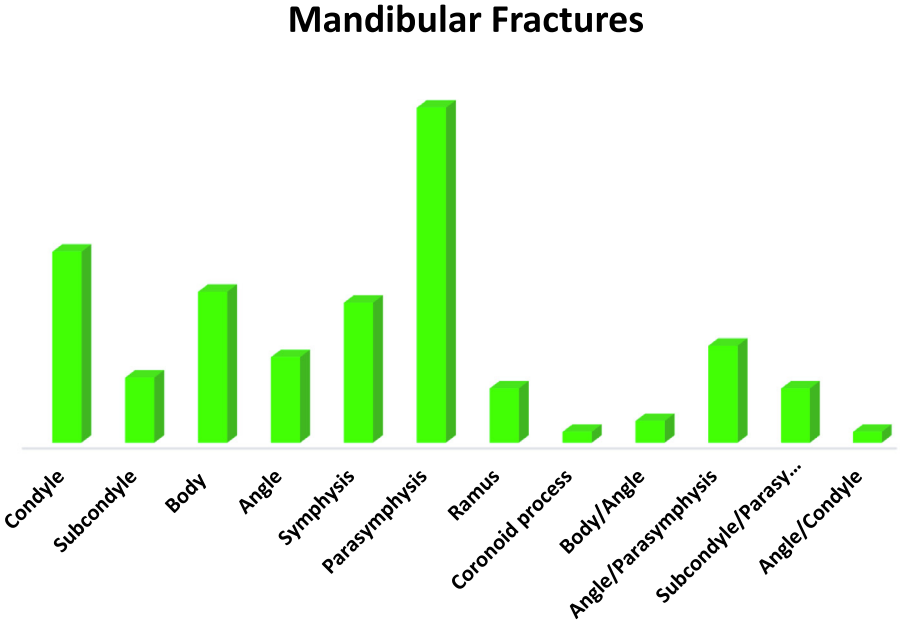

Fig. 2 Mandibular fractures in the road traffic accidents.

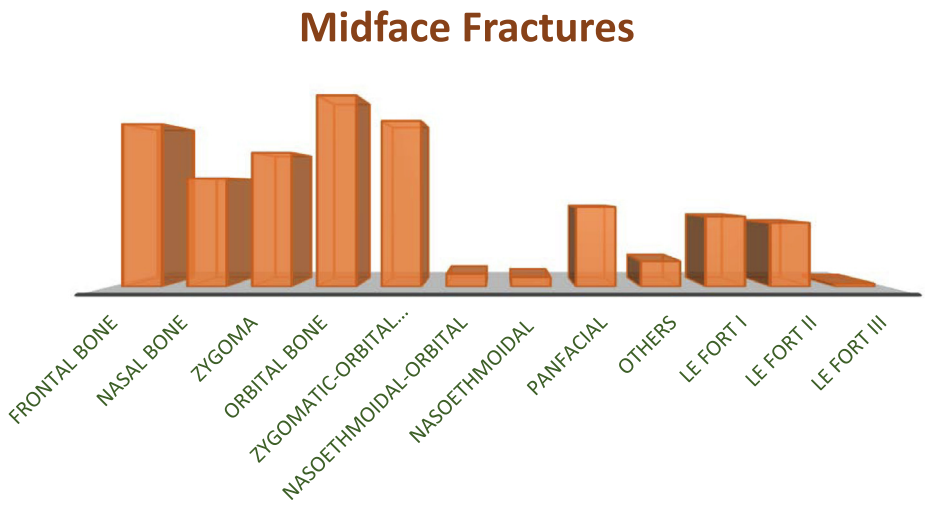

Fig. 3 Midface fractures in the road traffic accidents.

