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Original Research Article

Patterns, aetiology and associated complications of maxillofacial fractures at a tertiary care centre: a cross-sectional observational study

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ABSTRACT

Background: Maxillofacial fractures impose a major challenge in trauma care, affecting patient outcomes and healthcare resource utilisation. This study aimed to assess the patterns, aetiology and associated complications of maxillofacial fractures at a tertiary care centre.
Methods: This cross-sectional observational study was carried out among patients who presented with trauma and had maxillofacial fractures at a tertiary care unit from May 2019 to April 2022. A thorough clinical examination and radiological investigation were carried out and after the diagnosis of maxillofacial fractures, a structured questionnaire was used to obtain relevant information regarding the patient's social-demographic status and aetiology. Clinical findings, treatment needs of the patients, as well as complications, were noted. The data was analysed using the Statistical Package for Social Sciences (SPSS) software version 20.0.
Results: Overall, 155 patients were identified, where most of them were aged between 21 and 30 and a male predominance was noted in this study (87.7%). Road traffic accidents (RTAs) accounted for the most common cause (86.5%), followed by assault (7.1%) and falls (4.5%). Out of 155 patients, 71.6% suffered from midfacial fractures, followed by mandibular fractures (20.6%), panfacial fractures (5.1%) and the rest had both (2.5%). About 68.38% patients underwent Open reduction and internal fixation, 30% of patients underwent Intermaxillary fixation, closed reduction of their fractures (20.64%) and 9.03% patients underwent conservative management.
Conclusions: Maxillofacial fractures are most common in young people aged 21 to 30, generally as a result of RTA and the majority of them have midfacial fractures, most of which are zygomaticomaxillary complexes.

Keywords: Etiological factor, Facial fractures, Maxillofacial injury, Road traffic accident

INTRODUCTION

Trauma is the leading cause of death among people under the age of 40 and traumatic injuries are the major cause of reduced productivity, accounting for more lost working years than cancer and cardiovascular disease combined.[1] In trauma patients, facial injuries are common and necessitate quick evaluation and treatment. In both battle and peacetime, maxillofacial injuries are prevalent. Because of the increase in traffic, the number of maxillofacial injuries is on the rise and failure to adopt traffic safety precautions leads to road traffic accidents, which are the leading cause of maxillofacial fractures.[2] According to the World Health Organization (WHO) estimates, road traffic accidents (RTAs) account for approximately 25% of all injury fatalities, with 90% occurring in low- and middle-income countries.[3] RTAs have been progressively declining in developed countries but are increasing in low- and middle-income countries.[4]

The epidemiology of face fractures differs depending on the type of injury, severity, case and the demographics analysed. In underdeveloped countries, road traffic accidents account for the bulk of the incidents, but in developed countries, assaults account for most of the incidents. Observing maxillofacial trauma allows

researchers to examine people's behaviour patterns in different parts of the world and devise efficient ways to prevent injury.[5] The management of maxillofacial injuries would be difficult without a thorough understanding of the harm to the victim's other body systems. Due to advancements in technology, like current osteosynthesis plates and less invasive surgical techniques, it is now possible to undertake surgery later without compromising the outcome.[6-8]

Many epidemiological studies have been published, but descriptive data are challenging to interpret due to several confounders. Thus, it's crucial to keep track of the aetiology of maxillofacial trauma and the information obtained shows the success of the preventive measures. This study aims to examine the patterns of maxillofacial fractures, their aetiology, demographic pattern, associated injuries, treatment modalities and associated complications in patients at inpatient and outpatient units at a tertiary care centre.

METHODS

This cross-sectional observational study was carried out among patients from both the inpatient and outpatient units at the Departments of Plastic and Reconstructive Surgery and Emergency Medicine of Shija Hospitals and Research Institute in Imphal, Manipur, India, from May 2019 to April 2022. The study protocol was reviewed by the institutional ethics committee and ethical clearance was obtained to investigate further (Ethics No. IEC/SHRI/APL/03/19). Patients who presented with trauma and had maxillofacial fractures and agreed to participate in this study were included. Those who were diagnosed with soft tissue injury without any underlying facial skeletal injury and those with maxillofacial fractures who refused to consent for various reasons, were excluded.

A thorough clinical examination was carried out in the Emergency room or ward once the patient had been stabilized after receiving basic resuscitation procedures. A non-contrast computed tomography (NCCT) face with 3D reconstruction was done when the patient was stable. On radiological evidence of fracture, the patient was given the patient information sheet. After the diagnosis of maxillofacial fractures, informed consent was obtained from the patient or caregiver. A structured questionnaire was used to obtain relevant information regarding the patient's social-demographic status (age, sex, address, marital status and occupation and education level) and aetiology (place, time and cause).

A clinical evaluation form was used for recording the clinical findings. Treatment needs of the individual patients, as well as complications, were noted. The sample size was estimated by using this formula, $N \geq ((p (1 - p))/(MOE/z\alpha/2)2$ where $Z\alpha$ is the value of Z at a two-sided alpha error of 5%, MOE is the margin of error and p is the proportion of patients with mandibular fractures or proportion of patients with middle third as the location of the maxillofacial fracture. Using Pandey et al, it was observed that 66.42% of patients had maxillofacial fractures in the middle third region. With this reference, the minimal sample size required, with a 7.5% margin of error and a 5% significance level, is 153 patients.[9] The data was entered in the Microsoft Excel spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 20.0. Categorical variables were presented in the form of numbers and percentages (%) and continuous variables were presented as mean±standard deviation (SD) and median if the data were skewed. Tests of significance, like Chi-square, were applied whenever needed and a p value of less than 0.05 was considered statistically significant.

RESULTS

In this study, a total of 155 patients were identified with maxillofacial fractures during the study period. The mean age of the study population was 33±13 years, with a minimum age is 7 years and a maximum of 93 years. Notably, the maxillofacial fractures were most common in people aged 21 to 30. Table 1 presents the age and gender wise categorisation of maxillofacial fractures. Also, there was a male predominance noted in this study of 87.7% with the male vs. female ratio of 7.13:1 and this difference is statistically significant ($p<0.001$). The majority of the study population (80%) was employed, with 20% being unemployed. Being employed necessitates moving out and more travelling.

Of the 155 patients with maxillofacial fractures, RTA accounted for the most common cause of 86.5%. The other significant causes were assault (7.1%) and falls (4.5%) (Figure 1). Among the injuries caused by RTA, motorcycle accidents were the leading cause of injury (83.5%), followed by motor vehicle accidents (7.46%) and pedestrians (6.71%). The percentage of victims who were wearing personal protective equipment, such as helmets, seat belts, was only 7.7%. There is a statistically significant association between not using personal protective equipment and sustaining a craniofacial injury ($p<0.001$). About 29% patients were under the influence of alcohol.

The median time lag was 3 hours, ranging from 30 minutes to 10 days. About 59.3% of patients reported pain as the chief complaint upon admission, followed by swelling (40.6%), bleeding (39.3%), difficulty in opening the mouth (29%), diplopia (1.3%) and loss of sight (0.6%). Upon examination at the hospital, the most frequent finding was swelling over the face, followed by laceration and difficulty opening the mouth (Table 2). During palpatory findings, tenderness was noted in 96.1% of patients, step deformity in 16.1% and crepitus in 10.3% of patients. Of 155 patients with maxillofacial fractures, most patients suffered from midfacial fractures of 71.6%, followed by mandibular fractures (20.6%), panfacial fractures (5.1%) and the rest had both

mandibular and midfacial fractures (2.5%) (Figure 2). The total fractures sustained by 155 patients was 191, among them 131 fractures were of the midfacial skeleton, 58 were of the mandible and 2 involved the frontal region. Out of 131 midface fractures, zygomaticomaxillary complex fractures were the commonest of 68 (51.9%), followed by zygomatic arch fractures of 27 (20.6%), maxillary fractures of 16 (12.2%), nasal fractures of 9 (6.8%), naso-orbital-ethmoid fractures of 6 (4.6%) and orbital floor of 5 (3.8%). Of the 58 mandibular fractures, parasymphyseal fractures were more common of 22 (37.9%), followed by fractures of the angle of 12 (20.6%), those of the symphysis of 11 (18.9%), body of 8 (13.7%), condyle of 2 (3.4%) and sub-condylar of 3 (5.2%). While analysing the tooth deformity, nearly 70% of the patients have class 1 malocclusion, 14.1% of them have class 2 malocclusion and 3.8% of them have class 3 malocclusion, respectively (Table 3).