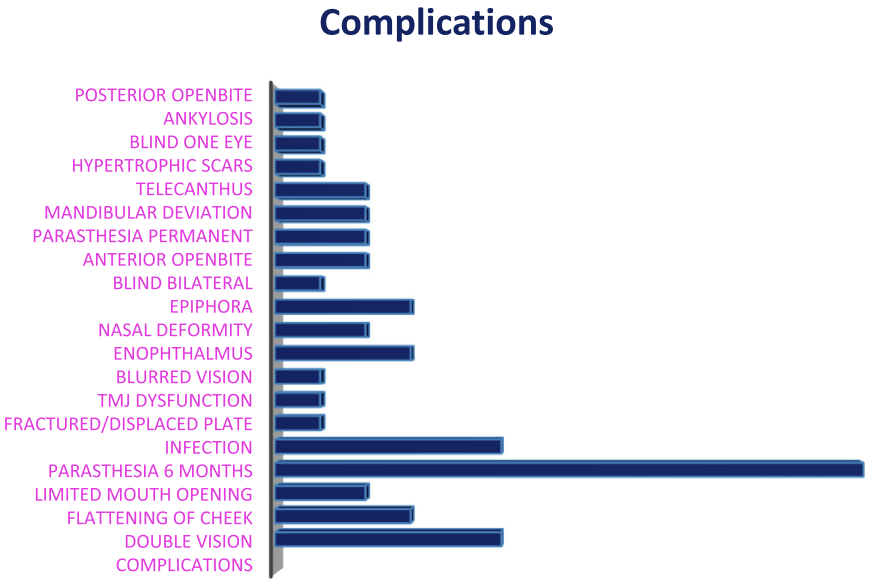

Fig. 4 Postoperative complications.

crossing and the carelessness of the drivers or pedestrians walking on a non-designated walk.

Our research exhibited unilateral fractures dominating bilateral fractures, which is in accordance with previous two studies carried out in Greece (Zachariades et al., 2006) and Brazil (Sawazaki et al., 2010). Midface fractures were more common than mandibular fractures. This finding is in disagreement with a number of previous studies (Al Ahmed et al., 2004, Oji, 1999, Karyouti, 1987, Cheema and Amin, 2006, Obuekwe et al., 2003, Akhlaghi et al., 2019) where mandibular fractures were more common. In the mandibular fractures, parasymphysis was the most prominently affected region, which contradicts with many earlier studies, such as that performed in Libya (Khalil and Shaladi, 1981), where body of the mandible and angle of the mandible was the most commonly affected region in studies conducted in Australia (Dongas and Hall, 2002) and Egypt (Sakr et al., 2006). In addition, according to a study (Al Ahmed et al., 2004) conducted in Sharjah, United Arab Emirates, the condyle was found as the frequently fractured region in the mandible.

In the midface, the orbital bone had the highest prevalence of trauma, similar to the results found in Malaysia by Abosadegh et al., 2019, followed by the zygomatico-orbital fractures. This result contradicts with studies performed in India (Subhashraj et al., 2007, Shankar et al., 2012), Saudi Arabia (Al-Masri et al., 2015), and Nepal (Khadk and Chaurasia, 2014) where the zygoma was found to have the highest incidence.

During our research, we found that people ranging from the ages of 31 to 40 were the majority that was affected by the orbital and parasymphyseal fractures. Pedestrians were commonly involved in orbital fractures, whereas drivers were mostly affected by parasymphyseal fractures. The orbital floor may be known as a "pure" type of blowout fracture when it occurs in isolation, or it may be known as an "impure fracture" when it occurs in combination with fractures in the zygo-