About 68.38% patients underwent open reduction and internal fixation (ORIF), where load-sharing fixation using titanium mini plates and screws (1.5 mm for midface and 2 mm for mandible) was done in the majority of the cases. Those with comminuted fractures of the mandible underwent rigid fixation using reconstruction plates. Fixation devices used for individual patients were not recorded. Nearly 30% of patients underwent intermaxillary fixation (IMF), which was done before proceeding with ORIF.

IMF was achieved with arch bars, 26-gauge stainless steel wires in half the patients and with the help of intermaxillary fixation screws, which are cortical screws in the other half. About 20.64% patients underwent closed reduction of their fractures, which included reduction of nasal bone fractures using Asch or Walsham forceps and reduction of zygomatic arch fractures using the Gillies method.

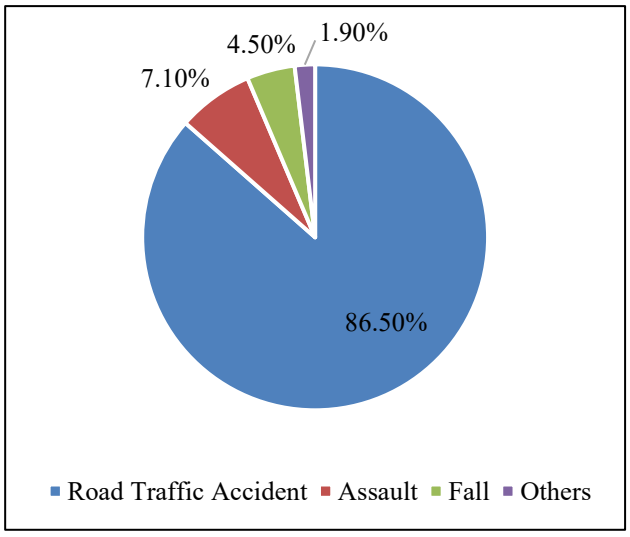

Figure 1: Distribution of patients based on the cause of maxillofacial fractures.

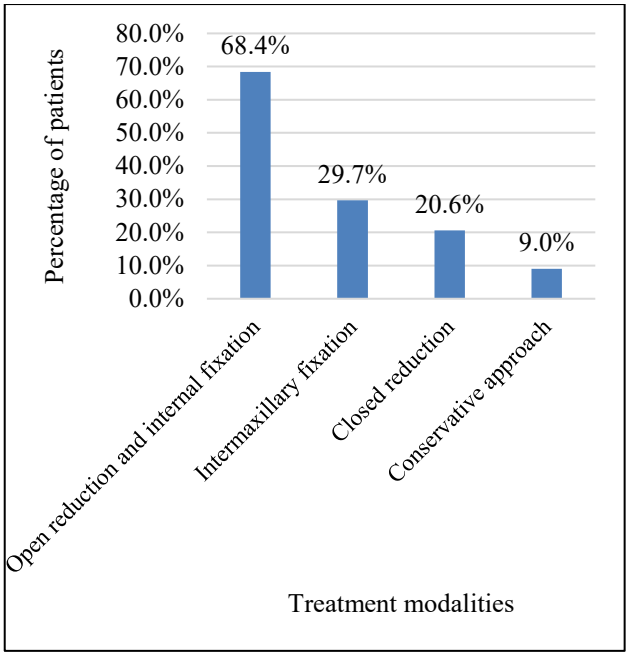

Figure 2: Distribution of patients based on the type of fracture.

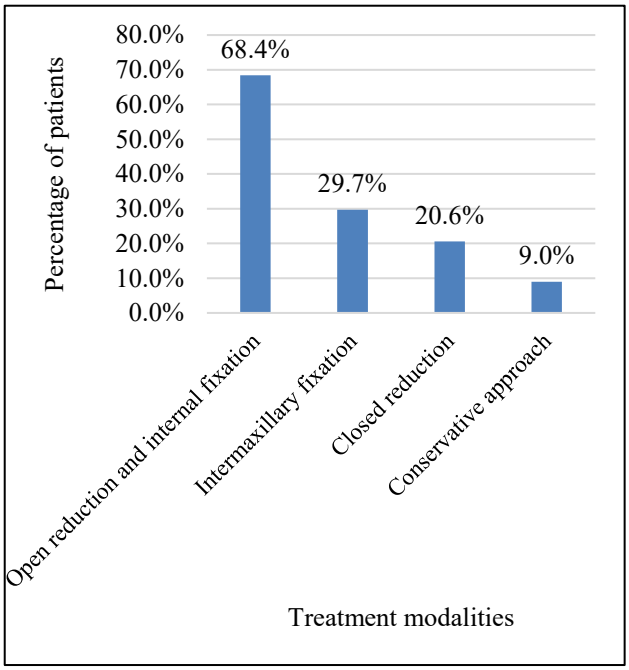

Figure 3: Distribution of treatment modalities in different types of maxillofacial fractures.

Only 9.03% patients underwent conservative management because of minimally displaced fractures requiring no surgical intervention (Figure 3). Overall, 61 (39.3%) patients suffered one or more complications. Nerve injury was the most common complication (68.8%), followed by soft and hard tissue damage and loss (26.2%). Among the nerve injury patients, 93% of patients reported trigeminal nerve-related paraesthesia and the remaining 7% had facial nerve injury.

Table 1: Age and gender wise distribution of the maxillofacial fracture patients.

Age group (in years)	Male (n=136), N (%)	Female (n=19), N (%)	Overall (n=155), N (%)
≤20	13 (8.4)	3 (1.9)	16 (10.3)
21-30	58 (37.4)	7 (4.6)	65 (42)
31-40	33 (21.3)	3 (1.9)	36 (23.2)
41-50	20 (12.9)	4 (2.6)	24 (15.5)
51-60	6 (3.9)	1 (0.6)	7 (4.5)
>60	6 (3.9)	1 (0.6)	7 (4.5)

Table 2: Distribution of patients based on extra-oral examination findings.

Extra oral examination	N (%)*
Swelling	128 (82.5)
Laceration	81 (52.2)
Difficulty opening the mouth	45 (29)
Bleeding	37 (23.8)
Periorbital ecchymoses	19 (12.2)
Nasal deformity	5 (3.2)

*Multiple response.

Table 3: Distribution of patients based on tooth deformity.

Type of deformity	N (%)
Class 1 malocclusion	108 (69.6)
Class 2 malocclusion	22 (14.1)
Class 3 malocclusion	6 (3.8)
Anterior open bite	4 (2.5)
Posterior open bite	3 (1.9)
Posterior crossbite	2 (1.2)
Anterior crossbite	1 (0.64)

DISCUSSION

In our analysis, the most frequently injured age group was 21 to 30 years old, which was comparable to other studies in the literature.[10-13] This finding is due to people being more socially, professionally and physically active throughout this decade of their lives, which makes them prone to trauma. Furthermore, males outweigh females with a male-to-female ratio of 7.13:1, resulting from reckless driving, working outside and alcoholism. This was similar to Agarwal et al, who reported a male-to-female ratio of 8:1, respectively.[14]

The present study showed that RTA constituted the most common cause of injury (86%) followed by assault (7%) and fall (5%). Kalathil et al observed similar results in their study in which RTA were responsible for the bulk of the reported maxillofacial injuries (71.23%) followed by falls (23.29%) and assault (1.37%).[11] Agarwal et al observed that maxillofacial fractures were most commonly caused by RTA, followed by fall-related face injuries and assault.[14] Contrarily, Juncar et al found that interpersonal violence was the most common traumatic etiology, accounting for 59.38%, with falls accounting for 16.02% and motor traffic accidents accounting for 8.4%.[13] These differences in aetiologic pattern could be due to socioeconomic differences which exist between developed and developing countries. In the current study, 8.92% of the motorcyclists were wearing helmets at the time of the accident. None of the pillion riders wore helmets. Patients who wore helmets suffered no brain injury. 20% of the motor vehicle accident victims were wearing seatbelts at the time of impact. These findings were similar to the previous studies.[10,12] This strongly highlights that a lack of protection can cause a higher number of maxillofacial injuries. Helmets prevent injuries to the upper and midface by 65%. Seat belts reduce the risk of serious injury by 50%.[15] Importantly, alcohol intoxication is another contributory factor towards maxillofacial injuries, playing a significant role in the etiology of RTA, assault or fall. This is evident that 29% patients were under the influence of alcohol, which was consistent with Mondal et al who had similar findings that a considerable proportion of their patients had a significant association between alcohol consumption and maxillofacial injury.[12] Pain (59.35%), swelling (40.65%) and bleeding (39.35%) were the main chief complaints among the study population. Notably, the most common physical findings were swelling (82.5%) and laceration (52.2%). On palpation, tenderness was elicited in 96.1% of patients and step deformity (16.1%) and crepitus were felt in 10.3% patients. The