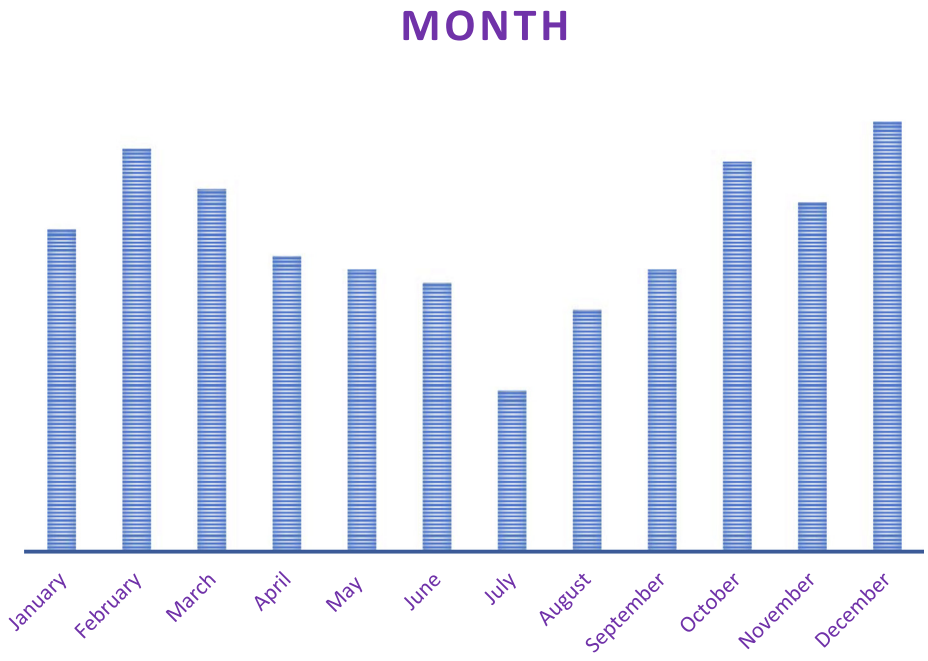

Fig. 5 Prevalence of accidents during the year.

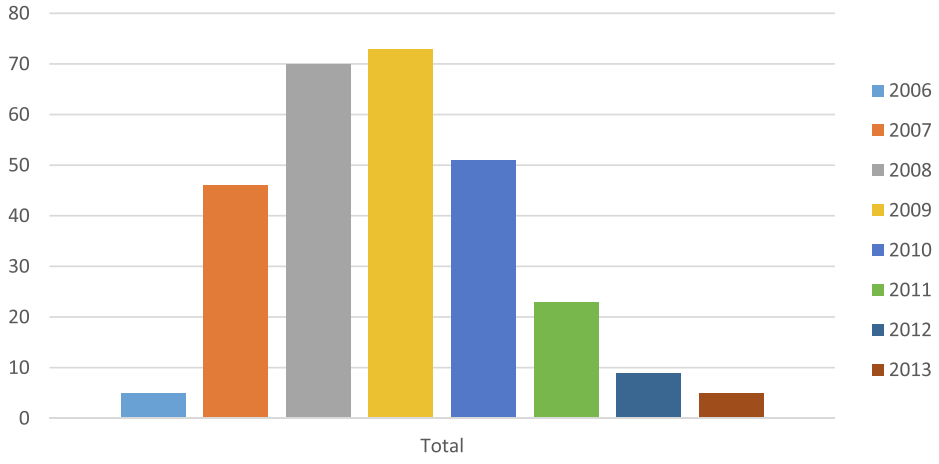

Fig. 6 Prevalence of accidents in the period of 7 years.

matic region (Williams, 1994). According to the transmission theory, fractures of the orbital wall may occur as a result of transmitted forces from the orbital rim, causing them to deform and buckle (Ernst et al., 2006).

The majority of our patients were treated by open reduction and fixation, which is in agreement with reports from China (Mijiti et al., 2014), Italy (Roccia et al., 2008) and UK (Fordyce et al., 1999). However, the methods we used differ from the one that was carried out in Sharjah, UAE, (Al Ahmed et al., 2004) where the majority of the cases were treated by closed reduction and in Tanzania, where open reduction and internal fixation was performed in only 6.8% of cases. In addition, in Iran, 70.8% of cases were treated by closed reduction and fixation (Ansari, 2004), and in India, Shekar and Reddy reported that more than 78% of the patients treated for maxillofacial injuries had closed reduction with arch bar fixation. Out of the 6 cases observed ranging the ages 1–10, three of the fractures were treated conservatively, which included orbital fracture, frontal bone, and Le Fort II. On the other hand, one of the cases that involved the frontal bone and parasymphysis was treated by open reduction. A fracture of the body and parasymphysis was treated with open reduction by internal fixation with plates and screws. Conservative treatment is any treatment without surgical intervention and may include only a prescription of analgesics and/or antibiotics or only medical management. Lastly, a dentoalveolar fracture was treated using intermaxillary fixation.

The percentage of complications was lower than the study conducted in three different hospitals in the UAE in 2007 (Al-Khateeb and Abdullah, 2007). According to our results, paresthesia over 6 months was found as the dominating complication. It occurred in association with fractures of the parasymphysis, mandibular angle, floor of the orbit, body of the mandible, zygomatic body, and Le Fort 1, with

parasymphysis dominating all other fractures. The significant age group ranged from 31 to 40 years.

Most of the accidents occurred in December. Early morning fog, rain, and low visibility could account for this finding.

Driving under the influence of alcohol or drugs is a significant factor for RTAs. However, our research could not include this, as the police department did not release the information to us.

The results of recent literature indicate a significant amount of difference in the incidence of fractures caused by motor vehicle accidents in developed countries such as Japan (Ryo et al., 2009), the Netherlands (Salentijn et al., 2014), and Ireland (Walker et al., 2012) when compared with developing countries such as India (Weihsin et al., 2014) and China (Li et al., 2015). However, this data cannot be taken into account as there is a difference in the regulations and their applications (Ruslin et al., 2015).

Regardless of the obligatory law of seatbelts, the incidence of RTAs and the concurrent maxillofacial injuries is still high. Therefore, certain measures need to be taken in order to implement adequate prevention. Statistics show that a lack of driving experience is directly linked to the probabilities of accidents; the probabilities of serious accidents increase in the case of young drivers (Dubai Police. Traffic Safety Issues, 2015). Although our research had no evidence of people not wearing seatbelts or using electronic devices, implementing strict rules against traffic rule violations in regard to this can help in reducing the incidence. According to the Dubai police statistics, in 2002, 60 people were killed in road accidents due to speeding and not wearing seatbelts (Dubai Police. Traffic Safety Issues, 2015). Increasing fines for over speeding and rash driving and executing stern rules for jaywalking may also be helpful. Since back passengers accounted as the third commonly affected group, one of the most important advancements would be the use of backseat restraints for both adults and children. The provision of one-way roads instead of two-way can decrease the incidence of head-on collisions. A track for cyclists could greatly reduce their risk in RTAs. Last and the most important implementation would be spreading public awareness about traffic rules and safety measures.

The limitation of the study is its retrospective design or methodology, which includes a lack of detailed information and improper recording of the patients' details. Also, the focus of the study was limited to Dubai. On the other hand, Rashid Hospital is the tertiary center of trauma cases, and thus, the study shows an accurate representation of the trauma related to motor vehicle accidents. The epidemiology helps in understanding the prevalence and planning strategic preventive measures. It can also guide authorities to review traffic legislations and increase public awareness.

To conclude, males in the 31–40 age group dominate the maxillofacial injuries in traffic accidents. Our study showed that pedestrians are more affected than drivers are. The previous studies carried out in Al Ain and Sharjah found that the majority of the fractures occurred in the mandible, which is in contrast with our study, where mid-facial fractures prevailed. This signifies that the incidence varies from country to country and even within the same country. According to our study, the majority of the fracture cases were treated by open reduction, and the most prevalent postoperative complication was found to be paresthesia over 6 months, which is mostly associated with parasymphyseal fractures. An increase in trauma centers and better facilities would perhaps improve the management of such fractures.

CRediT authorship contribution statement

Sam Thomas Kuriadom: Conceptualization, Methodology, Resources, Writing - review & editing, Visualization, Supervision, Project administration. **Sahrash Dar:** Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft. **Faranak Saffari:** Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft. **Mohammad Jaber:** Resources, Writing - review & editing, Visualization.

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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