results of this study exhibit that the most common maxillofacial fractures were those of the midface (71.6%). In the midface, zygomaticomaxillary complex (ZMC) fractures were the commonest (51.9%), followed by zygomatic arch fractures (20.6%) and maxillary fractures (12.2%). This was consistent with Deora et al who noted that the most commonly fractured sites were the ZMC and symphysis, with an increasing incidence of maxillofacial trauma noted with age.[16] ZMC is a major buttress of the midfacial skeleton and is important to the structural, functional and aesthetic appearances of the facial skeleton. A ZMC fracture is also known as a tripod, tetrapod or quadripod fracture, trimalar fracture or malar fracture and results from direct trauma.[17]

The second most fractured site was the mandible (20.6%). The parasymphysis (37.9%) was the most fractured, followed by the angle (20.6%) and symphysis (18.9%). The position and anatomy of the mandible are the most prominent and often the most likely fractured bone of the facial region. The mandible is a strong bone, but it has certain areas of weakness. It is thin at the angles where the body joins with the ramus and the neck of the condyle. The mental foramen through which the mental nerve and vessels extend to the tissues of the lateral aspect of the face is an area of weakness through which fractures frequently occur.

These factors contribute to the occurrence of high numbers of fractures of the mandibular parasymphysis, angle and symphysis, as shown in this study and are in agreement with other studies.[10-14] The differences in fracture lines are due to the place of action, speed and kinetic energy of the wounding agent, on the one hand and the position of the head and time of impact, on the other hand, all influence the location of the fracture line in the mandible.[18] Moreover, the left side of the face was the predominantly fractured side in this study, which is similar to the findings of Kalathil et al.[11] In the present study, almost all the patients with maxillofacial fractures were given analgesia for pain control and prophylactic antibiotics. Tetanus wound prophylaxis was given to all patients with open wounds. Surgical wound debridement and wound suturing were done in 64.5% patients. Over 68.38% of patients underwent ORIF and 29.67% of patients underwent IMF. For patients who presented in serious conditions, these procedures were delayed until adequate stabilization of the patient. Nevertheless, during the interim, the patients were put on strong broad-spectrum antibiotics.

Likewise, Aleksanyan et al, found similar findings where ORIF was used to treat 42.6% of their patients, closed reduction for 51.9% and conservative treatment for 2.94% of the patients.[10] In addition, Kalathil et al, stated that most patients with maxillofacial fractures were treated with ORIF (42.36%), conservative treatment for 38.8% and closed reduction for 15.97% of the patients.[11] However, these treatment options are determined by several criteria, including the form of the injury, the presence of concomitant injuries and comorbidities and the surgeon's expertise. In total, 39.3% of the patients suffered one or more complications. Nerve injury was the most common complication (68.8%), followed by soft and hard tissue damage and loss (26.2%). Among the nerve injury patients, 93% reported trigeminal nerve-related paraesthesia, whereas the remaining (7%) had facial nerve injury. The inferior alveolar nerve and infraorbital nerve are frequently injured in association with facial fractures because of their anatomic proximity to the mandible and orbitozygomatic complex, respectively. Similarly, Schultze-Mosgau reported that the most often affected nerves in face injuries are the branches of the facial and trigeminal nerves.[19] While understanding associated injuries in maxillofacial trauma, Patil et al, observed that head injuries were most frequent (60%), followed by orthopaedic injuries (38%), similar to the findings of the present study.[20]

Although this study has some limitations, such as a smaller study population and shorter study period compared to previous studies, this is the first study conducted over 3 years in the Northeastern part of India. This study was important because in Manipur, RTAs are on the rise due to a gradual increase in the number of motor vehicles and motorcycles plying the roads. Moreover, improvements in infrastructure have not kept abreast with the surge in motor vehicles and motorcycles on the road. Hence, this study influences the use of seat belts and helmets, following speed limits and traffic rules and also reinforces the propagation of awareness, preventive measures, safety guidelines and legislation on strict traffic rules.

CONCLUSION

This study analysed the various trends, their associated factors, patterns and management of facial injuries. It was highlighted that road traffic accidents were the most common cause of maxillofacial fractures, consistent with earlier studies, followed by assaults/interpersonal violence as the second most common cause of maxillofacial trauma. These findings should alert the authorities, particularly the government and the road safety commission, to the need for the provision of good roads, enforcement of existing traffic laws and general improvement of the socio-economic condition of the population.

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